Fishery Data Series No. 93-15

# A Summary for Abundance, Catch Per Unit Effort, and Mean Length Estimates of Burbot Sampled in Rivers of Interior Alaska, 1986-1992

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ABSTRACT

This report compiles all catch per unit effort and mean length estimates obtained from sampling during 1986-1992 in 67 river sections located throughout the Tanana River drainage. Estimates were calculated for three length categories: partially recruited "small" burbot (300 to 449 millimeters total length), fully recruited "medium" burbot (450-799 millimeters total length), and partially recruited "large" burbot (≥800 millimeters total length). In addition, seven estimates of abundance for burbot ≥450 millimeters total length from five different river sections are presented.

The specific objectives of this report were to estimate mean length and mean CPUE in one 24 kilometer section of the Tanana River and in one 24 kilometer section of the Chena River sampled during August and September, 1992. Estimates of mean CPUE in the Tanana River section were 0.21 (number of burbot caught per 24 hour set of one hoop trap) (SE = 0.03) for small burbot, 0.96 (SE = 0.08) for medium burbot, and 0.06 (SE = 0.01) for large burbot. Estimates of mean CPUE in the Chena River section were 0.07 (SE = 0.02) for small burbot, 0.41 (SE = 0.05) for medium burbot and 0.004 (SE = 0.004) for large burbot. Estimates of mean length for burbot sampled in the Tanana River section were 398 (millimeters total length) (SE = 6) for small burbot, 557 (SE = 5) for medium burbot, and 864 (SE = 16) for large burbot. Estimates of mean length for burbot sampled from the Chena River section were 388 (millimeters total length) (SE = 10) for small burbot and 575 (SE = 7) for medium burbot.

KEY WORDS: burbot, *Lota lota*, hoop traps, Tanana River, Chena River, catch per unit effort, mean length, abundance.

## INTRODUCTION

Research concerning burbot *Lota lota* stocks in flowing waters of the Tanana River system has been ongoing since 1983. The objectives of this research program have been to determine biological characteristics such as size, age, and density distributions, identify migratory and reproductive behavior, examine spawning characteristics, monitor harvests, and determine characteristics of the sport fishery. Results of this research have been published in a number of documents (Hallberg 1984 - 1986; Hallberg et al. 1987; Guinn and Hallberg 1990; Evenson 1988, 1989, 1990, 1991, 1992; Evenson and Hansen 1991; Clark et al. 1991; Bernard et al. 1991).

Initially, this research sought to identify individual stocks by identifying movements throughout the system. This was accomplished through a rigorous sampling program which marked and subsequently recaptured burbot in the mainstream Tanana River and in many tributary streams. This information indicated that movements were frequent and extensive throughout the system, and that for management purposes, the entire drainage should be considered a single stock (Evenson 1989 and 1990).

Since 1986, when extensive stock assessment sampling began, a number of estimates of abundance, CPUE, and mean length have been obtained (Hallberg et al. 1987; Evenson 1988, 1989, 1990, 1991, 1992). Assessment of this stock has been accomplished by estimating abundance, relative abundance through mean catch per unit effort (CPUE), and mean length for many sections of river throughout the system using a standardized design. These estimates have been obtained annually or semi-annually for important river sections (areas of large harvest such as the Chena and Tanana rivers near the city of Fairbanks) This assessment has indicated that annual exploitation is low relative to abundance for the entire system. Thus, the stock assessment research has been reduced, and is focused toward those river sections where a substantial harvest occurs.

The ultimate management goal of this stock assessment research has been to determine if annual harvests are sustainable. The purpose of this report is to compile into a single document all estimates of abundance, mean CPUE, and mean length obtained since 1986. The specific objectives of this investigation during 1992 were to estimate:

1. mean CPUE for all burbot 450 mm total length (TL) and longer in one 24 km section of the Tanana River and in one 24 km section of the Chena River; and,

2. mean length of all burbot 450 mm TL and longer in these two sections.

## STUDY AREA

The Tanana River is of glacial origin flowing over 900 km and draining 44,500 square miles. Major tributaries flowing from the south are primarily silt-laden glacial streams, while tributaries flowing from the north are clear run-

off streams (Figure 1). The upper and middle Tanana River is accessible year-round along most of its course from the Richardson and Parks Highways which parallel the river from the headwaters region near Northway downstream to Nenana. Many of the tributaries in this area are also accessible via various road systems. The lower Tanana River can be accessed by road only at Nenana, Minto, and Manley.

Throughout this report, sample sections will be referred to in terms of river kilometers (measured as the distance upstream from the rivers mouth). The river kilometers of important landmarks along the course of the Tanana River are shown in Table 1. Further, throughout this report sample sections are referred to as being located in one of three geographic areas. The "lower" section begins at the confluence of the Tanana and Yukon rivers and extends upstream to the confluence of the Tanana and Nenana Rivers (river kilometers 0-267), and includes the Nenana River and all other tributaries located within. The "middle" section extends upstream to the confluence of the Delta River (river kilometers 268-514) and includes the Delta River and all other tributaries located within. The "upper" section includes the Tanana River and all tributaries upstream from the confluence of the Delta River.

Since 1986, nearly the entire length of the Tanana River has been sampled, as have sections in the lower reaches of the Kantishna, Tolovana, Nenana, Chena, Goodpaster, Chisana, and Nabesna rivers. During this investigation, one section of the Tanana River (river kilometers 336-360) and one section of the Chena River were sampled (river kilometers 0-24).

## METHODS

### Gear Description

Burbot were captured in two sizes of commercially available hoop traps. Large hoop traps were used for all sampling conducted in 1986 and 1987, while small hoop traps were used for all sampling conducted from 1988 through 1992. Bernard et al. (1991) provides a comprehensive account of the efficacy of both large and small traps. Small hoop traps were 3.05 m long with seven 6.35 mm steel hoops (Figure 2). Hoop diameters tapered from 0.61 m at the entrance to 0.46 m at the cod end. Each trap had a double throat (tied to the second and fourth hoops) which narrows to an opening 10 cm in diameter. All netting was knotted nylon woven into 25 mm bar mesh, bound with No. 15 cotton twine, and treated with an asphaltic compound. Each trap was kept stretched with two sections of 19 mm polyvinyl chloride (PVC) pipe attached by snap clips to the end hoops. These traps were used in all sections from 1988-1992.

Large hoop traps were of similar design, but were 3.66 m long, and had fiberglass hoops with inside diameters tapering from 91 to 69 cm (Figure 2). Throat diameters were 36 cm. Spreader bars made from PVC were also used to keep the traps stretched. These traps were used in all sections during 1986 and 1987.

Hoop traps were baited with cut Pacific herring *Clupea harengus* placed in perforated plastic containers. One end of a five to 10 m section of

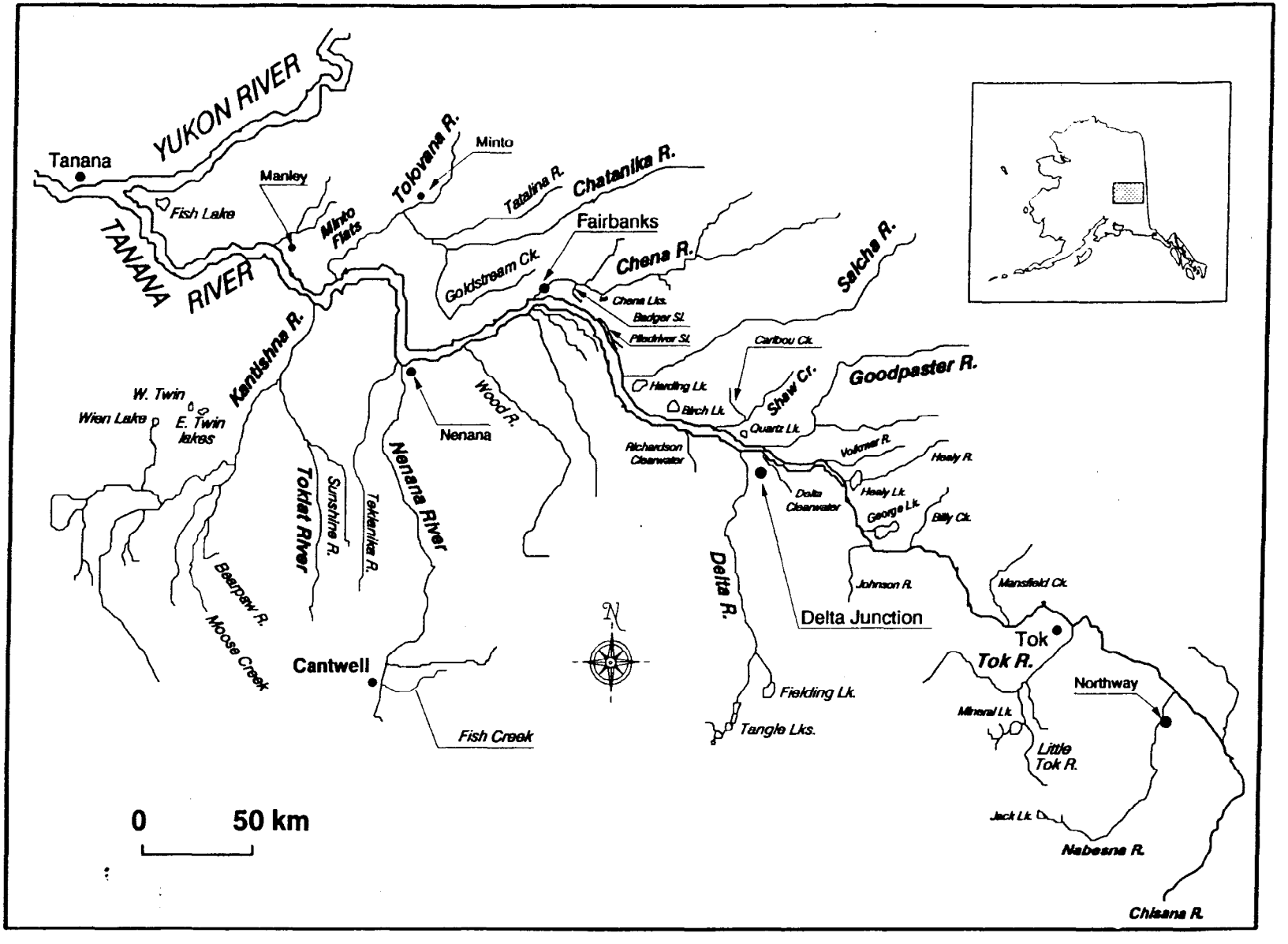


Figure 1. Map of the Tanana River drainage.

Table 1. Confluences of major tributaries and locations of bridges along the course of the Tanana River in river kilometers.

| | Landmark | River Kilometer[a] |
|---|---|---|
| Lower River | | |
| | Chitanana River | 54 |
| | Cosna River | 64 |
| | Manley Hot Springs Slough | 98 |
| | Kantishna River | 154 |
| | Tolovana River | 168 |
| | Nenana River | 267 |
| | Parks Highway Bridge | 267 |
| Middle River | | |
| | Wood River | 298 |
| | Chena River | 358 |
| | Moose Creek | 392 |
| | Salcha River | 429 |
| | Little Delta River | 462 |
| | Shaw Creek | 498 |
| | Delta River | 515 |
| | Richardson Highway Bridge | 515 |
| Upper River | | |
| | Goodpaster River | 530 |
| | Volkmar River | 568 |
| | Healy Lake Outlet | 587 |
| | George Lake Outlet | 619 |
| | Johnson River | 630 |
| | Robertson River | 696 |
| | Tok River | 795 |
| | Alaska Highway Bridge | 816 |
| | Confluence of Chisana Nabesna River (Headwaters) | 902 |

[a] Measured upstream from the Tanana River confluence with the Yukon River.

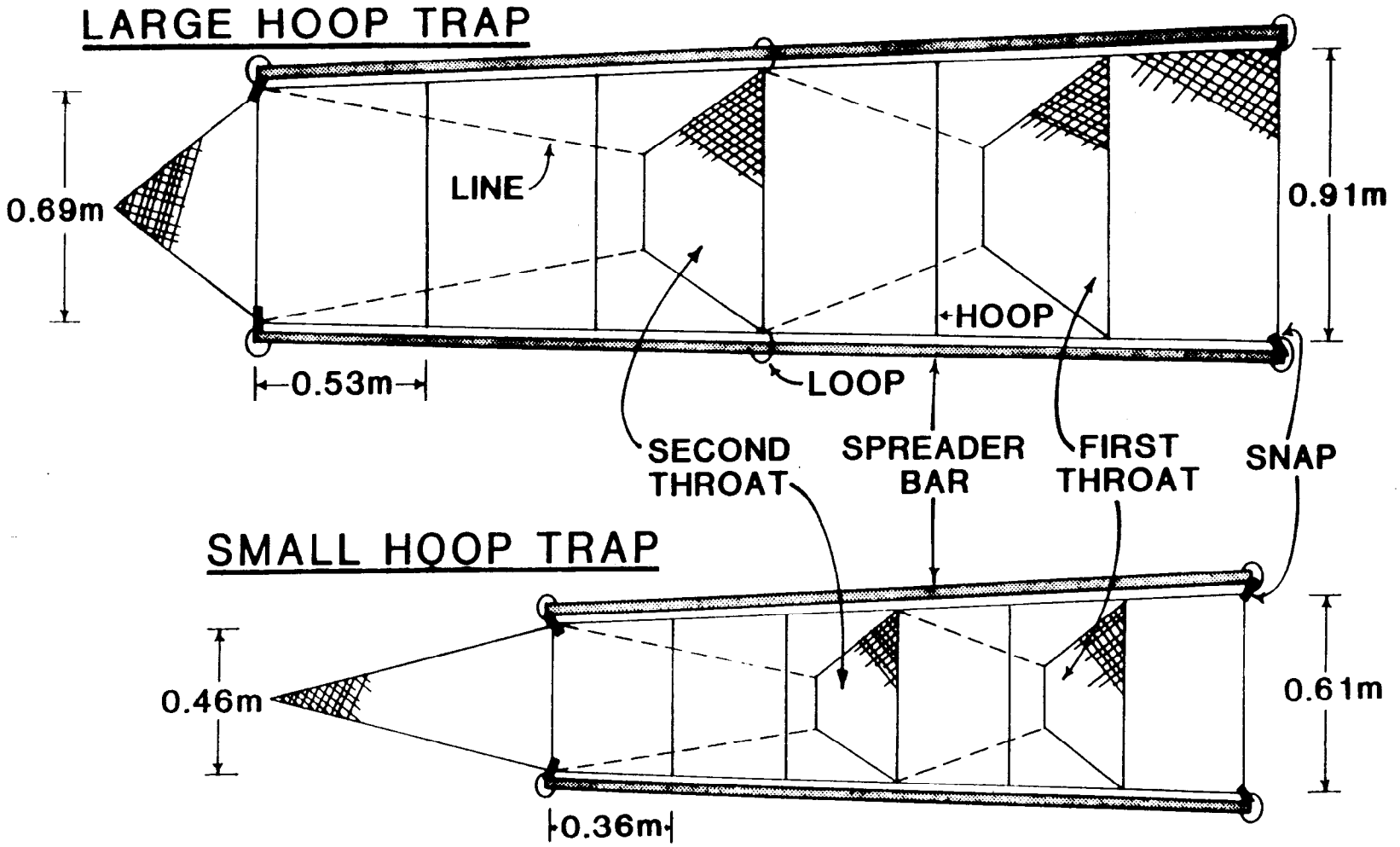


Figure 2. Diagrams of large and small hoop traps used to catch burbot in flowing waters of the Tanana River drainage.

polypropylene rope was tied to the cod end of each trap, while the other end was tied off to shore. The traps then fished on the river bottom near shore with the opening facing downstream. An outboard-powered riverboat was used to set, move, and retrieve the traps.

Study Design

The general sampling protocol was similar for all river sections, except that the duration of the sampling events, and amount of effort were somewhat variable for each. Typically, a sampling event lasted five days and four nights. The density of traps within a section was variable and depended on the size of the section (has ranged from 16-64 km since 1986) and whether one or two sampling crews were used. A systematic sampling design was used in all sections. Traps were set along both shores at near equal intervals beginning at the most downstream end of the section and progressing to the most upstream end of the section. All traps were fished for approximately 24 hours, were rebaited, and were moved to a slightly upstream area. All trap locations were marked on a 1:63,360 USGS maps and were recorded to the nearest kilometer. All burbot captured were measured for total length (TL) to the nearest millimeter, and were tagged using individually numbered Floy internal anchor tags. All fish were released at the capture site.

During this investigation, two crews were used to sample each of the two sections. Each crew worked opposite sides of the river. Each section was 24 km in length, and in each section traps were set at a density of three traps per kilometer per day.

Estimation of Parameters

Both sizes of traps effectively catch burbot 300 mm TL and larger. Burbot smaller than 300 mm TL can swim through the net mesh; they also tend not to be attracted to the bait as effectively as larger burbot. However, full recruitment of burbot to both large and small hoop traps has been tested using mark-recapture techniques and typically begins at 450 mm TL (Bernard et al. 1991; Evenson 1988 and 1990-1992). Burbot larger than 800 mm TL may not be fully recruited to small hoop traps, (that is, recaptured at the same rate as they were caught) but likely are to large hoop traps (Bernard et al. 1991). For these reasons, estimates of mean CPUE and mean length described below are given for three length strata: "small" (300-449 mm TL) "medium" (450-799 mm TL) and "large" (≥800 mm TL). Because few burbot ≥800 mm TL are captured, medium and large burbot are typically combined when estimating abundance.

Catch per Unit Effort:

Estimates of mean CPUE have been obtained for 67 river sections since 1986 (Appendix A). The understanding of the selectivity of the hoop trap gear has been progressive. In 1986, size-selectivity of hoop traps had not been tested for. Consequently, estimates of mean CPUE were for all fish 300 mm TL and larger. In 1987, mark-recapture experiments conducted in the Tanana River indicated burbot became fully recruited to large hoop traps at 450 mm TL (Evenson 1988). Therefore, from 1987 through 1990, CPUE estimates were calculated for those burbot 300-449 mm TL (small), and for those larger than

450 mm TL (medium and large). In 1991, data were available which suggested that burbot 800 mm TL and larger (large) residing in the Tanana River were not fully recruited to small hoop traps (Bernard et al. 1991). Thus, mean CPUE estimates from 1991 and 1992 were calculated for three length categories (small, medium, and large). For the reasons described above regarding the progressive understanding of the gear selectivity, and because of the way data were recorded on data forms[1], estimates of standard errors are not available for many CPUE estimates for various length strata.

Mean CPUE for each river section and its associated variance were calculated from the number of burbot caught per net-night for all traps set during each sampling period based upon the following equations from Wolter (1984):

$$\overline{CPUE_c} = \bar{X}_c = t^{-1} \sum_{h=1}^{t} X_{ch}; \tag{1}$$

$$V[\overline{CPUE_c}] = \frac{\sum_{h=2}^{t} [X_{ch} - X_{ch-1}]^2}{2t[t-1]} \tag{2}$$

where:

$X_{ch}$ = catch of burbot of size class c in hoop trap h;

t = the total number of hoop traps in a river section; and,

s = the set number such that s = 1 to t in order with i = 1 the most downstream set and i = t the most upstream.

All estimates of mean CPUE throughout this report are given in units of number of burbot per net per overnight set, or burbot per net-night (bb/nn).

Mean Length:

Mean length and its associated variance was also calculated for three length categories as:

$$\bar{l}_a = \sum_{b=1}^{n} \frac{l_{ab}}{n_a}; \tag{3}$$

$$V[\bar{l}_a] = \sum_{b=1}^{n} \frac{(l_{ab} - \bar{l}_a)^2}{n_a(n_a-1)} \tag{4}$$

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[1] From 1986 through 1988, two separate computer coded data forms were used to record catch and length information. The design of these forms did not allow for lengths of fish caught to be correlated with a given trap.

where:

$l_{ab}$ = length of burbot b in length category a; and,

$n_a$ = number of samples in length category a.

All estimates of mean length are expressed to the nearest millimeter of total length (TL).

Abundance:

Two different modifications of the basic formula for the Petersen model for two sample mark-recapture experiments (described in Seber 1982) have been used during past years to estimate abundance in three different sections of the Tanana River, one section of the Chena River, and one section of the Tolovana River. The assumptions for accurate use of the Petersen model and methods of testing these assumptions are described by Bernard and Hansen (1992). If these assumptions were all met, and if inter-river section movements were observed in low proportions, then the modified Petersen estimator of Bailey (1951, 1952) was used to estimate abundance. Alternatively, if significant movement of fish in the study section was observed between the marking (first event) and recapture (second event) samples, a modified Petersen estimator (Bernard Pers. Comm.[2]; Evenson 1988) was used to compensate for the movement of marked burbot out of the study section. Detailed descriptions of these estimates are given by Hallberg et al. (1987) and Evenson (1988, 1990, and 1991).

## RESULTS

### Catch per Unit Effort

A total of 339 and 131 burbot larger than 300 mm TL were caught with 277 and 272 net-nights of effort in the Tanana River and Chena River sections, respectively during 1992. Estimates of mean CPUE in the Tanana River section were 0.21 bb/nn (SE = 0.03) for small burbot, 0.96 bb/nn (SE = 0.08) for medium burbot, and 0.06 bb/nn (SE = 0.01) for large burbot. Estimates of mean CPUE in the Chena River section were 0.07 bb/nn (SE = 0.02) for small burbot, 0.41 bb/nn (SE = 0.05) for medium burbot and 0.004 bb/nn (SE = 0.004) for large burbot.

### Mean Length

Estimates of mean length for burbot sampled from the Tanana River section were 398 mm TL (SE = 6) for small burbot, 557 mm TL (SE = 5) for medium burbot, and 864 mm TL (SE = 16) for large burbot. Estimates of mean length for burbot sampled from the Chena River section were 388 mm TL (SE = 10) for small burbot and 575 mm TL (SE = 7) for medium burbot. Only one large burbot was captured in the Chena River section.

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[2] Bernard, David. Personal Communication. ADFG, Sport Fish Division, 333 Raspberry Rd., Anchorage, AK 99518.

Abundance

A total of seven mark-recapture experiments have been conducted since 1986 to estimate abundance in five different river sections (Appendix C). Densities of burbot (expressed in burbot per linear river kilometer; bb/km) have ranged from a low of 71 bb/km (SE = 14) in a section of the Chena River (river kilometer 0 - 24), to a high of 572 bb/km (SE = 41) in a section of the Tanana River (river kilometer 582 - 589).

## DISCUSSION

A total of 66 CPUE estimates have been obtained since 1986 (Appendix A). The largest estimate of mean CPUE for small burbot was 1.83 in a section of the Tanana River (river kilometer 523 - 532) in 1986. Estimates of mean CPUE for fully recruited burbot (medium) ranged from 0 in the lower Goodpaster River (river kilometer 0-15) during 1989 to 10.14 in a section of the Tanana River (river kilometer 553-564) during 1986. The largest estimate of mean CPUE for large burbot was 0.43 in a section of the Tanana River (river kilometer 889 - 903) in 1986.

Mean length estimates have been obtained for the same 66 sections sampled since 1986 (Appendix B). The largest mean length for fully recruited burbot (medium) was 691 mm noted in a section of the Yukon River (river kilometer 0-24 downstream from the Dalton Highway Bridge), while the smallest was 510 mm from a section of the Chena River (river kilometer 0-24) in 1990. Mean lengths for small burbot ranged from 350 mm in a section of the Kantishna River (river kilometer 0-43) sampled during 1989, to 422 mm in a section of the Tolovana River (river kilometer 37-78) sampled during 1988. Mean lengths of large burbot in sections for which more than 10 burbot were caught (16 of the 66 sections) ranged from 830 mm in a section of the Tanana River (river kilometer 784-848) sampled during 1988, to 915 mm in a section of the Tanana River (river kilometer 889-903) sampled during 1986.

Given the immenseness of the system, population parameters such as abundance, survival, and recruitment are difficult to determine with any degree of accuracy. Based on the single stock definition, and the estimated densities of burbot in various sections throughout the system, it is apparent that annual exploitation rates are quite low, and present harvest levels are sustainable.

Estimating mean CPUE for a given section requires less than half as much effort as does estimating abundance in the same section. Therefore, more of the system can be assessed through abundance indexing than can be from estimating actual abundance. However, because of the passive nature of hoop trap gear, the behavior of the fish can greatly influence the estimates of CPUE and size compositions. Thus, it is difficult to assess whether changes in these estimates from one sampling event to the next are real or perceived. Some seasonal patterns in these behavioral changes in catch rates are apparent. In general, catches tend to be high and variable in the spring (after ice-out) and in the fall (prior to ice cover). During the summer,

catches tend to be lower and more stable. The reasons for these fluctuations are unclear, and the timing of the fluctuations seems to vary by river area. These seasonal variations in catch rates have important implications when conducting mark-recapture experiments to estimate actual abundance. When catch rates are low, a great deal of fishing effort must be expended to obtain an adequate sample size. This may be cost-prohibitive in many cases. However, care must be taken when sampling during the spring and fall such that significant movements are not occurring during the sampling period, which can bias estimates of abundance using closed population models.

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# APPENDIX A

Appendix A1. Catch per unit effort (CPUE) estimates of burbot sampled in sections of the lower Tanana River, 1986 through 1989.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Net Nights | Small (300-449 mm TL) Catch | Small (300-449 mm TL) CPUE | Small (300-449 mm TL) SE | Medium (450-799 mm TL) Catch | Medium (450-799 mm TL) CPUE | Medium (450-799 mm TL) SE | Large (≥800 mm TL) Catch | Large (≥800 mm TL) CPUE | Large (≥800 mm TL) SE | Medium + Large (≥450 mm TL) Catch | Medium + Large (≥450 mm TL) CPUE | Medium + Large (≥450 mm TL) SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 06/23-06/27 | 1986 | 98-116 | Large | 104 | 71 | 0.68 | NA[a] | 257 | 2.47 | NA | 4 | 0.04 | NA | 261 | 2.51 | NA |
| 07/07-07/11 | 1986 | 247-265 | Large | 100 | 90 | 0.82 | NA | 82 | 0.82 | NA | 2 | 0.02 | NA | 84 | 0.84 | NA |
| 06/23-06/26 | 1987 | 102-112 | Large | 89 | 20 | 0.22 | 0.07 | 190 | 2.13 | NA | 6 | 0.07 | NA | 196 | 2.20 | 0.25 |
| 07/14-07/17 | 1988 | 48-112 | Small | 254 | 60 | 0.24 | 0.03 | 242 | 0.95 | NA | 5 | 0.02 | NA | 247 | 0.97 | 0.08 |
| 08/17-08/20 | 1988 | 160-216 | Small | 215 | 35 | 0.16 | 0.03 | 231 | 1.07 | NA | 25 | 0.12 | NA | 256 | 1.19 | 0.09 |
| 07/12-07/15 | 1989 | 0-54 | Small | 228 | 47 | 0.21 | 0.03 | 91 | 0.40 | NA | 0 | 0 | 0 | 91 | 0.40 | 0.05 |

[a] Means data is not available for this estimate (see Methods section for explanation).

Appendix A2. Catch per unit effort (CPUE) estimates of burbot sampled in sections of the middle Tanana River, 1986 through 1992.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Net Nights | Small (300-449 mm TL) Catch | CPUE | SE | Medium (450-799 mm TL) Catch | CPUE | SE | Large (≥800 mm TL) Catch | CPUE | SE | Medium + Large (≥450 mm TL) Catch | CPUE | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/19-08/22 | 1986 | 265-284 | Large | 67 | 23 | 0.34 | NA[a] | 196 | 2.93 | NA | 14 | 0.21 | NA | 210 | 3.13 | NA |
| 07/29-08/02 | 1986 | 334-352 | Large | 99 | 51 | 0.52 | NA | 94 | 0.95 | NA | 7 | 0.07 | NA | 101 | 1.02 | NA |
| 08/11-08/15 | 1986 | 334-352 | Large | 128 | 42 | 0.33 | NA | 57 | 0.45 | NA | 3 | 0.02 | NA | 60 | 0.47 | NA |
| 09/08-09/12 | 1986 | 356-377 | Large | 115 | 46 | 0.40 | NA | 70 | 0.61 | NA | 4 | 0.03 | NA | 74 | 0.64 | NA |
| 07/14-07/16 | 1987 | 270-283 | Large | 54 | 38 | 0.70 | 0.10 | 110 | 2.04 | 0.36 | 0 | 0 | 0 | 110 | 2.04 | 0.36 |
| 07/22-07/25 | 1987 | 339-354 | Large | 77 | 22 | 0.29 | 0.02 | 41 | 0.53 | NA | 6 | 0.08 | NA | 47 | 0.61 | 0.09 |
| 07/28-07/31 | 1987 | 339-354 | Large | 106 | 70 | 0.66 | 0.10 | 73 | 0.69 | NA | 6 | 0.06 | NA | 79 | 0.75 | 0.09 |
| 08/04-08/07 | 1987 | 339-354 | Large | 79 | 24 | 0.30 | 0.08 | 45 | 0.57 | NA | 2 | 0.03 | NA | 47 | 0.59 | 0.10 |
| 08/18-08/21 | 1987 | 339-354 | Large | 183 | 46 | 0.25 | 0.05 | 178 | 0.97 | NA | 14 | 0.08 | NA | 192 | 1.05 | 0.11 |
| 07/07-07/10 | 1987 | 360-378 | Large | 79 | 55 | 0.70 | 0.12 | 54 | 0.68 | NA | 6 | 0.08 | NA | 60 | 0.76 | 0.11 |
| 06/10-06/13 | 1987 | 430-442 | Large | 87 | 66 | 0.76 | 0.13 | 83 | 0.95 | NA | 4 | 0.05 | NA | 87 | 1.00 | 0.15 |
| 06/16-06/19 | 1987 | 498-510 | Large | 87 | 83 | 0.95 | 0.14 | 46 | 0.53 | 0.11 | 0 | 0 | 0 | 46 | 0.53 | 0.11 |
| 07/06-07/09 | 1988 | 312-376 | Small | 268 | 159 | 0.59 | 0.05 | 144 | 0.54 | NA | 1 | <0.01 | NA | 145 | 0.54 | 0.05 |
| 06/13-06/16 | 1989 | 317-374 | Small | 237 | 137 | 0.58 | 0.06 | 125 | 0.53 | NA | 6 | 0.03 | NA | 131 | 0.55 | 0.05 |
| 06/20-06/24 | 1989 | 418-474 | Small | 225 | 136 | 0.60 | 0.07 | 42 | 0.19 | 0.03 | 0 | 0 | 0 | 42 | 0.19 | 0.03 |
| 08/14-08/16 | 1990 | 344-376 | Small | 90 | 44 | 0.49 | 0.10 | 96 | 1.07 | NA | 4 | 0.04 | NA | 100 | 1.11 | 0.12 |
| 07/11-07/17 | 1991 | 336-360 | Small | 310 | 97 | 0.31 | 0.04 | 247 | 0.80 | 0.07 | 3 | 0.01 | 0.01 | 250 | 0.81 | 0.07 |
| 08/24-08/28 | 1992 | 336-360 | Small | 277 | 57 | 0.21 | 0.03 | 266 | 0.96 | 0.08 | 16 | 0.06 | 0.01 | 282 | 1.02 | 0.08 |

[a] Means data is not available for this estimate (see Methods section for explanation).

Appendix A3. Catch per unit effort (CPUE) estimates for burbot sampled in sections of the upper Tanana River, 1986 through 1990.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Net Nights | Small (300-449 mm TL) Catch | CPUE | SE | Medium (450-799 mm TL) Catch | CPUE | SE | Large (≥800 mm TL) Catch | CPUE | SE | Medium + Large (≥450 mm TL) Catch | CPUE | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/07-08/08 | 1986 | 523-532 | Large | 54 | 99 | 1.83 | NA[a] | 146 | 2.70 | NA | 2 | 0.04 | NA | 148 | 2.74 | NA |
| 08/11-08/15 | 1986 | 553-564 | Large | 90 | 96 | 1.07 | NA | 913 | 10.14 | NA | 19 | 0.21 | NA | 932 | 10.36 | NA |
| 07/08-07/11 | 1986 | 578-584 | Large | 100 | 108 | 1.08 | NA | 32 | 0.32 | NA | 0 | 0 | 0 | 32 | 0.32 | NA |
| 09/08-09/12 | 1986 | 608-619 | Large | 73 | 54 | 0.74 | NA | 63 | 0.86 | NA | 5 | 0.07 | NA | 68 | 0.93 | NA |
| 07/29-08/02 | 1986 | 705-721 | Large | 108 | 90 | 0.83 | NA | 120 | 1.11 | NA | 5 | 0.05 | NA | 125 | 1.16 | NA |
| 07/23-07/27 | 1986 | 889-903 | Large | 194 | 84 | 0.43 | NA | 425 | 2.19 | NA | 83 | 0.43 | NA | 508 | 2.62 | NA |
| 06/16-06/19 | 1987 | 520-536 | Large | 97 | 102 | 1.05 | 0.13 | 144 | 1.48 | 0.18 | 0 | 0 | 0 | 144 | 1.48 | 0.18 |
| 08/11-08/14 | 1987 | 553-571 | Large | 101 | 55 | 0.54 | 0.10 | 145 | 1.44 | NA | 1 | 0.01 | NA | 146 | 1.45 | 0.21 |
| 07/28-07/31 | 1987 | 578-594 | Large | 96 | 99 | 1.03 | 0.16 | 456 | 4.75 | NA | 7 | 0.07 | NA | 463 | 4.82 | 0.51 |
| 08/04-08/07 | 1987 | 578-594 | Large | 91 | 76 | 0.84 | 0.14 | 606 | 6.66 | NA | 9 | 0.10 | NA | 615 | 6.76 | 0.84 |
| 08/25-08/28 | 1987 | 578-594 | Large | 82 | 56 | 0.68 | 0.11 | 561 | 6.84 | NA | 14 | 0.17 | NA | 575 | 7.01 | 0.94 |
| 07/07-07/10 | 1987 | 806-829 | Large | 97 | 85 | 0.88 | 0.12 | 128 | 1.32 | NA | 6 | 0.06 | NA | 134 | 1.38 | 0.15 |
| 08/11-08/14 | 1987 | 842-853 | Large | 77 | 44 | 0.57 | 0.10 | 188 | 2.44 | NA | 9 | 0.17 | NA | 197 | 2.56 | 0.27 |
| 07/14-07/17 | 1987 | 894-915 | Large | 93 | 45 | 0.48 | 0.10 | 173 | 1.86 | NA | 17 | 0.18 | NA | 190 | 2.04 | 0.23 |
| 08/05-08/08 | 1988 | 526-592 | Small | 256 | 154 | 0.60 | 0.06 | 331 | 1.29 | NA | 3 | 0.01 | NA | 334 | 1.30 | 0.14 |
| 07/31-08/03 | 1988 | 656-720 | Small | 262 | 167 | 0.64 | 0.07 | 103 | 0.39 | NA | 2 | 0.01 | NA | 105 | 0.40 | 0.05 |
| 07/21-07/24 | 1988 | 784-848 | Small | 248 | 88 | 0.35 | 0.05 | 195 | 0.79 | NA | 15 | 0.06 | NA | 210 | 0.85 | 0.06 |

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Appendix A3. (Page 2 of 2).

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Net Nights | Small (300-449 mm TL) Catch | CPUE | SE | Medium (450-799 mm TL) Catch | CPUE | SE | Large (≥800 mm TL) Catch | CPUE | SE | Medium + Large (≥450 mm TL) Catch | CPUE | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/08-08/11 | 1989 | 632-662 | Small | 239 | 107 | 0.45 | 0.05 | 286 | 1.20 | NA | 7 | 0.03 | NA | 293 | 1.23 | 0.18 |
| 08/13-08/16 | 1989 | 714-766 | Small | 234 | 149 | 0.64 | 0.07 | 92 | 0.39 | NA | 1 | <0.01 | NA | 93 | 0.40 | 0.05 |
| 06/21-06/28 | 1990 | 888-912 | Small | 458 | 109 | 0.24 | 0.03 | 254 | 0.55 | NA | 14 | 0.03 | NA | 268 | 0.59 | 0.04 |
| 07/10-07/18 | 1990 | 888-912 | Small | 393 | 89 | 0.23 | 0.02 | 331 | 0.84 | NA | 33 | 0.08 | NA | 364 | 0.93 | 0.05 |

[a] Means data is not available for this estimate (see Methods section for explanation).

Appendix A4. Catch per unit effort (CPUE) estimates of burbot sampled in sections of tributaries of the Tanana River and in sections of the Yukon River, 1988 through 1992.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Net Nights | Small (300-449 mm TL) Catch | Small CPUE | Small SE | Medium (450-799 mm TL) Catch | Medium CPUE | Medium SE | Large (≥800 mm TL) Catch | Large CPUE | Large SE | Medium + Large (≥450 mm TL) Catch | Medium + Large CPUE | Medium + Large SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chena River | | | | | | | | | | | | | | | | |
| 09/07-09/09 | 1988 | 0-24 | Small | 88 | 23 | 0.32 | 0.08 | 65 | 0.90 | 0.13 | 0 | 0 | 0 | 65 | 0.90 | 0.13 |
| 06/27-06/30 | 1989 | 0-40 | Small | 120 | 30 | 0.25 | 0.06 | 74 | 0.62 | NA[a] | 1 | 0.01 | NA | 75 | 0.63 | 0.09 |
| 06/12-06/15 | 1990 | 0-24 | Small | 232 | 14 | 0.06 | 0.02 | 16 | 0.07 | NA | 0 | 0 | 0 | 16 | 0.07 | 0.02 |
| 08/21-08/24 | 1990 | 0-24 | Small | 204 | 41 | 0.20 | 0.04 | 82 | 0.40 | NA | 1 | <0.01 | NA | 83 | 0.41 | 0.06 |
| 08/27-08/31 | 1990 | 0-24 | Small | 203 | 59 | 0.29 | 0.04 | 204 | 1.00 | NA | 1 | <0.01 | NA | 205 | 1.01 | 0.11 |
| 09/06-09/07 | 1990 | 0-24 | Small | 73 | 26 | 0.36 | 0.03 | 90 | 1.23 | NA | 0 | 0 | 0 | 90 | 1.23 | 0.09 |
| 09/27-09/28 | 1990 | 0-24 | Small | 80 | 9 | 0.11 | 0.03 | 66 | 0.83 | NA | 2 | 0.03 | NA | 68 | 0.85 | 0.05 |
| 08/27-08/30 | 1991 | 0-24 | Small | 268 | 35 | 0.13 | 0.03 | 218 | 0.81 | 0.09 | 0 | 0 | 0 | 218 | 0.81 | 0.09 |
| 09/04-09/07 | 1991 | 0-24 | Small | 248 | 28 | 0.11 | 0.03 | 171 | 0.69 | 0.08 | 3 | 0.01 | <0.01 | 174 | 0.70 | 0.08 |
| 08/31-09/04 | 1992 | 0-24 | Small | 272 | 19 | 0.07 | 0.02 | 111 | 0.41 | 0.05 | 1 | <0.01 | <0.01 | 112 | 0.41 | 0.05 |
| Tolovana River | | | | | | | | | | | | | | | | |
| 09/14-09/21 | 1988 | 37-78 | Small | 192 | 5 | 0.03 | 0.01 | 211 | 1.10 | NA | 28 | 0.15 | NA | 239 | 1.24 | 0.10 |
| 07/29-08/01 | 1989 | 0-43 | Small | 121 | 6 | 0.05 | 0.02 | 87 | 0.72 | NA | 8 | 0.07 | NA | 95 | 0.79 | 0.09 |
| 06/12-06/19 | 1991 | 0-48 | Small | 570 | 37 | 0.07 | 0.01 | 595 | 1.04 | 0.06 | 1 | <0.01 | <0.01 | 596 | 1.05 | 0.06 |
| 06/26-07/03 | 1991 | 0-48 | Small | 568 | 39 | 0.07 | 0.01 | 235 | 0.41 | 0.03 | 2 | <0.01 | <0.01 | 237 | 0.42 | 0.03 |
| Yukon River | | | | | | | | | | | | | | | | |
| 08/24-08-27 | 1988 | (-22)-56 | Small | 239 | 6 | 0.03 | 0.01 | 122 | 0.51 | NA | 18 | 0.08 | NA | 140 | 0.59 | 0.06 |
| 07/16-07/18 | 1989 | (-242)-(-203) | Small | 170 | 8 | 0.05 | 0.02 | 33 | 0.19 | NA | 9 | 0.05 | NA | 42 | 0.25 | 0.05 |
| 10/01-10/04 | 1991 | (-24)-0 | Small | 173 | 1 | <0.01 | <0.01 | 78 | 0.45 | 0.06 | 32 | 0.19 | 0.03 | 110 | 0.64 | 0.07 |

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Appendix A4. (Page 2 of 2).

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Net Nights | Small (300-449 mm TL) Catch | CPUE | SE | Medium (450-799 mm TL) Catch | CPUE | SE | Large (≥800 mm TL) Catch | CPUE | SE | Medium + Large (≥450 mm TL) Catch | CPUE | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kantishna River | | | | | | | | | | | | | | | | |
| 07/29-08/01 | 1989 | 0-43 | Small | 113 | 25 | 0.23 | 0.05 | 19 | 0.17 | 0.03 | 0 | 0 | 0 | 19 | 0.17 | 0.03 |
| Goodpaster River | | | | | | | | | | | | | | | | |
| 06/27-06/28 | 1989 | 0-18 | Small | 58 | 17 | 0.29 | 0.15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Chisana River | | | | | | | | | | | | | | | | |
| 08/27-08/29 | 1989 | 0-38 | Small | 122 | 13 | 0.11 | 0.04 | 112 | 0.92 | NA | 13 | 0.11 | NA | 125 | 1.02 | 0.13 |
| Nenana River | | | | | | | | | | | | | | | | |
| 08/20-08/23 | 1991 | 0-24 | Small | 242 | 67 | 0.28 | 0.04 | 147 | 0.61 | 0.07 | 13 | 0.05 | 0.02 | 160 | 0.66 | 0.07 |

[a] Means data is not available for this estimate (see Methods section for explanation).

# APPENDIX B

Appendix B1. Mean length estimates of burbot sampled in sections of the lower Tanana River, 1986 through 1989.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Length Range (mm TL) | Small (300-449 mm TL) | | | Medium (450-799 mm TL) | | | Large (≥800 mm TL) | | | Medium + Large (≥450 mm TL) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Catch | Mean | SE | Catch | Mean | SE | Catch | Mean | SE | Catch | Mean | SE |
| 06/23-06/27 | 1986 | 98-116 | Large | 270-990 | 71 | 388 | 5 | 257 | 564 | 5 | 4 | 838 | 21 | 261 | 596 | 5 |
| 07/07-07/11 | 1986 | 247-265 | Large | 295-912 | 90 | 386 | 4 | 82 | 534 | 7 | 2 | 891 | 22 | 84 | 543 | 9 |
| 06/23-06/26 | 1987 | 102-112 | Large | 302-866 | 20 | 388 | 9 | 190 | 600 | 6 | 6 | 836 | 10 | 196 | 607 | 6 |
| 07/14-07/17 | 1988 | 48-112 | Small | 304-845 | 60 | 391 | 6 | 242 | 560 | 5 | 5 | 824 | 10 | 247 | 566 | 5 |
| 08/17-08/20 | 1988 | 160-216 | Small | 275-952 | 35 | 392 | 6 | 231 | 583 | 6 | 25 | 859 | 8 | 256 | 610 | 8 |
| 07/12-07/15 | 1989 | 0-54 | Small | 289-773 | 47 | 380 | 7 | 91 | 562 | 9 | 0 | ID[a] | ID | 91 | 562 | 9 |

[a] Insufficient data.

Appendix B2. Mean length estimates of burbot sampled in sections of the middle Tanana River, 1986 through 1992.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Length Range (mm TL) | Small (300-449 mm TL) | | | Medium (450-799 mm TL) | | | Large (≥800 mm TL) | | | Medium + Large (≥450 mm TL) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Catch | Mean | SE | Catch | Mean | SE | Catch | Mean | SE | Catch | Mean | SE |
| 08/19-08/22 | 1986 | 265-284 | Large | 280-1,010 | 23 | 391 | 9 | 196 | 602 | 6 | 14 | 879 | 16 | 210 | 621 | 7 |
| 07/29-08/02 | 1986 | 334-352 | Large | 260-863 | 51 | 382 | 6 | 94 | 552 | 8 | 7 | 839 | 9 | 101 | 572 | 10 |
| 08/11-08/15 | 1986 | 334-352 | Large | 266-905 | 42 | 379 | 7 | 57 | 556 | 14 | 3 | 846 | 29 | 60 | 570 | 13 |
| 09/08-09/12 | 1986 | 356-377 | Large | 294-954 | 46 | 365 | 6 | 70 | 548 | 11 | 4 | 887 | 35 | 74 | 566 | 14 |
| 07/14-07/16 | 1987 | 270-283 | Large | 307-790 | 38 | 399 | 6 | 110 | 554 | 8 | 0 | ID[a] | ID | 110 | 554 | 18 |
| 07/22-07/25 | 1987 | 339-354 | Large | 315-1,025 | 22 | 400 | 7 | 41 | 544 | 12 | 6 | 888 | 41 | 47 | 588 | 21 |
| 07/28-07/31 | 1987 | 339-354 | Large | 304-1,079 | 70 | 396 | 5 | 73 | 552 | 9 | 6 | 885 | 45 | 79 | 578 | 13 |
| 08/04-08/07 | 1987 | 339-354 | Large | 308-1,028 | 24 | 399 | 7 | 45 | 569 | 12 | 2 | 937 | 92 | 47 | 584 | 16 |
| 08/18-08/21 | 1987 | 339-354 | Large | 311-1,000 | 46 | 411 | 4 | 178 | 570 | 7 | 14 | 882 | 17 | 192 | 593 | 9 |
| 07/07-07/10 | 1987 | 360-378 | Large | 312-937 | 55 | 389 | 5 | 54 | 524 | 8 | 6 | 854 | 24 | 60 | 557 | 15 |
| 06/10-06/13 | 1987 | 430-442 | Large | 305-952 | 66 | 387 | 5 | 83 | 556 | 9 | 4 | 899 | 17 | 87 | 572 | 11 |
| 06/16-06/19 | 1987 | 498-510 | Large | 300-743 | 83 | 385 | 4 | 46 | 525 | 10 | 0 | ID | ID | 46 | 525 | 10 |
| 07/06-07/09 | 1988 | 312-376 | Small | 235-855 | 159 | 388 | 3 | 144 | 520 | 5 | 1 | 855 | ID | 145 | 523 | 5 |
| 06/13-06/16 | 1989 | 317-374 | Small | 278-895 | 137 | 381 | 4 | 125 | 535 | 6 | 6 | 849 | 13 | 131 | 549 | 8 |
| 06/20-06/24 | 1989 | 418-474 | Small | 275-773 | 136 | 372 | 3 | 42 | 560 | 13 | 0 | ID | ID | 42 | 560 | 13 |
| 08/14-08/16 | 1990 | 344-376 | Small | 300-900 | 44 | 393 | 6 | 96 | 540 | 8 | 4 | 856 | 23 | 100 | 553 | 8 |
| 07/11-07/17 | 1991 | 336-360 | Small | 238-922 | 97 | 386 | 5 | 247 | 530 | 4 | 3 | 893 | 19 | 250 | 534 | 4 |
| 08/24-08/28 | 1992 | 336-360 | Small | 277-1,040 | 57 | 398 | 6 | 266 | 557 | 5 | 16 | 864 | 16 | 282 | 574 | 6 |

[a] Insufficient data.

Appendix B3. Mean length estimates of burbot sampled in sections of the upper Tanana River, 1986 through 1990.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Length Range (mm TL) | Small (300-449 mm TL) | | | Medium (450-799 mm TL) | | | Large (≥800 mm TL) | | | Medium + Large (≥450 mm TL) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Catch | Mean | SE | Catch | Mean | SE | Catch | Mean | SE | Catch | Mean | SE |
| 08/07-08/08 | 1986 | 523-532 | Large | 279-921 | 99 | 390 | 4 | 146 | 536 | 6 | 2 | 864 | 58 | 148 | 541 | 6 |
| 08/11-08/15 | 1986 | 553-564 | Large | 295-962 | 96 | 421 | 3 | 913 | 579 | 3 | 19 | 842 | 10 | 932 | 584 | 3 |
| 07/08-07/11 | 1986 | 578-584 | Large | 235-742 | 108 | 355 | 3 | 32 | 528 | 13 | 0 | ID[a] | ID | 32 | 528 | 13 |
| 09/08-09/12 | 1986 | 608-619 | Large | 307-916 | 54 | 371 | 6 | 63 | 606 | 13 | 5 | 849 | 21 | 68 | 624 | 14 |
| 07/29-08/02 | 1986 | 705-721 | Large | 285-940 | 90 | 367 | 5 | 120 | 581 | 8 | 5 | 859 | 24 | 125 | 593 | 9 |
| 07/23-07/27 | 1986 | 889-903 | Large | 270-1,147 | 84 | 383 | 5 | 425 | 578 | 4 | 83 | 915 | 9 | 508 | 633 | 7 |
| 06/16-06/19 | 1987 | 520-536 | Large | 308-750 | 102 | 389 | 4 | 144 | 525 | 5 | 0 | ID | ID | 144 | 525 | 5 |
| 08/11-08/14 | 1987 | 553-571 | Large | 300-933 | 55 | 394 | 5 | 145 | 556 | 7 | 1 | 933 | ID | 146 | 559 | 7 |
| 07/28-07/31 | 1987 | 578-594 | Large | 312-962 | 99 | 409 | 3 | 456 | 566 | 3 | 7 | 863 | 23 | 463 | 571 | 4 |
| 08/04-08/07 | 1987 | 578-594 | Large | 321-920 | 76 | 404 | 4 | 606 | 606 | 3 | 9 | 848 | 14 | 615 | 615 | 3 |
| 08/25-08/28 | 1987 | 578-594 | Large | 344-895 | 56 | 417 | 4 | 561 | 585 | 4 | 14 | 837 | 7 | 575 | 591 | 4 |
| 07/07-07/10 | 1987 | 806-829 | Large | 305-1,000 | 85 | 379 | 4 | 128 | 558 | 7 | 6 | 874 | 31 | 134 | 572 | 9 |
| 08/11-08/14 | 1987 | 842-853 | Large | 326-985 | 44 | 399 | 6 | 188 | 587 | 6 | 9 | 866 | 22 | 197 | 600 | 7 |
| 07/14-07/17 | 1987 | 894-915 | Large | 307-1,010 | 45 | 392 | 6 | 173 | 570 | 7 | 17 | 865 | 18 | 190 | 569 | 9 |
| 08/05-08/08 | 1988 | 526-592 | Small | 268-865 | 154 | 390 | 3 | 331 | 560 | 4 | 3 | 846 | 10 | 334 | 563 | 5 |
| 07/31-08/03 | 1988 | 656-720 | Small | 290-966 | 167 | 374 | 3 | 103 | 578 | 10 | 2 | 890 | 76 | 105 | 584 | 10 |
| 07/21-07/24 | 1988 | 784-848 | Small | 288-908 | 88 | 382 | 4 | 195 | 587 | 6 | 15 | 830 | 7 | 210 | 604 | 7 |

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Appendix B3. (Page 2 of 2).

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Length Range (mm TL) | Small (300-449 mm TL) Catch | Mean | SE | Medium (450-799 mm TL) Catch | Mean | SE | Large (≥800 mm TL) Catch | Mean | SE | Medium + Large (≥450 mm TL) Catch | Mean | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 08/08-08/11 | 1989 | 632-662 | Small | 274-1,070 | 107 | 388 | 4 | 286 | 581 | 5 | 7 | 866 | 36 | 293 | 588 | 6 |
| 08/13-08/16 | 1989 | 714-766 | Small | 205-820 | 149 | 374 | 3 | 92 | 547 | 8 | 1 | 820 | ID | 93 | 550 | 9 |
| 06/21-06/28 | 1990 | 888-912 | Small | 246-986 | 109 | 389 | 4 | 254 | 564 | 5 | 14 | 846 | 15 | 268 | 579 | 5 |
| 07/10-07/18 | 1990 | 888-912 | Small | 270-1,030 | 89 | 396 | 4 | 331 | 590 | 5 | 33 | 884 | 12 | 364 | 617 | 5 |

[a] Insufficient data.

Appendix B4. Mean length estimates of burbot sampled in sections of tributaries of the Tanana River and in sections of the Yukon River, 1988 through 1992.

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Length Range (mm TL) | Small (300-449 mm TL) Catch | Mean | SE | Medium (450-799 mm TL) Catch | Mean | SE | Large (≥800 mm TL) Catch | Mean | SE | Medium + Large (≥450 mm TL) Catch | Mean | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Chena River | | | | | | | | | | | | | | | | |
| 09/07-09/09 | 1988 | 0-24 | Small | 306-754 | 23 | 394 | 8 | 65 | 557 | 8 | 0 | ID[a] | ID | 65 | 557 | 8 |
| 06/27-06/30 | 1989 | 0-40 | Small | 295-802 | 30 | 366 | 6 | 74 | 568 | 10 | 1 | 802 | ID | 75 | 571 | 10 |
| 06/12-06/15 | 1990 | 0-24 | Small | 265-600 | 14 | 375 | 14 | 16 | 510 | 12 | 0 | ID | ID | 16 | 510 | 12 |
| 08/21-08/24 | 1990 | 0-24 | Small | 302-873 | 41 | 400 | 7 | 82 | 540 | 8 | 1 | 873 | ID | 83 | 544 | 8 |
| 08/27-08/31 | 1990 | 0-24 | Small | 294-852 | 59 | 409 | 5 | 204 | 555 | 5 | 1 | 852 | ID | 205 | 556 | 5 |
| 09/06-09/07 | 1990 | 0-24 | Small | 316-762 | 26 | 391 | 9 | 90 | 554 | 7 | 0 | ID | ID | 90 | 554 | 7 |
| 09/27-09/28 | 1990 | 0-24 | Small | 315-905 | 9 | 381 | 18 | 66 | 554 | 9 | 2 | 888 | 18 | 68 | 564 | 9 |
| 08/27-08/30 | 1991 | 0-24 | Small | 288-785 | 35 | 385 | 8 | 218 | 562 | 5 | 0 | ID | ID | 218 | 562 | 5 |
| 09/04-09/07 | 1991 | 0-24 | Small | 295-895 | 28 | 382 | 9 | 171 | 565 | 5 | 3 | 850 | 27 | 174 | 569 | 5 |
| 08/31-09/04 | 1992 | 0-24 | Small | 307-843 | 19 | 388 | 10 | 111 | 575 | 7 | 1 | 843 | ID | 112 | 577 | 7 |
| Tolovana River | | | | | | | | | | | | | | | | |
| 09/14-09/21 | 1988 | 37-78 | Small | 364-910 | 5 | 422 | 15 | 211 | 634 | 6 | 28 | 851 | 6 | 239 | 660 | 7 |
| 07/29-08/01 | 1989 | 0-43 | Small | 280-875 | 6 | 397 | 13 | 87 | 584 | 9 | 8 | 831 | 9 | 95 | 605 | 11 |
| 06/12-06/19 | 1991 | 0-48 | Small | 299-807 | 37 | 398 | 8 | 595 | 577 | 3 | 1 | 807 | ID | 596 | 577 | 3 |
| 06/26-07/03 | 1991 | 0-48 | Small | 249-875 | 39 | 373 | 8 | 235 | 558 | 4 | 2 | 853 | 23 | 237 | 560 | 4 |
| Yukon River | | | | | | | | | | | | | | | | |
| 08/24-08-27 | 1988 | (-22)-56 | Small | 311-1,000 | 6 | 392 | 20 | 122 | 628 | 7 | 18 | 874 | 16 | 140 | 660 | 10 |
| 07/16-07/18 | 1989 | (-242)-(-203) | Small | 209-970 | 8 | 374 | 18 | 33 | 585 | 13 | 9 | 887 | 19 | 42 | 650 | 22 |
| 10/01-10/04 | 1991 | (-24)-0 | Small | 400-1,070 | 1 | 400 | ID | 78 | 691 | 9 | 32 | 893 | 12 | 110 | 750 | 8 |

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Appendix B4. (Page 2 of 2).

| Sampling Dates | Year | River km Sampled | Hoop Trap Size | Length Range (mm TL) | Small (300-449 mm TL) Catch | Mean | SE | Medium (450-799 mm TL) Catch | Mean | SE | Large (≥800 mm TL) Catch | Mean | SE | Medium + Large (≥450 mm TL) Catch | Mean | SE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Kantishna River | | | | | | | | | | | | | | | | |
| 07/29-08/01 | 1989 | 0-43 | Small | 242-610 | 25 | 350 | 9 | 19 | 526 | 12 | 0 | ID | ID | 19 | 526 | 12 |
| Goodpaster River | | | | | | | | | | | | | | | | |
| 06/27-06/28 | 1989 | 0-18 | Small | 335-445 | 17 | 386 | 6 | 0 | ID | ID | 0 | ID | ID | 0 | ID | ID |
| Chisana River | | | | | | | | | | | | | | | | |
| 08/27-08/29 | 1989 | 0-38 | Small | 347-1,060 | 13 | 410 | 10 | 112 | 616 | 8 | 13 | 883 | 21 | 125 | 644 | 11 |
| Nenana River | | | | | | | | | | | | | | | | |
| 08/20-08/23 | 1991 | 0-24 | Small | 290-903 | 67 | 380 | 5 | 147 | 574 | 7 | 13 | 842 | 9 | 160 | 596 | 6 |

[a] Insufficient data.

# APPENDIX C

Appendix C1. Abundance, density and catch per unit effort (CPUE) estimates of burbot 450 mm TL and larger sampled in various river sections throughout the Tanana River drainage.

| River | River km Sampled[a] | Year | Abundance[b] | SE | Density[b] | SE | CPUE[c] | SE | Catchability Coefficient[d] |
|---|---|---|---|---|---|---|---|---|---|
| Tanana | 336 - 352 | 1986 | 1,936[e] | 448 | 121 | 28 | 0.82 | ND[j] | 0.007 |
| Tanana | 336 - 352 | 1987 | 2,541[f] | 680 | 159 | 43 | 0.86 | 0.10 | 0.005 |
| Tanana | 582 - 589 | 1987 | 4,004[g] | 287 | 572 | 41 | 7.02 | 0.86 | 0.012 |
| Tanana | 888 - 912 | 1990 | 2,232[h] | 456 | 93 | 19 | 0.93 | 0.05 | 0.010 |
| Chena | 0 - 24 | 1990 | 1,752[h] | 264 | 73 | 11 | 0.79 | 0.03 | 0.011 |
| Chena | 0 - 24 | 1991 | 1,704[i] | 336 | 71 | 14 | 0.76 | 0.06 | 0.011 |
| Tolovana | 0 - 48 | 1991 | 6,048[i] | 2,256 | 126 | 47 | 0.73 | 0.03 | 0.006 |

[a] River kilometers are measured upstream from the river mouth.
[b] Abundance and density estimates are shown as number of large burbot (450 mm TL and larger) per river kilometer.
[c] Catch-per-unit-effort estimates (CPUE) are shown as number of burbot 450 mm TL and larger caught per net-night.
[d] Calculated as CPUE divided by density (from Everhart and Youngs 1981).
[e] Modified from Hallberg et al. (1987). Original estimate was for burbot 300 mm TL and longer
[f] From Evenson (1988).
[g] Modified from Evenson (1988). Original estimate was given for a larger section
[h] Modified from Evenson (1991). Original estimate was for burbot 400 mm TL and longer.
[i] From Evenson (1992).
[j] No data available.