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Salmon surveys on the Koyukuk and Nowitna
National Wildlife Refuges, Alaska, 1993

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Abstract.— Surveys were conducted on the Koyukuk and Nowitna National Wildlife Refuges (Refuge) to determine the presence of salmon *Oncorhynchus* spp. Effort was targeted on summer chum *Oncorhynchus keta* and chinook salmon *O. tshawytscha* in early summer and fall chum and coho salmon *O. kisutch* in September. On the Koyukuk Refuge, no salmon were captured in the North or South Fork Huslia rivers in July, or in the mainstem Huslia River or Billy Hawk Creek in September. On the Nowitna Refuge, chinook salmon were captured in the mainstem Nowitna River in July, and fall chum and coho salmon were captured in September.

Escapement estimates of salmon in the Yukon River drainage have shown a steady decline since the early 1980's. These declines have been particularly evident in summer chum salmon *Oncorhynchus keta* stocks. Data necessary to effectively manage the Yukon River refuge salmon stocks are lacking. Escapement goals for the Yukon drainage and individual streams are derived from sonar counts and aerial surveys. Aerial surveys are interpreted as an index which may or may not adequately depict total escapement. Other data gaps include the contribution of smaller salmon runs to the harvest and the effect a mixed-stock harvest has on these runs. More specific to the Koyukuk National Wildlife Refuge (Koyukuk Refuge), aerial surveys suggest the presence of a fall chum run and the occurrence of coho salmon *O. kisutch* has not been documented. On the Nowitna National Wildlife Refuge (Nowitna Refuge) there are no salmon escapement estimates even though there is documentation for the presence of salmon.

The villages of Kaltag, Nulato, Koyukuk, Galena, and Huslia harvest Koyukuk Refuge salmon stocks for subsistence, while Galena, Ruby, and Tanana harvest stocks from the Nowitna Refuge. Commercial fishing also occurs along the mainstem of the Yukon River which borders both refuges. Some chinook and chum salmon captured in the subsistence and commercial fishery are transboundary stocks originating in Canada. Negotiations began in 1985 between the U.S. and Canada to address allocation issues of these stocks. Documentation of additional stocks and status of known stocks is necessary for developing treaty guidelines.

The involvement of the U.S. Fish and Wildlife Service (Service) concerning salmon stocks in the Yukon drainage is derived from the obligations of the Service to manage the Koyukuk and Nowitna refuges as mandated in the Alaska National Interest Lands Conservation Act of 1980 (U.S. Public Law 96-487). Three of the purposes for the establishment of these refuges were: to conserve fish and wildlife populations and their habitats in their natural diversity; to provide the opportunity for continued subsistence uses by local residents; and to fulfill the international treaty obligations of the United States with respect to fish and wildlife and their habitats. As an initial step towards conducting projects in support of salmon management, the 1993 study objectives were limited to:

1. Review and compile all literature on salmon distribution and escapement in rivers on the Koyukuk and Nowitna refuges.

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2. Determine presence of chinook, chum, and coho salmon in rivers where information is lacking (or incidental) in the Koyukuk and Nowitna refuges.
3. Record the presence of resident fish species captured during the salmon sampling effort on the North and South Fork Huslia rivers, and Nowitna River.
4. Collect biological data on fish species captured.

Sample Site Locations

Koyukuk Refuge.— During July, effort was targeted on summer chum and chinook salmon. Sampling locations in both the North and South Fork Huslia rivers were about one km above their confluence (65° 52.6'N, 157° 35.8'W) (Figure 1). In September, sampling locations were in the lower Huslia River near the confluence of Billy Hawk Creek (65° 56.7'N, 156° 40.7'W) (Figure 1). Summer chum have been documented in the Billy Hawk and potentially fall chum and coho may use this river as well, but late summer and fall surveys in this stream have not been conducted. This location would document salmon migrating into both Billy Hawk Creek and the upper Huslia River.

Nowitna Refuge.— On the Nowitna Refuge the sampling location in July and September was in the lower Nowitna River about 15 km below the confluence of the Sulatna River (64° 39.5'N, 154° 34.1'W) (Figure 2). This site was below any major tributaries in the drainage.

Methods

Literature and unpublished data on salmon distribution for the Koyukuk and Nowitna rivers collected by the Alaska Department of Fish and Game and the Service were reviewed and summarized.

Fish were collected using multifilament gill nets. In July, two stretch mesh sizes of gill nets were used; 21 cm to target chinook salmon and 14.9 cm for chum salmon. Gill nets used on the mainstem Nowitna River were 30.5 m long and those employed on the North and South Fork Huslia rivers were 9.1 m long. In September, only the 14.9 cm mesh was used to target chum and coho salmon. In the Nowitna River the nets were 30.5 m long and in the Huslia River and Billy Hawk Creek they were 18.2 m long.

There were three sampling periods per day, with about a 3 h effort during each period. The sampling periods were generally between 4-8 am, noon - 4 pm, and 9 pm - midnight. Sampling in the North and South Fork Huslia rivers occurred on alternate days.

All fish captured were identified to species and counted. Sex of adult salmon was determined by the presence/absence of a kype. Salmon were measured to the nearest cm from the mid-eye to fork of the caudal fin (MEL). All other species were measured to the nearest cm fork length (FL).

Results

Literature Review

Koyukuk Refuge.— Two species of salmon are found on the Koyukuk Refuge; chinook (*O. tshawytscha*), and chum salmon (U.S. Fish and Wildlife Service 1993). Chinook and a summer run of chum salmon reach the Koyukuk River from late June to mid-July. Chinook salmon have been documented in the Gisasa, Kateel, Dakli, and Indian rivers (Barton 1984; Alaska Department of Fish and Game, unpublished data). Summer chum have been documented in the Gisasa, Kateel, North Fork Huslia rivers, Billy Hawk Creek, the Dakli, Hogatza, and Indian rivers (Barton 1984; Alaska Department of Fish and Game, unpublished data). A concurrent fish study in mid-August 1993 documented chum salmon in Billy Hawk Creek which may be part of a fall run in that stream (Wiswar 1994). Coho salmon have been documented in rivers on the refuge.

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Escapement estimates for chinook and chum salmon began on the Koyukuk Refuge in 1960 and 1961 when aerial surveys were conducted in the Gisasa, Kateel, Hogatza, Indian, and Dakli rivers (Table 1). There was a hiatus in surveys between 1961 and 1974, but since 1974 the Alaska Department of Fish and Game has periodically focused on selected index streams (Barton 1984; Hawkinson and Deshermeier 1985; Alaska Department of Fish and Game, unpublished data).

Aerial escapement data (1960 - present) for chinook and summer chum is available for the Gisasa, Kateel, Dakli, and Hogatza rivers. These rivers have only their lower reach flowing through the Koyukuk Refuge. Surveys conducted since 1987 appear to indicate that the Dakli drainage supports higher numbers of summer chum; whereas, chinook numbers have been higher in the Gisasa River.

Escapement estimates have been highly variable over the years and numbers may only indicate relative run strength. Weather conditions, river stage, time of survey relative to timing of the spawning run, aircraft type, and different observers may all contribute to this variability. When aerial survey estimates were compared with estimates derived from sonar in the Chandalar River, numbers varied by a factor of 2.70 to 6.17 (Daum 1992).

Nowitna Refuge.— Summer chum were found in the Nowitna Refuge near the confluence of the Big Mud River and the Nowitna River and fall chum were captured near the mouth of the Sulukna River (Alt 1985). Coho salmon were captured in the upper Nowitna River near Our Creek (Alt 1985). Chinook salmon have not been previously documented on the refuge.

Salmon were not observed during aerial surveys conducted in the Nowitna River in 1960, 1975 (Barton 1984), and 1984 (Hawkinson and Deshermeier 1985); however, about 50 carcasses of summer chum salmon were found near the mouth of the Big Mud River and coho were found near Our Creek in September 1984 (Alt 1985). Summer chum would be expected to move into the Nowitna River in late June and mid-July based upon lower Yukon River catch dates.

Fish Sampling

Rivers selected for sampling in 1993 were the mainstem Huslia River, the North and South Forks of the Huslia River, and Billy Hawk Creek on the Koyukuk Refuge. The mainstem Nowitna River was sampled on the Nowitna Refuge.

Koyukuk Refuge.— Sampling for chinook and summer chum salmon in the North and South Fork Huslia rivers was conducted July 8-18, 1993. Salmon were not captured in either river (Table 2). In the North Fork Huslia River, two northern pike were captured. In the South Fork Huslia River, two northern pike and three broad whitefish were captured.

In the Huslia River mainstem and Billy Hawk Creek sampling was conducted September 1-7. In the mainstem Huslia River, 6 northern pike, 3 broad whitefish, and 1 sheefish were captured (Table 2). In Billy Hawk Creek, 7 northern pike and 2 broad whitefish were captured. High water levels and an increase in floating woody debris prevented sampling to continue after September 7.

Nowitna Refuge.— Sampling for chinook and summer chum salmon in the Nowitna River began on June 29 and continued until July 18. The effort resulted in capturing 12 chinook salmon, 59 northern pike *Esox lucius*, 70 broad whitefish *Coregonus nasus*, and 31 sheefish *Stenodus leucichthys* (Table 2). Chinook salmon were captured between July 2-12. Sex was determined for nine of the chinook salmon captured; 5 females and 4 males. Chinook salmon measured in the chum size net ranged from 58 to 81 cm MEL.

Sampling for fall chum and coho salmon was conducted on September 3 and 4. Two chum salmon, one coho salmon, 11 northern pike, 5 broad whitefish, and 2 sheefish were captured. The chum salmon captured were a male and female and measured 53 and 59 cm MEL, respectively; the coho was a female and measured 57 cm MEL. Several days of rain raised the river level about 3 m and increased the woody debris load which prevented sampling to continue after September 4.

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Summary and Recommendations

Chinook salmon captured in the Nowitna River was the first time this species was documented in the drainage. The low number of chinook salmon captured in 1993 ($N = 12$) may be due to: the majority of the run had already migrated upriver, therefore the start of sampling effort was late; the Nowitna River was higher than what has been considered normal for late June - July and the areal coverage of our sampling gear was inadequate; the number of chinook salmon using the Nowitna drainage is small. Identification of spawning areas would allow an assessment to be made on the best techniques to be employed to enumerate escapement. Applying radiotelemetry technology to chinook salmon migrating up the Nowitna river would be a recommended method to aid in identifying spawning areas. Enumeration techniques, such as a weir, counting tower, or carcass counts, could then be assessed depending on the size of the run and the area.

There were no chum or chinook salmon captured in either the lower North or South Fork of the Huslia River in July. Net site selection and areal coverage in both rivers was adequate to detect the presence of salmon. One possibility for their absence is that the majority of the run had already migrated upriver before gill net sampling occurred. Also, record low summer chum returns to the Yukon River may not have reflected a normal yearly recruitment. The presence of chum salmon in the North Fork Huslia River is based on one observation of two live fish and four carcasses during an aerial survey (Hawkinson and Deshermeier 1985). Water clarity in the lower North and South Fork of the Huslia River was judged to be too discolored from tannin in July 1993 for reliable aerial survey observations. However, in upstream reaches, discolored water may be less of a problem.

In September, in both the Nowitna and Huslia drainages, high water levels and increased amounts of floating woody debris prevented adequate net placement and soak time. Chum and coho salmon in the Nowitna River were documented previously (Alt 1985). Run strength has not been determined and spawning areas have not been located. Further investigations similar to the studies recommended for chinook salmon in the Nowitna River would be applicable to these two salmon species.

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TABLE 1.— Escapement estimates of summer chum and chinook salmon from aerial surveys conducted in rivers flowing in or through the Koyukuk Refuge (from Barton 1984; Alaska Department of Fish and Game unpublished data).

Year	Survey rating	Gisasa River		Kateel River		Hogatza River		Dakli River		Indian River	
		Summer chum	Chinook	Summer chum	Chinook	Summer chum	Chinook	Summer chum	Chinook	Summer chum	Chinook
1960		400	300	46	4					2,120	
1961			266								
1974		22,022	161	1,661	14						
1975		56,904	385	8,552	60						
1976		21,342	332	238	8						
1977		2,204	255							57	
1978		9,280	45			10,204					
1979		10,962	484			28,442					
1980		10,388	951	6		19,786		19,096	6	4,420	38
1981											
1982		334	421			9,968		1,197	1	300	4
1983		2,356	572			56,282		24,866		836	93
1984	Fair					184					
1985	Good	13,232	735			22,566	1				
1986	Fair-good	12,114	1,346								
1987	Fair-good	2,137	731			5,669					

TABLE 1.—Continued.

Year	Survey rating	Gisasa River		Kateel River		Hogatza River		Dakli River		Indian River	
		Summer chum	Chinook	Summer chum	Chinook	Summer chum	Chinook	Summer chum	Chinook	Summer chum	Chinook
1988	Good	9,284	797			6,890					
1989	Not surveyed										
1990	Poor	450	536	338	185	2,177				781	
1991	Fair-good	7,003	1,690			9,947		14,403	0		
1992	Fair-good	9,300	910			2,986		11,159	1	1,597	0

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TABLE 2.— Capture data and lengths of fish caught by gill nets in the North and South Forks of the Huslia River, the Huslia River mainstem, Billy Hawk Creek, and Nowitna River in July and September 1993. Two gill net sizes were used. The chum size net was 14.9 cm stretch mesh and the king size was 21.0 cm stretch mesh.

Date	Capture data				Fork length (cm)							
	Net mesh	Effort (h)	Species	N	N	Mean	SD	Range				
North Fork Huslia River												
Jul 8-18	chum	79.6	Northern pike	2	2	77.0	4.2	74-80				
	king	77.2		0								
South Fork Huslia River												
Jul 9-17	chum	59.2	Northern pike	2	2	71.5	17.7	59-84				
	chum	59.2	Broad whitefish	3					3	52.0	1.0	51-53
	king	58.5		0								
Huslia River mainstem												
Sep 1-7	chum	56.7	Northern pike	6	6	85.7	4.9	77-91				
	chum	56.7	Broad whitefish	3					3	53.3	2.5	51-56
	chum	56.7	Sheefish	1								
Billy Hawk Creek												
Sep 1-7	chum	55.3	Northern pike	7	7	88.0	6.3	78-98				
	chum	55.3	Broad whitefish	2					2	54.5	0.7	54-55
Nowitna River												
Jun 29 - Jul 18	chum	159.2	Chinook	11	11	68.9	5.9	58-76				
	chum	159.2	Northern pike	55					48	93.9	10.9	42-109
	chum	159.2	Broad whitefish	64					44	54.5	3.0	50-62
	chum	159.2	Sheefish	31					29	72.2	4.8	60-84
	king	162.5	Chinook	1					1	81		
	king	162.5	Northern pike	4					4	70.3	15.9	61-94
	king	162.5	Broad whitefish	6					5	53.4	3.1	50-58
Sep 3-4	chum	16.2	Chum	2	2	56.0	4.2	53-59				
	chum	16.2	Coho	1					1	57		
	chum	16.2	Northern pike	11					11	95.1	10.4	78-114
	chum	16.2	Broad whitefish	5					5	53.8	3.0	49-57
	chum	16.2	Sheefish	2					2	68.5	6.4	64-73

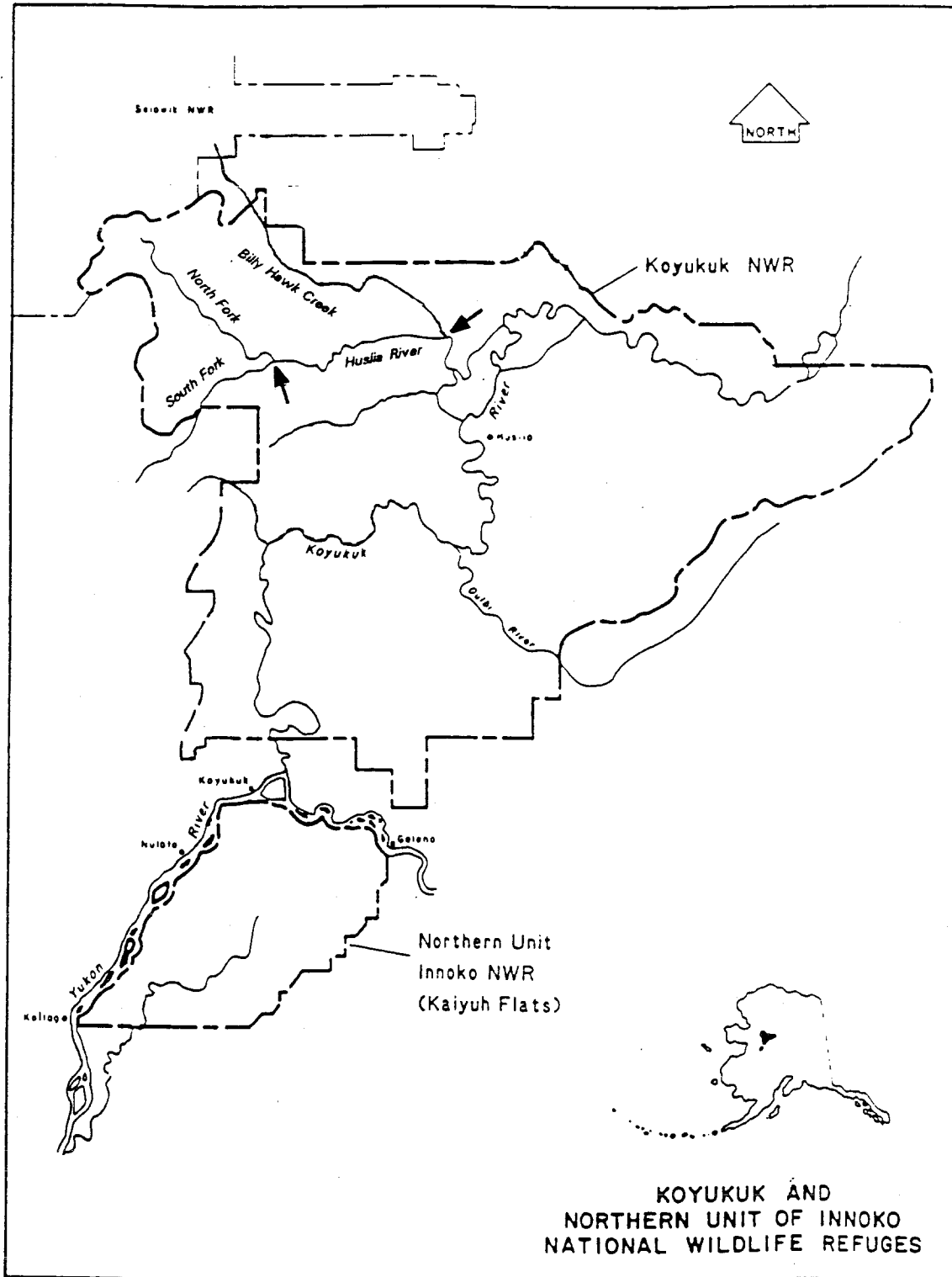


FIGURE 1.—Areas sampled for salmon (arrows) in the North and South Fork Huslia River, mainstem Huslia River, and Billy Hawk Creek, Koyukuk National Wildlife Refuge, July and September 1993.

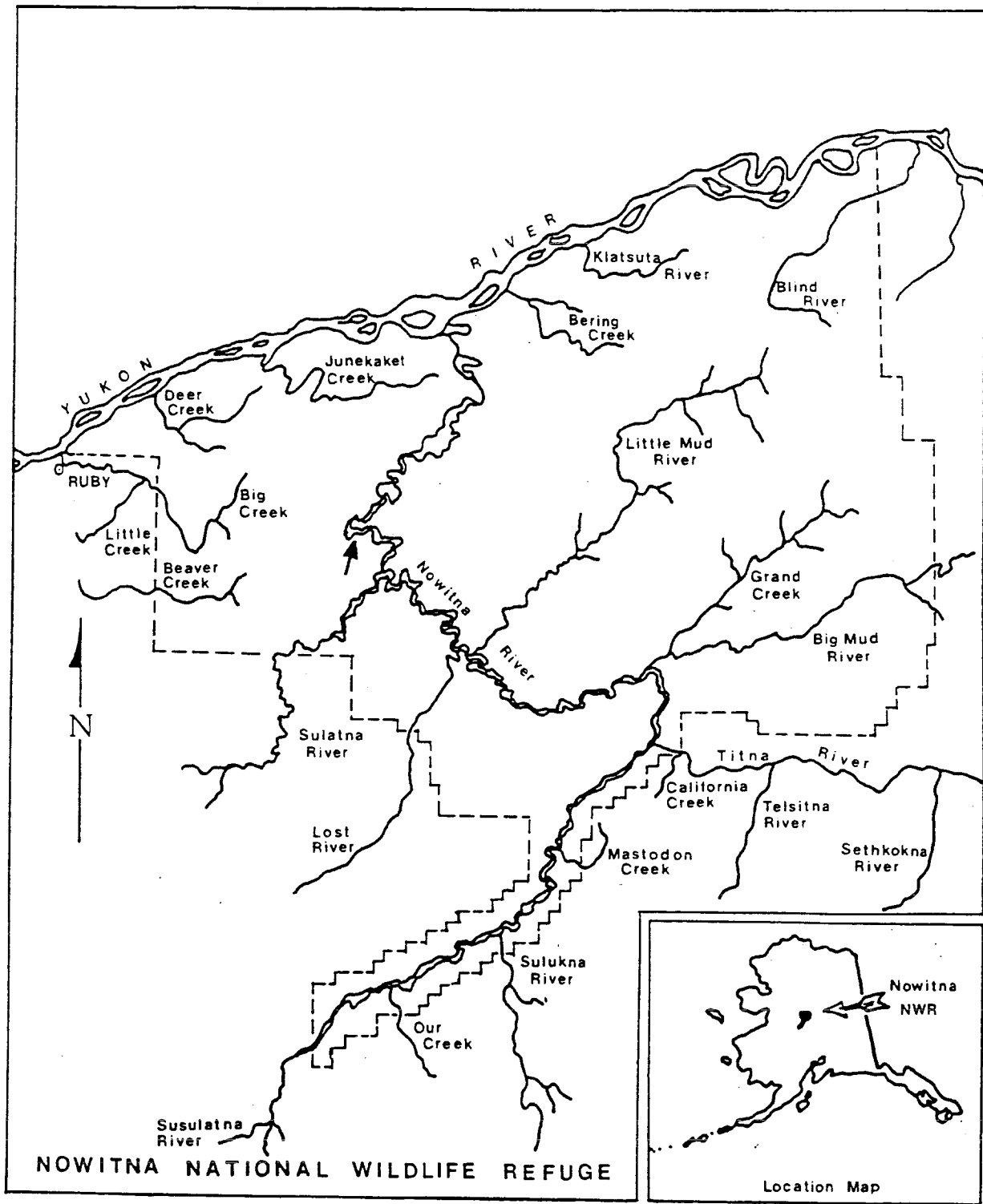


FIGURE 2.—The area sampled for salmon (arrow) in the mainstem Nowitna River, Nowitna National Wildlife Refuge, June, July, and September 1993.