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Estimation of Coho Salmon Escapement in Streams Adjacent to Perryville, Alaska Peninsula National Wildlife Refuge, 2005

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Jeffry L. Anderson

Abstract

Recent runs of coho salmon *Oncorhynchus kisutch* in the Kametolook, Three Star, and Long Beach rivers near Perryville have declined, and residents can no longer meet their subsistence needs in those rivers. Local residents are now taking coho salmon from streams outside the immediate vicinity of Perryville. With fishing effort spread out to other streams, we need to ensure escapement is maintained to meet the subsistence needs of the Native Village of Perryville. In order to prevent over harvest of these small stocks, escapement in those other streams needs to be monitored. In 2005, two aerial surveys were conducted to count adult coho salmon in streams near Perryville using low-level helicopter flights. Numbers of coho salmon counted in 2005 were lower than those observed during surveys in 2003 and 2004. Coho salmon run timing was also different in 2005. Most coho salmon were counted during the survey in late October 2005, whereas peak counts in previous years occurred in early October. Weather and local water quality conditions affected the survey interval and effectiveness in some streams.

Introduction

The residents of Perryville depend on fish and wildlife resources for subsistence, and salmon (primarily coho salmon *Oncorhynchus kisutch*) accounts for more than half of the subsistence food they consume (Hutchinson-Scarborough and Fall 1993). The average harvest of coho salmon in the Perryville area from 1993 to 2000 was estimated to be over 1,900 fish, with a range from 993 (1995) to 3,501 (1994) (ADFG 2002). Recent runs of coho salmon in the Kametolook, Three Star, and Long Beach rivers have declined, with escapement estimated at about 200 fish in 1996 (ADFG 1997a). Several reasons for the decline of coho salmon stocks in the Kametolook River drainage have been suggested, including a decrease in carrying capacity resulting from changes in habitat, over fishing in the river, and over fishing in the ocean. Concerns over poor returns and the inability of local residents to meet their subsistence needs in those three systems motivated the Native Village of Perryville to pass an ordinance that prohibits subsistence harvest in the Kametolook River. In addition, the Alaska Department of Fish and Game (ADFG) engaged in a project in 1996 to rebuild coho salmon stocks in the Kametolook River drainage using incubation boxes, with the intent of improving adult returns by increasing survival from the green egg to swim-up fry stage (ADFG 1997a).

During recent Board of Fisheries and Perryville Subsistence Working Group meetings, local residents stated that they were now taking coho salmon from other streams outside the immediate vicinity of Perryville. In many ways, these streams are similar to streams near Perryville in that they are short, high gradient streams with limited coho salmon abundance. As long as harvest effort is spread among several small streams and not concentrated on one system, the subsistence needs of the village should be met until rebuilding efforts on the Kametolook River become effective.

With fishing effort spread out to other streams, we need to ensure these runs are maintained to meet the subsistence needs of the Native Village of Perryville. In order to prevent over harvest of these small stocks, escapement in those other streams needs to be monitored. The ADFG

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monitors pink and chum salmon escapement until early September as part of their normal operation, but discontinue aerial surveys prior to the peak of coho salmon runs (Pappas et al. 2003). Escapement information is needed for effective in-season and post-season management of these stocks, and this project was initiated to address these needs. Aerial surveys have been used to monitor coho salmon escapement in streams near Perryville since 2003. Anderson (2004a; 2005) presents results from the first two years of monitoring, and this report summarizes the third year of surveys.

Study Area

The Perryville aerial survey area is located on the Pacific Ocean side of the Alaska Peninsula, and is entirely within the boundaries of the Alaska Peninsula National Wildlife Refuge Federal Conservation Unit (Figure 1). Coho, chinook *O. tshawytscha*, pink *O. gorbuscha*, chum *O. keta*, and sockeye *O. nerka* salmon, Dolly Varden *Salvelinus malma*, and steelhead *O. mykiss* are present in area streams. Streams were selected for monitoring based on consultations with local residents, documented presence of coho salmon from previous surveys (Pappas et al. 2001), and documented use by Perryville residents for subsistence harvest (Hutchinson-Scarbrough and Fall 1999). Streams chosen for coho salmon surveys included (ADFG stream numbers in parentheses; ADFG 1997b): Smoky Hollow Creek (275-40-10200), Ivanof River (275-40-10600), Red Bluff Creek (273-70-10200), Ivan River (273-72-10200), and an unnamed river in Humpback Bay (275-50-10200; Figure 1). Clark River (271-10-10310-2021) was also included in the survey since it was the site of a nearby monitoring project for which walking surveys had proven to be unfeasible (Anderson 2004b). Since 2004, Artemie's Creek (275-60-10000-2005), Three Star River (275-60-10050), Spring Creek (no ADFG number), Cross Creek Slough (no ADFG number), and portions of the Kametolook River (275-60-10100) have been included in the surveys (Figure 2). Prior monitoring in these streams had been accomplished using walking surveys in 2002 and 2003 (Anderson and Hetrick 2004).

Methods

Aerial surveys were conducted using low-level helicopter flights. During counts, the pilot maintained the slowest airspeed possible at an altitude ranging from 15 to 50 m above the streambed, depending on the terrain and vegetation. When necessary, the aircraft hovered over large schools of fish and schools with mixed species to assist with counting. Complete circuits of the study areas were completed either moving upstream from the mouth or moving downstream from the headwaters. Direction of the surveys (upstream or downstream) was dictated by local wind and visibility conditions. Surveys were conducted between 10:00 and 15:00 hours to increase the likelihood of direct overhead sunlight, and polarized sunglasses were worn to reduce glare. Starting and stopping points for each stream survey reach were marked on topographic maps. During each aerial survey, total numbers of coho salmon and other species observed were recorded for each reach. Lighting conditions (sun, partial overcast, overcast), water clarity (excellent, good, poor), and wind-generated surface turbulence (calm, moderate, rough) were qualitatively estimated for each reach. Locations of large areas of coho salmon spawning activity, and large congregations of migrating or staging coho salmon were noted, as were locations and numbers of active fishermen.

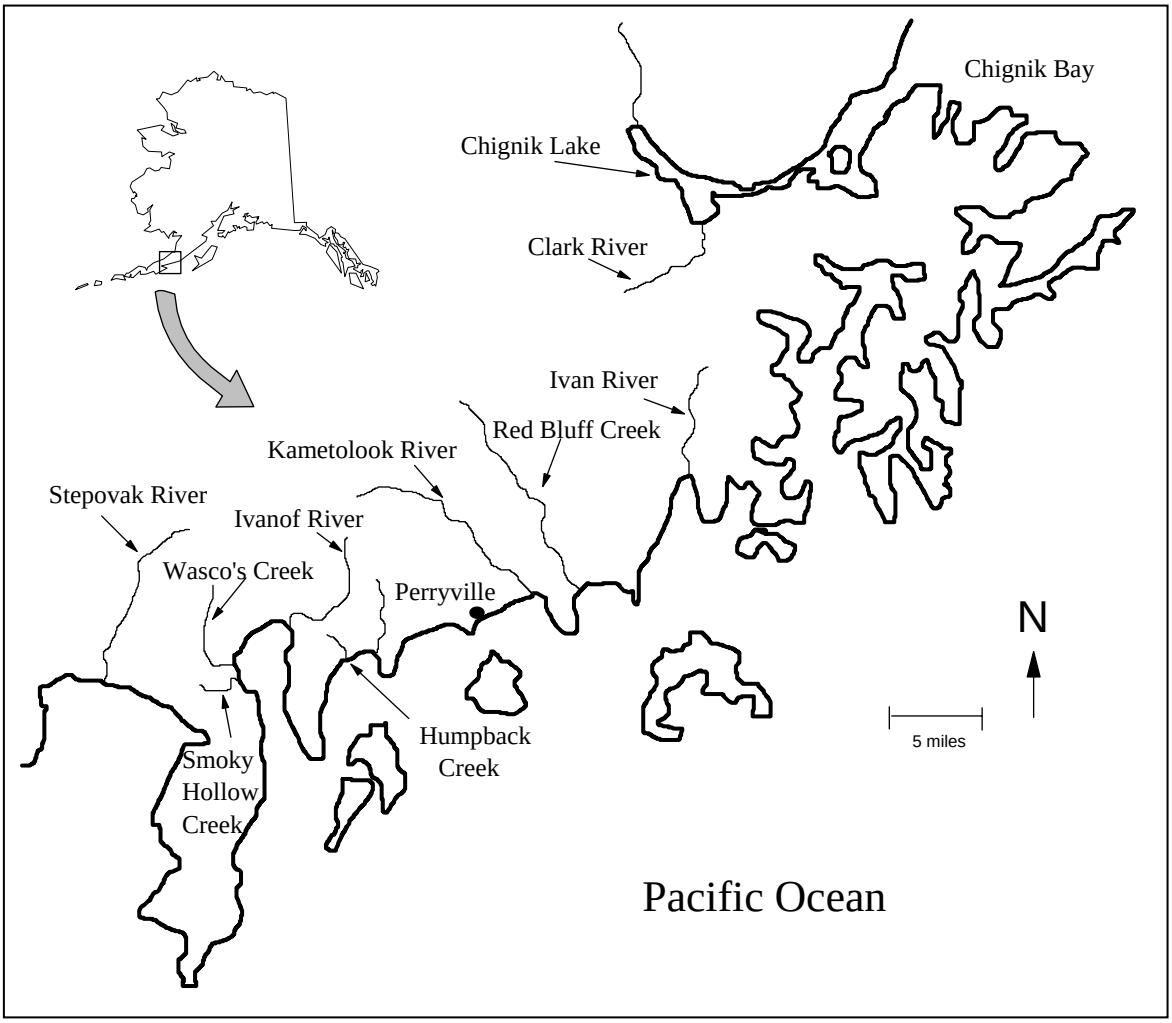

Figure 1. Location of streams in the Perryville area, Alaska Peninsula National Wildlife Refuge.

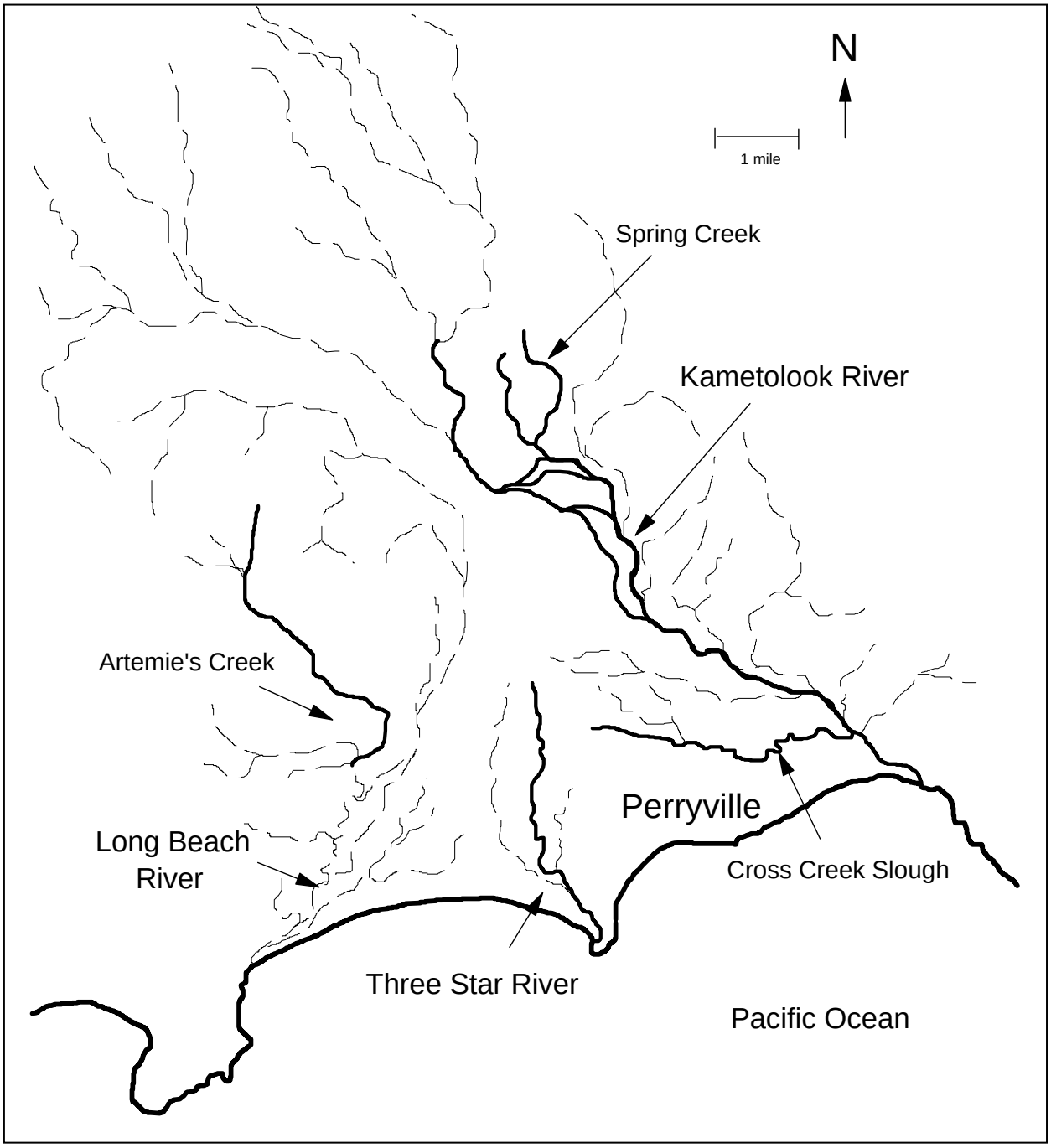

Figure 2. Perryville survey area, Alaska Peninsula National Wildlife Refuge. Streams shown with dashed lines were not surveyed.

Two stream surveys were planned, one in late September and one in mid October, and were scheduled based on weather forecasts, local stream conditions, and pilot availability. Flights were coordinated to minimize sampling error by avoiding periods of turbid flow and inclement weather. The first survey was completed during 7 and 8 October, and the second survey was completed during 25 and 26 October 2005. Due to logistic constraints (fuel range and available funding), entire watersheds were not surveyed. Generally, mainstem rivers and major tributary streams were surveyed until they began branching into numerous small tributaries, or until the vegetation canopy limited the ability of observers to count fish. Where practical, the stream reach delineations developed during the 2003 surveys were used in 2005. Survey reaches are considered to be index areas, and counts are minimum estimates of coho salmon abundance. Our assumption is that periodic aerial counts will provide a minimum index of coho salmon escapement.

The mainstem Ivanof River and its major tributary were surveyed until the canopy limited our ability to see the stream (Figure 3). Smoky Hollow Creek (Figure 3) was surveyed until the canopy limited visibility, and the unnamed river in Humpback Bay (Figure 3) was surveyed until the main stream split into two small tributaries. Artemie's Creek and Cross Creek Slough (Figure 2) were surveyed until overhead vegetation limited our ability to see the streams during the first survey, and until impassable waterfalls were encountered during the second survey. The entire Spring Creek system was surveyed on both occasions (Figure 2). We were not able to survey the Three Star and Kametolook rivers on the first flight because both streams were still affected by turbid glacial run-off, and visibility prohibited counting fish. The mainstem Three Star River and Kametolook River were both surveyed during the late October flight (Figure 2). The mainstem of Red Bluff Creek and its major tributary (Figure 4) were surveyed until the canopy enclosed the streams on both occasions. The mainstem Ivan River (Figure 5) was surveyed until it became a series of braided, intermittent channels, and the mainstem Clark River (Figure 6) was surveyed until it branched into two smaller tributary streams.

Results

For most streams surveyed in 2005, more coho salmon were observed during the aerial survey in late October than were observed during the survey in early October (Table 1). More coho salmon were observed in Red Bluff Creek than in other systems, and more sockeye salmon were observed in Clark River than in other systems. Numerous pink salmon carcasses were observed in Ivanof River, the unnamed river in Humpback Bay, and Ivan River during the early October survey. Most coho salmon were observed in large pods low in the mainstem rivers during the first survey, but fish were dispersed throughout the streams on the second survey. Most coho salmon observed during both surveys were not actively spawning, although some fish were observed spawning in Red Bluff Creek during the second survey. A pod of 600 fish was observed in the lagoon off the mouth of Smoky Hollow Creek during the second survey. With few exceptions, surveys were conducted when lighting, water clarity, and surface turbulence allowed for good visibility of fish in the streams. Although surveyors looked for fishing activity in and around the study streams, no fishermen were observed during the flights.

Table 1. Numbers of coho and sockeye salmon observed during fall aerial surveys of streams near Perryville, 2005. CO = coho salmon, SE = sockeye salmon.

	7 - 8 October Survey		25 - 26 October Survey	
Stream	CO	SE	CO	SE
Smoky Hollow Creek	54	0	147	0
Ivanof River	766	0	1,170	0
Unnamed River, Humpback Bay	82	0	207	0
Artemie's Creek[b]	0	0	0	0
Three Star River	--[a]	--[a]	107	0
Spring Creek System	10	0	24	0
Kametolook River	--[a]	--[a]	470	0
Cross Creek Slough	2	0	22	0
Red Bluff Creek	352	0	2,482	4
Ivan River	507	4	170	0
Clark River	240	3,520	800	4,100

[a] = Survey not completed due to poor water clarity.
[b] = Lower reaches captured by turbid Long Beach water.

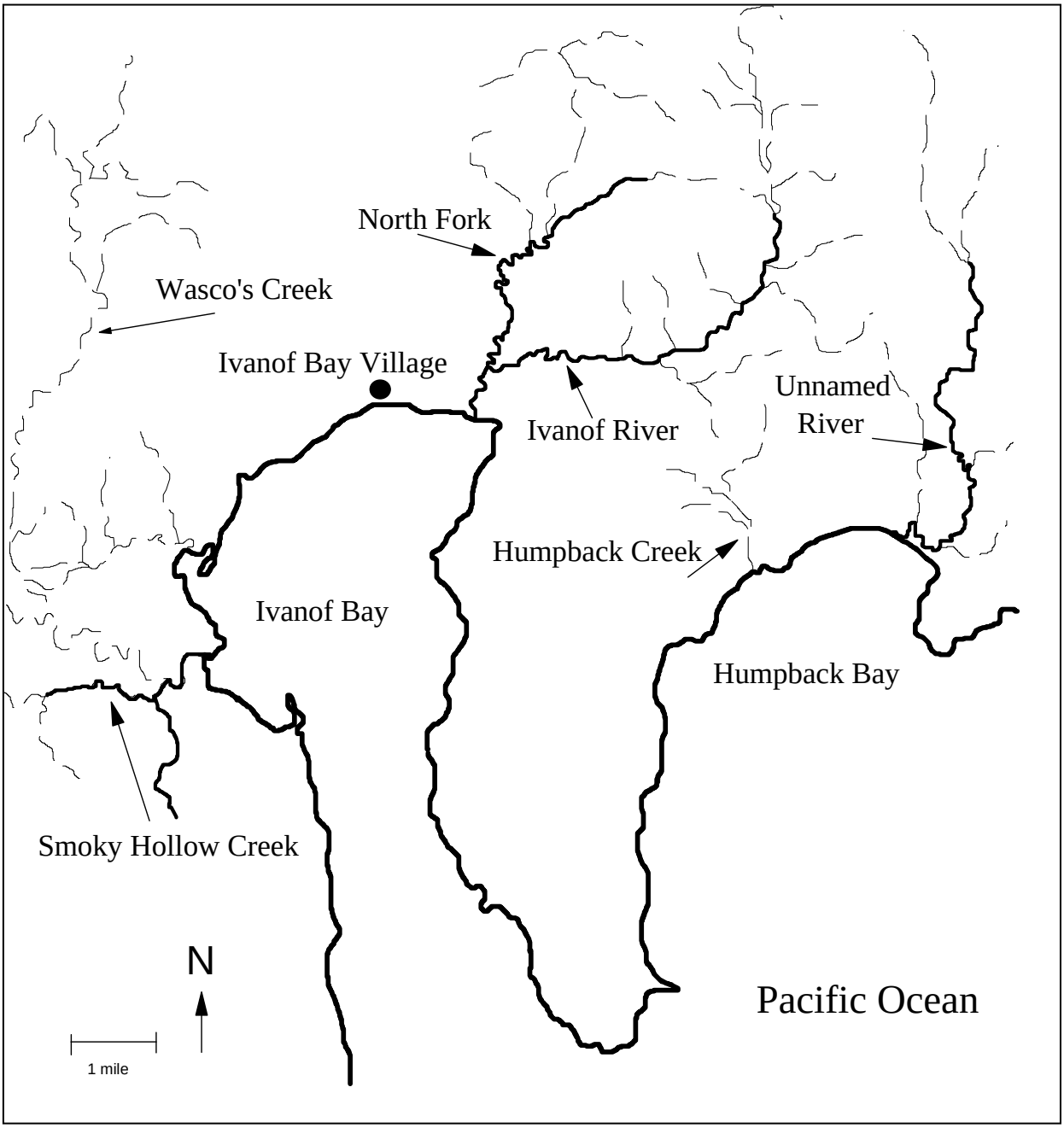

Figure 3. Ivanof and Humpback Bay survey areas, Alaska Peninsula National Wildlife Refuge. Streams shown with dashed lines were not surveyed.

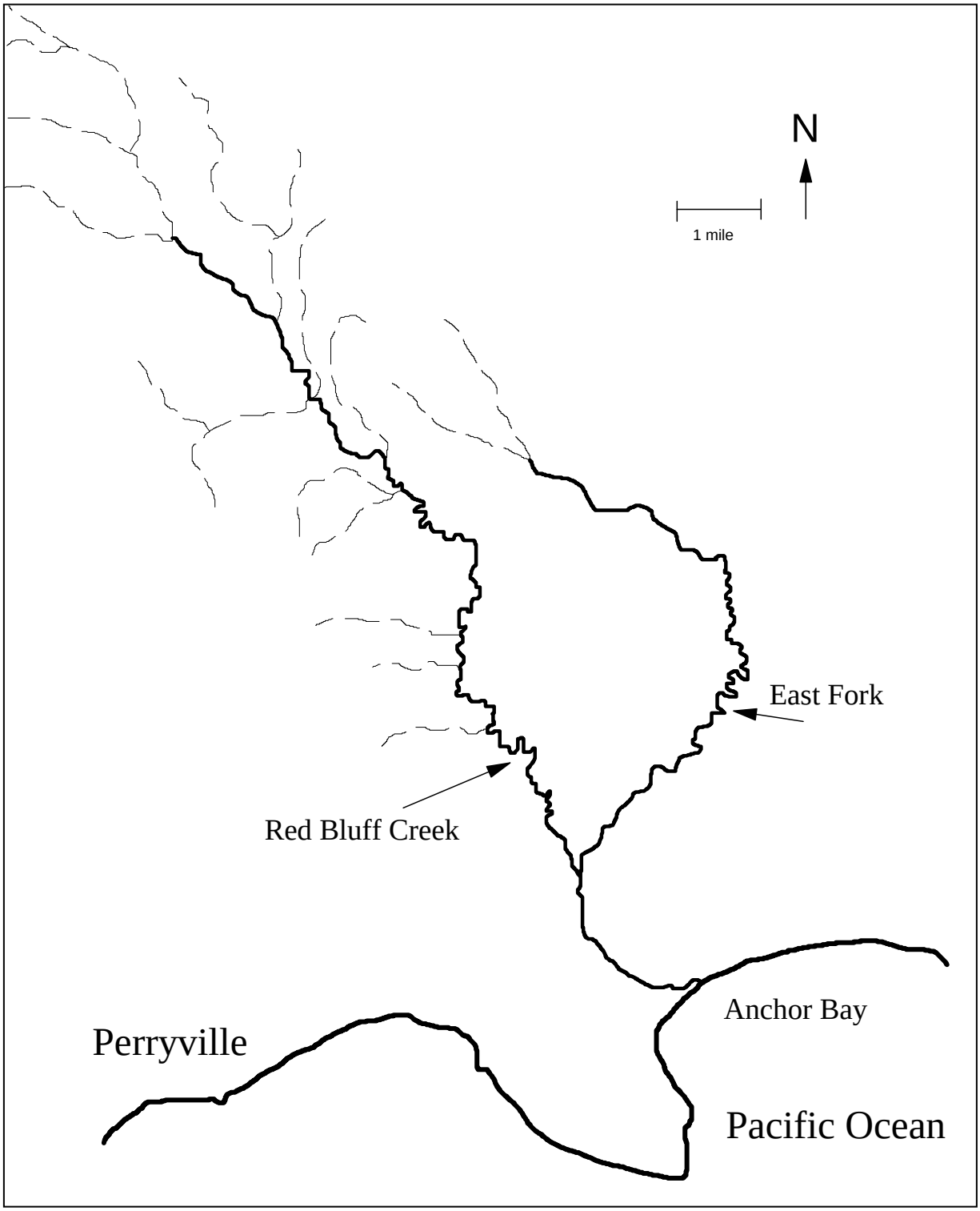

Figure 4. Red Bluff Creek survey area, Alaska Peninsula National Wildlife Refuge. Streams shown with dashed lines were not surveyed.

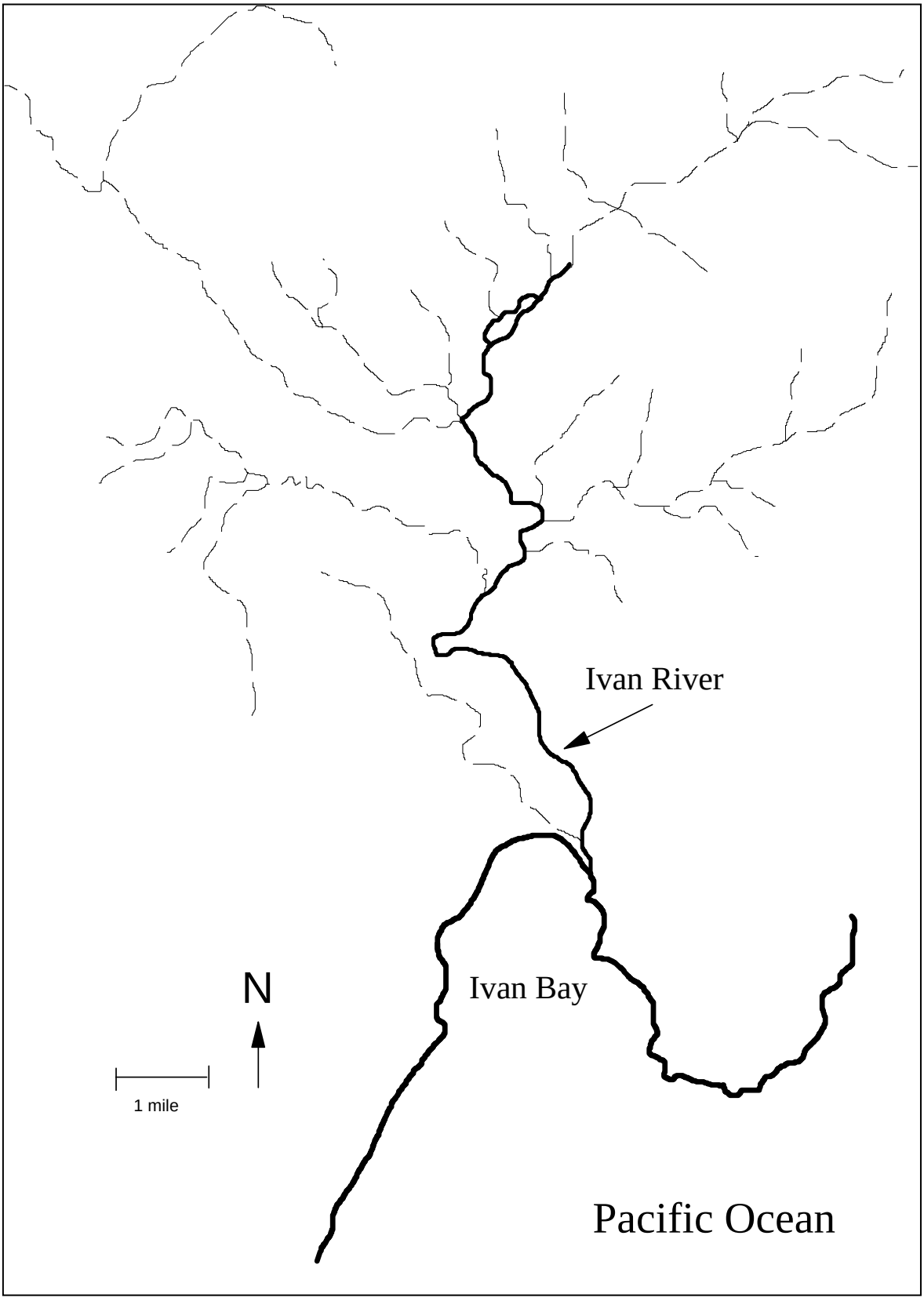

Figure 5. Ivan River survey area, Alaska Peninsula National Wildlife Refuge. Streams shown with dashed lines were not surveyed.

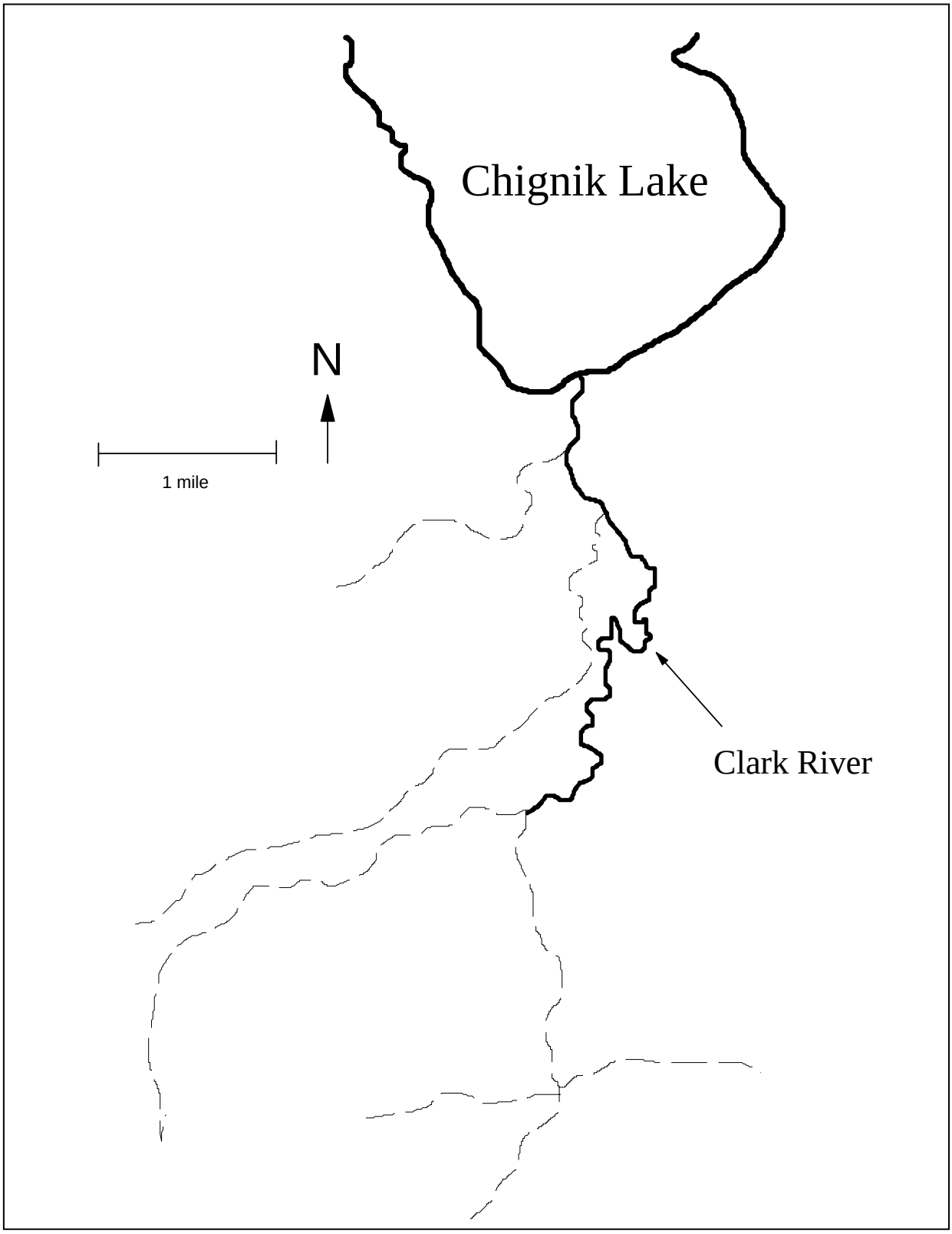

Figure 6. Clark River survey area, Alaska Peninsula National Wildlife Refuge. Streams shown with dashed lines were not surveyed.

Discussion

Coho salmon may have been present in smaller tributary streams that were not surveyed. These smaller streams were not surveyed due to logistical constraints, primarily fuel range of the helicopter and available funding. It is unlikely that coho salmon were present in the smaller tributary streams during the first survey because most fish were observed in large pods lower in the mainstem rivers. However, it is possible that some spawning fish were not counted during the second survey as coho salmon often spawn in smaller tributary streams (Sandercock 1991). Because entire drainages were not surveyed and count intervals were not adequate for expansion to area-under-the-curve estimates, surveys should be considered index counts of coho salmon abundance for a given stream reach and survey period, and not estimates of total abundance.

The coho salmon run for streams near Perryville in 2005 appeared to have different timing than in 2003 and 2004 (Table 2). The peak of the run in 2003 and 2004 occurred in early October, whereas the peak run in 2005 probably occurred in mid to late October. Count numbers for the early October survey in 2005 were considerably lower than for the same time period in 2003 and 2004. Numbers of coho salmon observed in Ivan River, Red Bluff Creek, and the unnamed river in Humpback Bay in 2005 were well below those observed in 2003 and 2004 (Table 2). We do not know if this represents a significant decrease in coho salmon abundance in 2005, or whether these numbers represent differences in run timing or survey timing between years.

The peak run in Ivan River may have occurred prior to our first survey. ADFG personnel observed 20,000 fish in Ivan River during aerial surveys on 7 September that they identified as coho salmon (K. Bouwens, ADFG, personal communication), although the fish might have been pink salmon given the large number of carcasses observed during our first survey in early October. It also appears that the peak coho salmon run in 2005 may have occurred after our second survey for streams west of Perryville, especially in Smoky Hollow Creek. However, local Perryville residents reported numerous fish in Red Bluff Creek, Ivanof River, and the unnamed river in Humpback Bay shortly after our first survey.

Weather and water conditions affected the aerial surveys in 2005. Glacial run-off from Mount Veniaminof near Perryville had captured the Three Star River, the lower portions of Artemie's Creek, and the Kametolook River during our first survey in early October. Glacial water from the Long Beach River also captured the lower portions of Artemie’s Creek during the second survey. Almost all glacial runoff from Mount Veniaminof was flowing into the Long Beach River during the second survey in 2005, which allowed us to survey most of the mainstem Kametolook River in late October.

Both surveys in 2005 occurred later than planned due to pilot availability and weather conditions. Attempts were made starting on 26 September to complete the first survey, but pilot availability and a suitable weather window did not allow for the completion of the survey until early October. The second survey was also postponed on two occasions due to inclement weather. In 2006, we will again schedule the first survey for late September and the second survey for mid October.

Table 2. Comparison of numbers of coho and sockeye salmon observed during fall aerial surveys of streams near Perryville, 2003-2005. Data for 2003 and 2004 are from Anderson (2004a; 2005). Dashes indicate survey was not flown.

	2003		2004		2005	
Stream	10 - 11 Oct.	21 - 22 Nov.	5 - 6 Oct.	6 - 7 Nov.	7 - 8 Oct.	25 - 26 Oct.
Smoky Hollow Creek	--	--	300[a]	140	54	147
Ivanof River	2,600	314	1,300	330	766	1,170
Unnamed, Humpback Bay	1,120	14	1,040	46	82	207
Kametolook System	--	--	22[b]	96	12[b]	516
Red Bluff Creek	5,000	330[c]	7,600	836	352	2,482
Ivan River	2,150	217	1,840	290	507	170
Clark River	900	300	400	800	240	800
Clark River (sockeye salmon)	6,100	9,700	5,890	3,240	3,520	4,100

[a] Survey was not completed due to poor water clarity.
[b] Mainstem Kametolook River was not surveyed due to poor water clarity.
[c] Mainstem Red Bluff Creek was not surveyed due to poor water clarity. Survey numbers represent count in the East Fork.

In contrast to 2003 (Anderson 2004a) and 2004 (Anderson 2005), a peak count of coho salmon abundance was probably not achieved in 2005 due to survey timing and the apparent shift in run timing from previous years. It is likely that coho salmon entered the systems, spawned, and died before, between, and after 2005 surveys. Perrin and Irvine (1990) report an average survey life for coho salmon of 11.4 days, which was compiled from 22 separate estimates throughout the Pacific Northwest and Alaska. Hetrick and Nemeth (2003) determined an average stream life for coho salmon of 13.7 days for coho salmon in a small stream on the Alaska Peninsula during October and November. Both estimates suggest that coho salmon may have entered, spawned, and died within surveyed streams without having been observed. Survey life for Pacific salmon can vary among and within streams and years (Perrin and Irvine 1990; Bue et al. 1998), so actual consequences of the three week survey interval used in trying to estimate 2005 peak abundance are unknown.

Coho salmon runs in the Kametolook River may be improving. Over 750 coho salmon were observed during walking surveys of the mainstem Kametolook River and its tributaries in 2003 (Anderson and Hetrick 2004), and although not many were observed with aerial surveys in 2004, local residents reported observing numerous fish between our two surveys (Anderson 2005). The 2005 observed count of 470 fish during the second survey represents an improvement over counts in the mid to late 1990's, and probably was not a peak count for the system in 2005. The

local ordinance passed by Perryville residents preventing coho salmon harvest in the Kametolook River may be allowing local stocks to rebuild.

Although not a total spawning escapement estimate, index counts can provide valuable information to area managers. The fundamental assumption is that index counts represent a constant proportion of the true counts across time. In general, the usefulness of any population survey depends upon obtaining unbiased, or nearly unbiased, and precise parameter estimates in a cost-efficient, logistically feasible manner (Thompson et al. 1998). The major problem in using index counts as a measure of abundance is that there is usually no estimate of either their accuracy or precision. Due to frequent inclement weather, high water events, and the inaccessibility of most of these streams, getting accurate and precise estimates of coho salmon escapement would be logistically difficult and expensive to obtain with other commonly used methods and equipment such as weirs, counting towers, sonar, and mark-recapture experiments. Walking surveys, which are subject to the same problems and limitations as aerial surveys, have not been effective in this area (Anderson 2003; Anderson 2004b; Anderson and Hetrick 2004). It may be more practical to examine and develop a different monitoring approach for these streams. For example, it may be possible to obtain and use estimates of juvenile coho salmon abundance as a surrogate for adult escapement information. Juvenile populations could be monitored during summer months when stream and weather conditions are more stable and predictable, and operating a field camp is more practical. For the near term, aerial surveys should be continued since they provide fishery managers with the only available information on coho salmon spawning populations in streams near Perryville, including minimum numbers and migration timing. Efforts should be made to adjust survey timing to better match coho salmon peak staging and migration timing. This would provide better estimates of peak abundance and allow more reliable comparisons to be made among years.

We recommend continuing the aerial surveys for additional years. The data collected to date with this project have provided managers with information for coho salmon spawning populations in streams near Perryville, including minimum numbers and migration timing. Monitoring in future years will further refine survey timing to coincide with peak staging and migration timing of coho salmon, allowing us to compare counts from year to year with more confidence.

Acknowledgements

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