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ESTIMATED RUN TIMING OF SELECTED SOCKEYE SALMON STOCKS ON THE WEST AND EAST SIDES OF KODIAK ISLAND

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INTRODUCTION

The Kodiak Salmon Management Area (KMA) includes the south side of the Alaska Peninsula from Cape Douglas south to Kilokak Rocks and the Kodiak Island archipelago (Figure 1). To the north is Cook Inlet and south, Chignik. The KMA supports strong local salmon runs. During the 1993 commercial salmon fishery, about 39 million salmon were harvested. Most of the catch was pink (86%) and sockeye (11%) salmon (Savikko and Simpson 1994). The 1994 outlook is for a 17.1 million salmon harvest including 13.7 million pink and 2.4 million sockeye salmon.

Over the years, the State Board of Fisheries (BOF) has adopted several salmon management plans which detail criteria for conducting commercial fisheries within the KMA (ADF&G 1993). They include but are not limited to the Cape Igvak, Alitak Bay, North Shelikof Strait, Westside, Eastside Afognak, and Spiridon Lake Salmon Management Plans. Inherent in the BOF adopted plans are the maintenance of traditional fishing opportunities and allocations, and stock conservation and product quality assurances.

During June, the west and east sides of the Kodiak Island group are managed for local early run sockeye salmon, July for local sockeye, pink and chum salmon, and post July for local sockeye, pink, chum, and coho salmon (ADF&G 1993). The exception is from 6-25 July in three sections of the Afognak District adjacent to North Shelikof Strait. For this area, the BOF has limited the sockeye catch to minimize the interception of Upper Cook Inlet (UCI) bound sockeye salmon.

At issue for the 1994 March BOF meeting is whether July KMA fisheries are intercepting relatively large numbers of UCI sockeye salmon while prosecuting traditional local stock fisheries. Tagging information is limited, however the data does suggest that UCI sockeye salmon migrate through KMA waters during certain times (Bevan 1948, 1949; Tyler et al. 1986). To address the interception issue, the BOF will require a variety of information including the estimated run timing of Kodiak and UCI sockeye stocks.

This report broadly examines the timing of the primary KMA sockeye runs along with the UCI sockeye run adjusted to the east and west sides of Kodiak Island.

METHODS

Stock Selection

The KMA has about 40 sockeye systems, not all of which are considered major producers (Barrett et al. 1990). The primary or important sockeye systems for this study were those in

the Kodiak Island group having a biological escapement goal of at least 25,000 fish. These were (Figure 2):

Litnik	Karluk	Upper Station
Pauls	-Early	-Early
Uganik	-Late	-Late
Spiridon	Ayakulik	Frazer
Little River	Akalura	Saltery

The Spiridon Lake run was included as an exception, because while there is no escapement requirement as a hatchery introduced run, the Spiridon run is expected to produce annually about 200,000 sockeye salmon (Lonnie White, Alaska Department of Fish and Game, Kodiak, personal communication).

The UCI Central District drift gillnet catch (1988-92) was used to represent UCI sockeye salmon. All major UCI sockeye stocks are harvested in the UCI Central District drift gillnet fishery (Tarbox 1988).

Timing

For the KMA stocks, 10 years (1984-93) of daily weir escapement count records were the basis for defining run timing. However, for several systems there were less years of complete escapement count data. These were:

Pauls: 1984-91 and 1993;
Akalura: 1986-93;
Uganik 1991-1992; and
Saltery: 1986-91 and 1993.

Due to an absence of daily sockeye escapement counts for Spiridon, we estimated the theoretical timing of the escapement based on late Upper Station escapement count data (1984-93) adjusted to estuary time. The Upper Station count data was used because the Spiridon run is entirely from Upper Station brood stock. Similarly, for Little River, the Karluk early run escapement counts (1984-93) were used because aerial observations and escapement sampling at the mouth of Little River were generally consistent with the escapement timing of the early Karluk run less 5 days (Dave Prokopowich, Alaska Department of Fish and Game, Kodiak, personal communication).

Local stock run timing at the weir sites was estimated by converting the daily escapement weir count data to percent of total escapement by day and then averaging the daily values. Cook Inlet run timing was determined from daily Central District drift gillnet catch numbers for 1988-1992. These numbers were adjusted to percent of total catch by day and averaged. All daily estimates of run timing were smoothed twice using a 3-day moving average.

Run timing estimates of Kodiak sockeye stocks for the west and east sides of Kodiak were determined by adjusting the weir counts back in time to account for travel. We used Cape Ugat for the west side reference location and Partition Cove on Sitkalidak Island for the east side

(Figure 2). For the Kodiak stocks, travel distance in miles from the respective reference points to the stream estuaries was determined using US Department of the Interior Geological Survey maps (scale: 1:250,000; 1952 series). The mileage was rounded up to the nearest 5-miles and then divided by a travel speed of 30 miles/day (Groot and Marcolis 1991). Further adjustment in run timing was made for the Kodiak stocks to account for milling in the estuary and migration through the weirs (Dave Prokopowich, Alaska Department of Fish and Game, Kodiak, personal communication; Tables 1 and 2).

The UCI run timing from the Central District drift gillnet catch was adjusted back in time to account for travel from the east and west sides of Kodiak Island. The adjustments were 9 days for the east side and 7 days for the west side; these numbers were determined using 260 miles and 200 miles from the respective Kodiak locations to the north end of Kalgin Island (UCI) and an assumed 30 mile/day travel rate.

The central 90% of the run timing period for each stock was determined by excluding 5% of the estimated average total run at the start and end of the migration.

Estimated Run Numbers

The potential run size for each Kodiak sockeye stock and UCI sockeye stocks combined was determined by expanding the upper end of the biological escapement goal by a factor of 2.5. This value is based on an average return per spawner of 2.5:1 for sockeye salmon (Chapman 1986). The Spiridon sockeye run was the exception where average smolt survival and presmolt stocking numbers were the basis for a total run estimate (Lonnie White, Alaska Department of Fish and Game, Kodiak, personal communication). Sockeye escapement goals for Kodiak were derived from Barrett et al. (1990) and Brennan et al. (1993), and for UCI from Ruesch and Fox (1993).

RESULTS

Kodiak escapement timing for selected sockeye stocks are illustrated in Appendix A.1-A.10. The dates for the central 90% escapement timing period and midpoint are provided in Table 3.

Both Karluk and Upper Station have two distinct runs, an early and a late run. The early run escapement timing for both systems are nearly identical with peak migration occurring in the second and third weeks of June. The late runs for these systems are less similar with peak migration in early September and mid August, respectively. The timing of Pauls and Litnik escapements are comparable to the early Karluk and early Upper Station escapements. Frazer escapement timing is later with peak migration occurring at the end of June. Little River escapement is slightly earlier than the early Karluk run. Ayakulik escapement timing spans a longer period than other single run systems, with a major migration beginning in early June and continuing through late July. Saltery, an eastside Kodiak sockeye stock, has a mid season escapement timing that spans all of July. For Akalura, nearly all the escapement occurs within August.

Within UCI, greater than 90% of the combined runs are during July (Table 3; Appendix A.11).

The estimated potential run size for the 13 selected Kodiak sockeye stocks totals approximately 5.1 million fish (Table 3). For individual systems, the range in run size is 0.1 million (Little River and others) to 1.4 million (late Karluk). For UCI, the combined run potential for all systems is estimated at approximately 3.8 million sockeye salmon.

Westside Kodiak Run Timing

Westside Kodiak run timing estimates for selected Kodiak stocks and UCI combined stocks are shown in Appendix B. The estimated central 90% run periods and midpoints are provided in Table 3. Estimates of sockeye stock composition by week for the mid June through mid August period on Kodiak's westside are given in Table 4.

Karluk early and late runs are estimated to be at peak abundance in mid June and late August, respectively. Both runs are estimated to be relatively weak in July. During 6-25 July, an estimated 4% of each run occurs.

The Upper Station early run timing peaks during June on the westside, and for the late run in early August. An estimated 16% of the late run timing coincides with the 6-25 July period.

Uganik sockeye salmon are estimated to reach peak abundance in late June and about 10% of the run is during 6-25 July.

Ayakulik sockeye run timing is from about late May to mid August on Kodiak's westside. During July, the run is estimated to be just below peak abundance. The 5-26 July period represents an estimated 21% of the migration.

The new sockeye run in Spiridon Bay is expected to provide a 100 thousand harvest in 1994 and a 200 thousand catch annually thereafter (L. White, Alaska Department of Fish and Game, Kodiak, personal communication). On Kodiak's westside, the Spiridon run should peak in mid August with about 13% of the run occurring during 6-25 July.

Little River run timing estimates indicate about 95% of the run is before 5 July. Litnik and Pauls run timing data show a similar trend with most of the fish migrating earlier than 5 July. The estimated run components during the 6-25 July period are 11% and 7%, respectively.

The estimated run timing for Akalura sockeye salmon is mainly during late August, with the 6-25 July period accounting for an estimated 5%.

Frazer sockeye salmon are estimated to be at peak abundance in mid June. The period of 6-25 July represents about 12% of the migration.

If the Saltery stock uses the westside for migration, the estimated timing is for a late June and July occurrence, with about 49% of migration during the 6-25 July period.

For 13 Kodiak sockeye systems combined, the estimated run potential for the 6-25 July period is about 0.5 million fish (Table 4; Figure 3). Several of the stocks have at least a 50,000 fish run potential during those approximately three weeks. These include: late Karluk (55,000); Ayakulik (160,000); Frazer (60,000); late Upper Station (80,000); and Saltery (50,000).

On Kodiak's westside, UCI sockeye salmon are estimated to reach peak abundance in July with most of the migration occurring during the two week period of 5-18 July (Table 4; Appendix B.12). From the run timing information, it is not possible to estimate the percentage of the total UCI run that may be present within three miles of Kodiak Island's westside. This is because UCI sockeye salmon access Cook Inlet by a variety of corridors, some of which are well outside the KMA (Ken Tarbox, Alaska Department of Fish and Game, Soldotna, personnel communication).

Eastside Kodiak Run Timing

Eastside Kodiak run timing estimates for selected Kodiak stocks and UCI combined stocks are provided in Appendix C. The estimated central 90% run periods and midpoints are in Table 3. Estimates of sockeye stock composition by week for the mid June through mid August period on Kodiak's eastside are presented in Table 5.

Saltery, the single most important sockeye stock on Kodiak's eastside, has a late June through early August run timing. Approximately 49% of the run is estimated to occur during the 5-26 July period.

Afognak Island's Pauls and Litnik sockeye stocks would occur mostly in June on the eastside with an estimated 6% and 11% of the run timing being during the 6-25 July period, respectively.

For southend Kodiak stocks, the Upper Station early run timing on the eastside is estimated to peak in early June and for the late run during early August. The respective early and late run components for the 6-25 period are 1% and 16%. The Frazer run timing peaks in mid June, while the July 6-25 period accounts for an estimated 13%. The Akalura stock's timing spans August, with the three weeks of 6-25 July providing about 5%.

Migration of westside Kodiak stocks on the island's eastside would mainly be during June and August. Ayakulik sockeye eastside timing for the 6-25 period is estimated to be 21%, early Karluk and Little River both at 2%, late Karluk at 6%, Spiridon at 19%, and Uganik at 9%.

For 13 Kodiak sockeye systems combined for the 6-25 July period, the estimated total run potential is about 0.5 million fish (Figure 4). Most of this is accounted for by: Ayakulik (29%); late Karluk (15%); late Upper Station (15%); Frazer (12%), and Saltery (9%).

On Kodiak's east side, UCI sockeye salmon expectedly would be present mainly from late June through late July (Appendix C.12). Most of the migration is estimated to occur during the two week period of 28 June through 11 July (Table 5). However, because UCI sockeye salmon have alternative access routes available to UCI that do not involve the eastside of Kodiak Island, no estimates of UCI run numbers by period are available.

DISCUSSION

Based on run timing, UCI sockeye salmon have a strong potential for being within KMA waters during July. Less pronounced are the Kodiak sockeye runs which tend to be strong only in June and August. Notable, however, are Ayakulik on the west side and Saltery on the east side where an estimated 21% and 49% respectively of these runs occur during July 6-25.

Irrespective of timing, Kodiak sockeye salmon have a higher catch ability per fish within Kodiak coastal waters than UCI sockeye salmon. This is because UCI sockeye stocks have alternative migration routes not all of which pass through the KMA. For example, UCI sockeye salmon enter Cook Inlet from Shelikof Strait which is within the KMA and by Kennedy and Stevenson Entrances which are outside the KMA (Ken Tarbox, Alaska Department of Fish and Game, Soldotna, personal communication). Additionally, while UCI sockeye salmon migrate through Shelikof Strait, not all the movement occurs within the 3-mile KMA fishing corridor which was evident during 1988 when some purse seine vessels operated seaward of the 3-mile line (Malloy 1988).

The authors intend that the selected sockeye run timing data, as presented, be used strictly as a general guide for determining the likelihood of stocks occurring over time within Kodiak Island waters. More definitive methods for defining stock composition in mixed stock fisheries are available. These include scale pattern analysis, catch sampling, and tagging studies all of which are costly. Further information on local and non-local sockeye stocks contributions for July KMA fisheries are available in Swanton and Nelson (1994), and Vining and Barrett (1994).

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Table 1. Approximate migration distance and travel time from the west side of Kodiak Island to selected sockeye salmon systems.

System	Distance From Kodiak West Side[a] to Terminal Estary (miles[b])	Travel Time (days)		
		West Side[a] To Estuary[c]	Estuary to Weir[d]	Total
Saltery	120	4	3	7
Litnik	50	2	5	7
Upper Station	130	4	5	9
Frazer	120	4	10	14
Akalura	125	4	5	9
Ayakulik (Red)	70	2	3	5
Karluk Early	30	1	5	6
Karluk Late	30	1	10	11
Spiridon	25	1	n/a	1
Little River	5	0	n/a	0
Uganik	30	1	3	4
Pauls	95	3	7	10

[a] The reference location for the west side of Kodiak Island is Cape Ugat.
[b] All mileage is approximate and is rounded up to the nearest 5 miles.
[c] Travel speed used for the calculation is 30 miles/day (Groot and Marcolis 1991).
[d] Source: Dave Prokopowich, Alaska Department of Fish and Game, Kodiak, personnel communication.

Table 2. Approximate migration distance and estimated travel time from the east side of Kodiak Island to selected sockeye salmon systems.

System	Distance From Kodiak East Side to Terminal Estary (miles[b])	Travel Time (days)		
		East Side To Estuary[a,c]	Estuary to Weir[d]	Total
Saltery	45	2	3	5
Litnik	100	3	5	8
Upper Station	105	4	5	9
Frazer	90	3	10	13
Akalura	95	3	5	8
Ayakulik (Red)	95	3	3	6
Karluk Early	150	5	5	10
Karluk Late	150	5	10	15
Spiridon	170	6	n/a	6
Little River	150	5	n/a	5
Uganik	170	6	3	9
Pauls	130	4	7	11

[a] The reference location for the east side of Kodiak Island is Paritition Cove at Sitkalidak Is.
[b] All mileage is approximate and is rounded up to the nearest 5 miles.
[c] Travel speed used for the calculation is 30 miles/day (Groot and Marcolis 1991).
[d] Source: Dave Prokopowich, Alaska Department of Fish and Game, Kodiak, personnel communication.

Table 3. Escapement goals and timing, and estimated total run numbers and estimated run timing on the east and west sides of Kodiak Island for selected sockeye stocks.

System	Escapement Goal (1,000's)	Escapement Timing[a]		Estimated Total Run Potential[b] (1,000's)	Kodiak East Side[c] Run Timing[a]		Kodiak West Side[d] Run Timing[a]	
		Midpoint	Central 90%		Midpoint	Central 90%	Midpoint	Central 90%
Karluk								
Early Run	150 - 250	17-Jun	05-Jun - 08-Jul	625	07-Jun	26-May - 28-Jun	11-Jun	30-May - 02-Jul
Late Run	400 - 550	05-Sep	09-Aug - 23-Sep	1,375	21-Aug	25-Jul - 08-Sep	25-Aug	29-Jul - 12-Sep
Ayakulik	200 - 300	30-Jun	04-Jun - 10-Aug	750	24-Jun	29-May - 04-Aug	25-Jun	30-May - 05-Aug
Frazer	140 - 200	30-Jun	14-Jun - 27-Jul	500	17-Jun	01-Jun - 14-Jul	16-Jun	31-May - 13-Jul
Upper Station								
Early Run	50 - 75	18-Jun	05-Jun - 07-Jul	188	09-Jun	27-May - 28-Jun	09-Jun	27-May - 28-Jun
Late Run	150 - 200	16-Aug	27-Jul - 03-Sep	500	07-Aug	18-Jul - 25-Aug	07-Aug	18-Jul - 25-Aug
Akalura	40 - 60	20-Aug	14-Jun - 09-Sep	150	12-Aug	06-Jun - 01-Sep	11-Aug	05-Jun - 31-Aug
Spiridon	0	11-Aug	22-Jul - 30-Aug	200	05-Aug	16-Jul - 24-Aug	10-Aug	21-Jul - 29-Aug
Uganik	80 - 120	30-Jun	10-Jun - 23-Jul	300	21-Jun	01-Jun - 14-Jul	26-Jun	06-Jun - 19-Jul
Saltery	20 - 40	18-Jul	28-Jun - 11-Aug	100	13-Jul	23-Jun - 06-Aug	11-Jul	21-Jun - 04-Aug
Litnik	40 - 60	18-Jun	02-Jun - 09-Aug	150	10-Jun	25-May - 01-Aug	11-Jun	26-May - 02-Aug
Pauls	20 - 40	20-Jun	01-Jun - 18-Jul	100	09-Jun	21-May - 07-Jul	10-Jun	22-May - 08-Jul
Little River	30 - 50	12-Jun	31-May - 03-Jul	125	07-Jun	26-May - 28-Jun	12-Jun	31-May - 03-Jul
Totals	1,320 -1,945			5,063				
Upper Cook Inlet	1,000 -1,500	16-Jul	05-Jul - 30-Jul	3,750	07-Jul	26-Jun - 21-Jul	09-Jul	28-Jun - 23-Jul

a Cental 90% timing excludes 5% of the escapement or run at both the migration begining and end.
b Run potential is based on upper escapement goal and an assumed 2.5:1 return per spawner or hatchery stocking level.
c The reference location for the east side of Kodiak Island is Partition Cove at Sitkalidak Island.
d The reference location for the west side of Kodiak Island is Cape Ugat.

Table 4. Escapement goal numbers, and estimated percent run by date adjusted for the west side of Kodiak Island and total run numbers by selected sockeye salmon system.

System	Biological Escapement Goal (1,000's)	West Side Kodiak Island Run Timing[a]											Est. Run	
		Pre. 15 June	June 6/15-6/21	June 6/22-6/28	June 6/28-7/04	July 7/05-7/11	July 7/12-7/18	July 7/19-7/25	August 7/26-8/01	August 8/02-8/06	August 8/07-8/13	Post August 13	Estimated Total Run Potential[b] (1,000's)	Potential[c] during July 5-25 (West Side Kodiak Is (1,000's)
Karluk														
Early Run	150 - 250	62.9%	19.7%	8.6%	4.6%	2.9%	1.4%	0.0%	0.0%	0.0%	0.0%	0.0%	625	27
Late Run	400 - 550						1.3%	2.5%	5.0%	4.3%	5.5%	81.4%	1,375	53
Ayakulik	200 - 300	32.2%	10.2%	13.8%	8.0%	7.6%	5.4%	9.3%	6.3%	2.9%	2.7%	1.6%	750	167
Frazer	140 - 200	42.7%	25.3%	11.4%	6.2%	6.9%	4.5%	1.5%	0.6%	0.3%	0.2%	0.2%	500	65
Upper Station														
Early Run	50 - 75	67.2%	17.6%	9.5%	4.6%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	188	2
Late Run	150 - 200					1.2%	5.5%	9.7%	13.9%	17.0%	23.5%	29.2%	500	82
Akalura	40 - 60	8.6%	0.8%	0.4%	0.1%	0.1%	0.7%	3.9%	4.7%	13.5%	24.5%	42.7%	150	7
Spiridon	0						3.0%	9.9%	9.4%	14.1%	24.2%	39.0%	200	26
Uganik	80 - 120	14.1%	5.0%	52.4%	15.3%	2.8%	3.9%	3.7%	0.8%	0.9%	0.5%	0.5%	300	31
Saltery	20 - 40	1.2%	4.4%	15.5%	13.4%	15.7%	19.9%	15.2%	7.6%	2.3%	1.9%	2.8%	100	51
Litnik	40 - 60	56.2%	11.7%	7.8%	5.4%	5.0%	4.0%	2.6%	1.8%	1.5%	2.4%	1.5%	150	17
Pauls	20 - 40	63.5%	13.9%	8.1%	6.2%	5.6%	1.1%	0.6%	0.4%	0.2%	0.3%	0.2%	100	7
Little River	30 - 50	59.3%	20.9%	10.0%	4.9%	3.0%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	125	6
Total	1,320 -1,945												5,063	541
Upper Cook Inlet	1,000 -1,500	0.0%	0.8%	5.5%	19.2%	35.1%	22.3%	14.4%	2.3%	0.2%	0.0%	0.0%		

a The reference location for the west side of Kodiak Island is Cape Ugat.

b Run potential is based on upper escapement goal and an assumed 2.5:1 return per spawner or hatchery stocking level.

c Only a fraction of these fish would be expected to be present in the subject waters due to alternative migration routes to spawning streams and interceptions in other shore based fisheries.

Table 5. Escapement goal numbers, and estimated percent run by date adjusted for the east side of Kodiak Island and total run numbers by selected sockeye salmon system.

System	Biological Escapement Goal (1,000's)	East Side Kodiak Island Run Timing[a]											Estimated Total Run Potential[b] (1,000's)	Est. Run Potential[c] during July 5-25 (East Side Kodiak Is (1,000's)
		Pre. 15 June	June 6/15-6/21	June 6/22-6/28	June 6/28-7/04	July 7/05-7/11	July 7/12-7/18	July 7/19-7/25	August 7/26-8/01	August 8/02-8/06	August 8/07-8/13	Post August 13		
Karluk														
Early Run	150 - 250	75.3%	13.3%	6.1%	2.8%	2.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	625	16
Late Run	400 - 550						2.4%	3.8%	6.1%	3.6%	9.0%	75.2%	1,375	85
Ayakulik	200 - 300	33.3%	10.8%	14.0%	7.1%	7.6%	5.5%	9.1%	6.3%	2.5%	2.5%	1.3%	750	166
Frazer	140 - 200	39.0%	27.5%	11.8%	6.4%	7.2%	5.0%	1.6%	0.7%	0.3%	0.2%	0.2%	500	69
Upper Station														
Early Run	50 - 75	67.2%	17.6%	9.5%	4.6%	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	188	2
Late Run	150 - 200					1.2%	5.5%	9.7%	13.9%	17.0%	23.5%	29.2%	500	82
Akalura	40 - 60	8.4%	0.9%	0.4%	0.2%	0.1%	0.2%	4.2%	3.1%	11.5%	24.1%	46.9%	150	7
Spiridon	0					2.1%	8.2%	8.8%	17.6%	17.1%	23.0%	23.1%	200	38
Uganik	80 - 120	18.4%	34.5%	32.3%	3.5%	2.6%	5.4%	1.0%	1.2%	0.4%	0.3%	0.3%	300	27
Saltery	20 - 40	0.8%	2.7%	12.1%	14.5%	15.5%	19.6%	16.3%	9.9%	3.2%	2.2%	3.2%	100	51
Litnik	40 - 60	58.3%	11.2%	7.5%	4.9%	5.1%	3.7%	2.5%	1.8%	1.6%	2.3%	1.2%	150	17
Pauls	20 - 40	66.2%	12.6%	7.9%	5.6%	5.0%	0.9%	0.6%	0.3%	0.2%	0.3%	0.1%	100	7
Little River	30 - 50	75.3%	13.3%	6.1%	2.8%	2.6%							125	3
Totals	1,320 -1,945												5,063	571
Upper Cook Inlet	1,000 -1,500	0.0%	1.6%	9.5%	22.2%	35.5%	19.0%	10.6%	1.3%	0.1%	0.0%	0.0%		

a The reference location for the east side of Kodiak is Partition Cove at Sitkalidak Island.

b Run potential is based on upper escapement goal and an assumed 2.5:1 return per spawner or hatchery stocking level.

c Only a fraction of these fish would be expected to be present in the subject waters due to alternative migration routes to spawning streams and interceptions in other shore based fisheries.

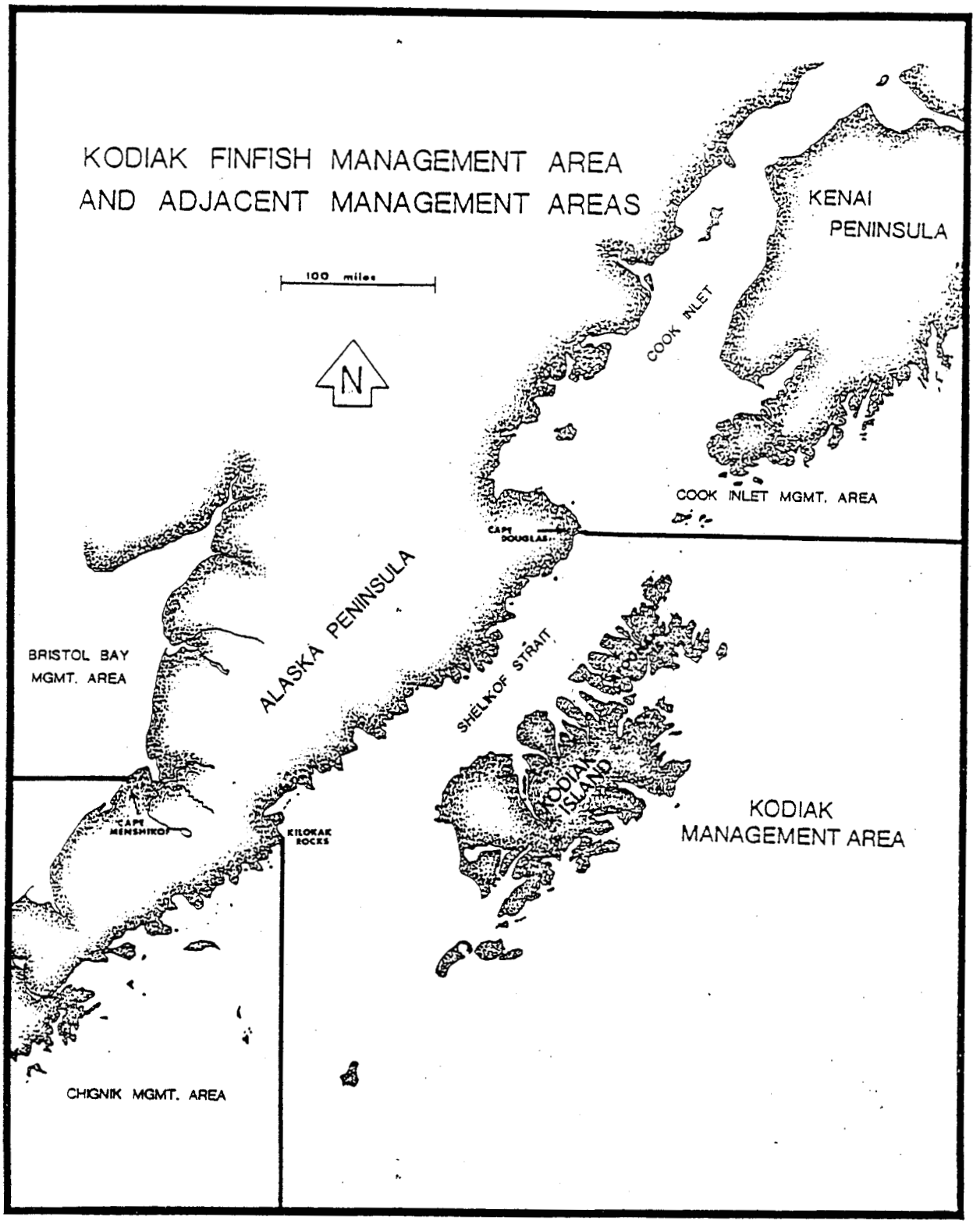


Figure 1. Map of Kodiak and adjacent management areas.

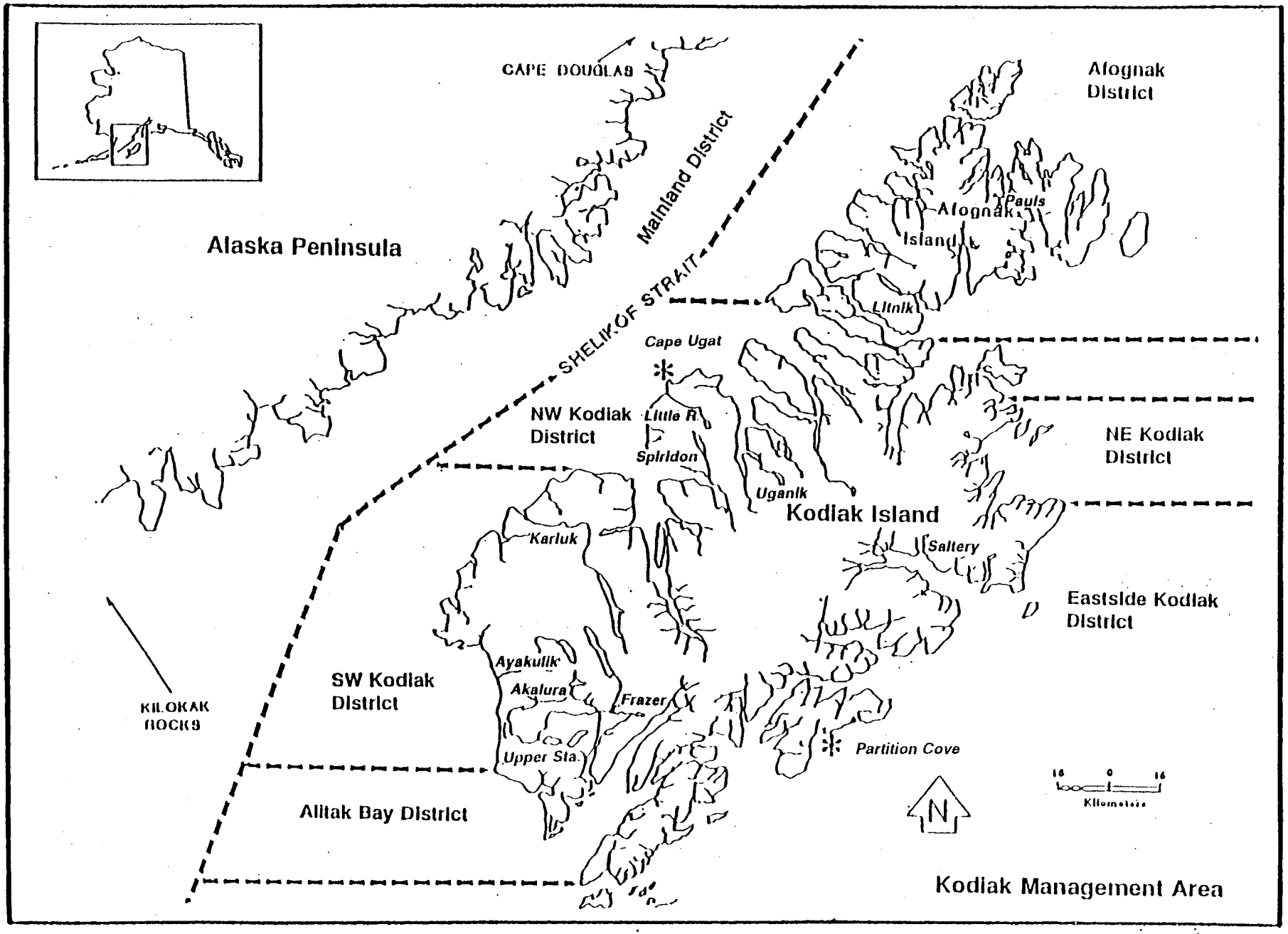


Figure 2. Map identifying selected sockeye salmon systems and Cape Ugat on the westside and Partition Cove on the eastside of the Kodiak Management Area.

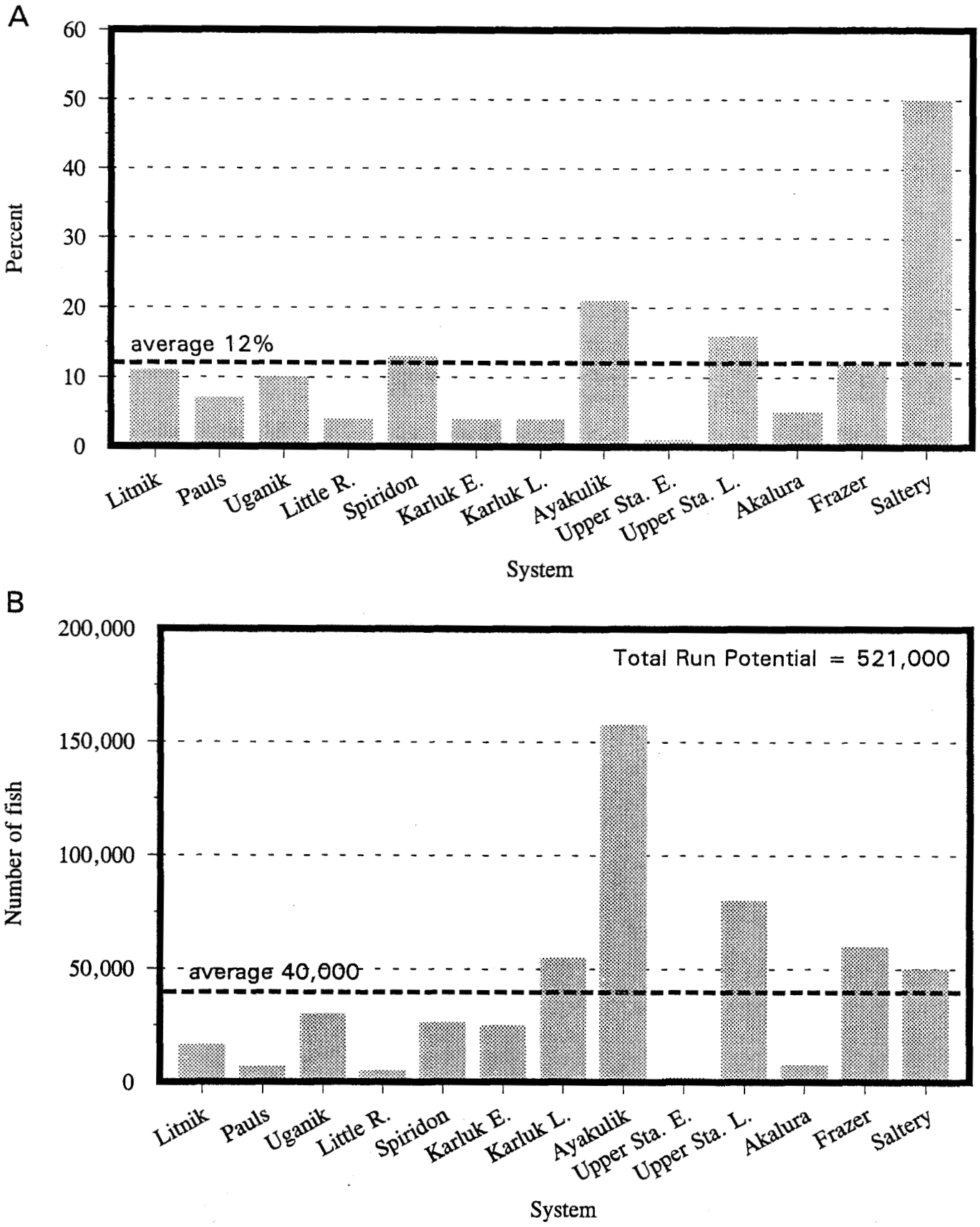


Figure 3. Estimated (A) percent of selected sockeye runs and (B) number of sockeye salmon by stock based on westside Kodiak run timing, 6-25 July.

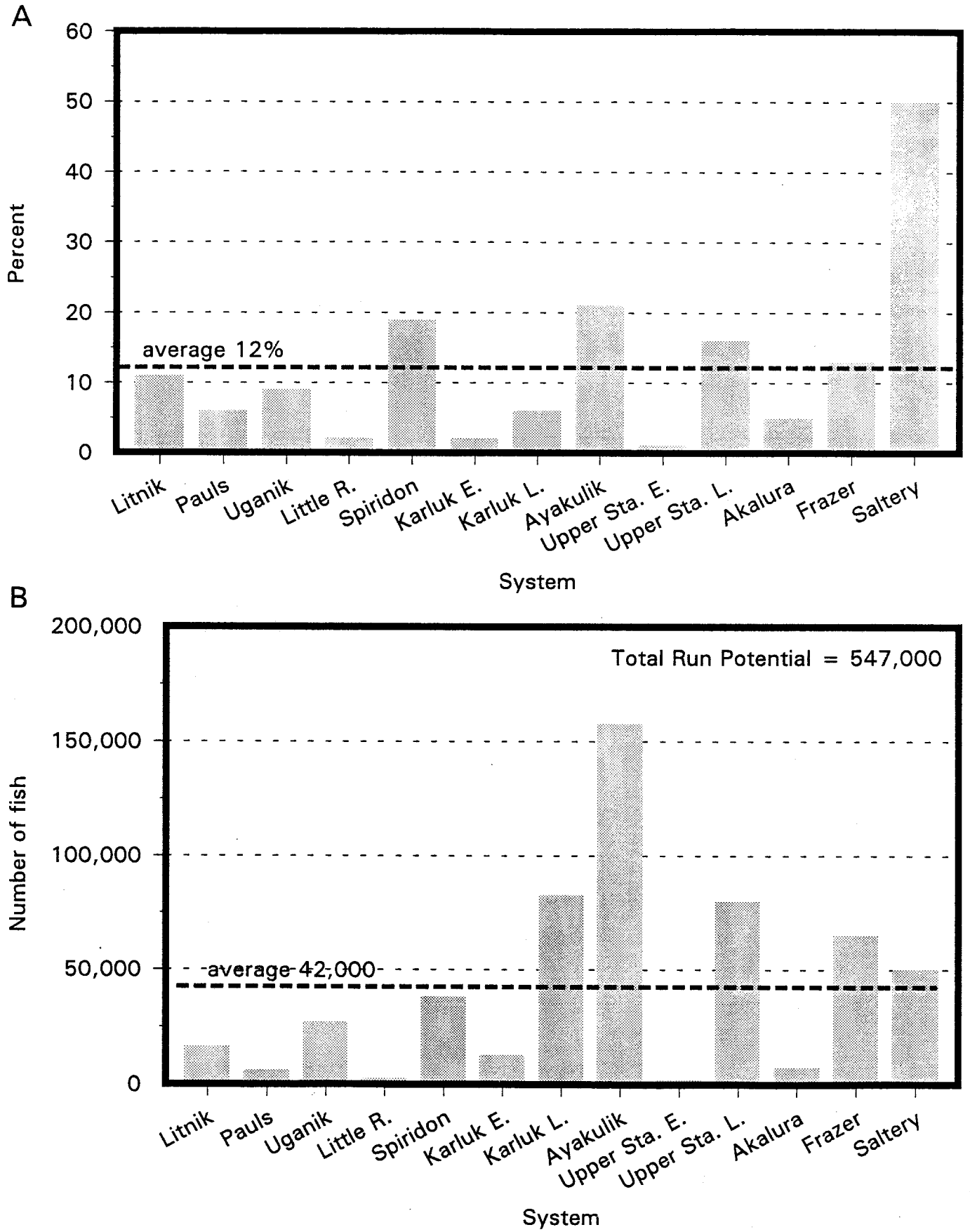
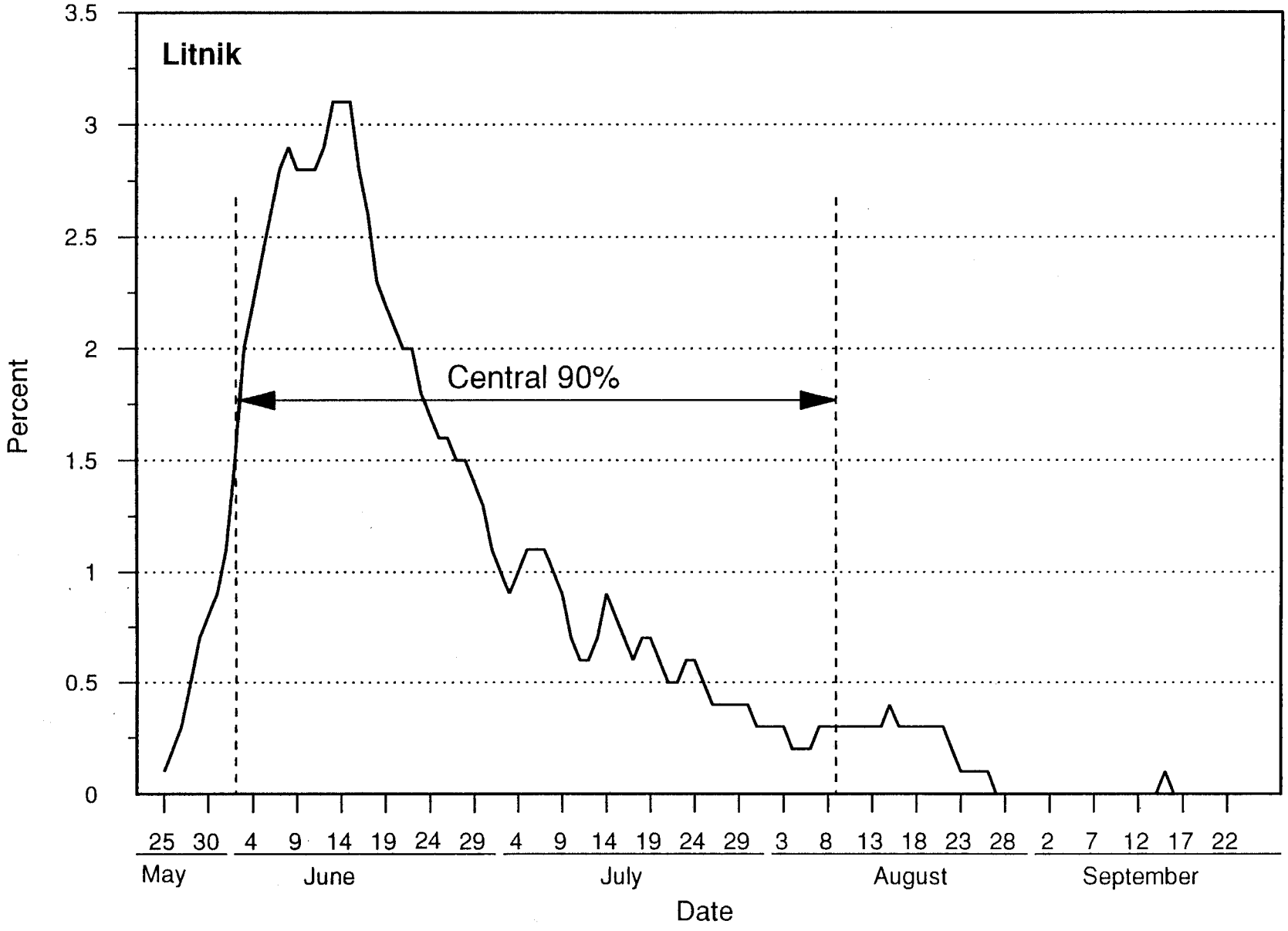
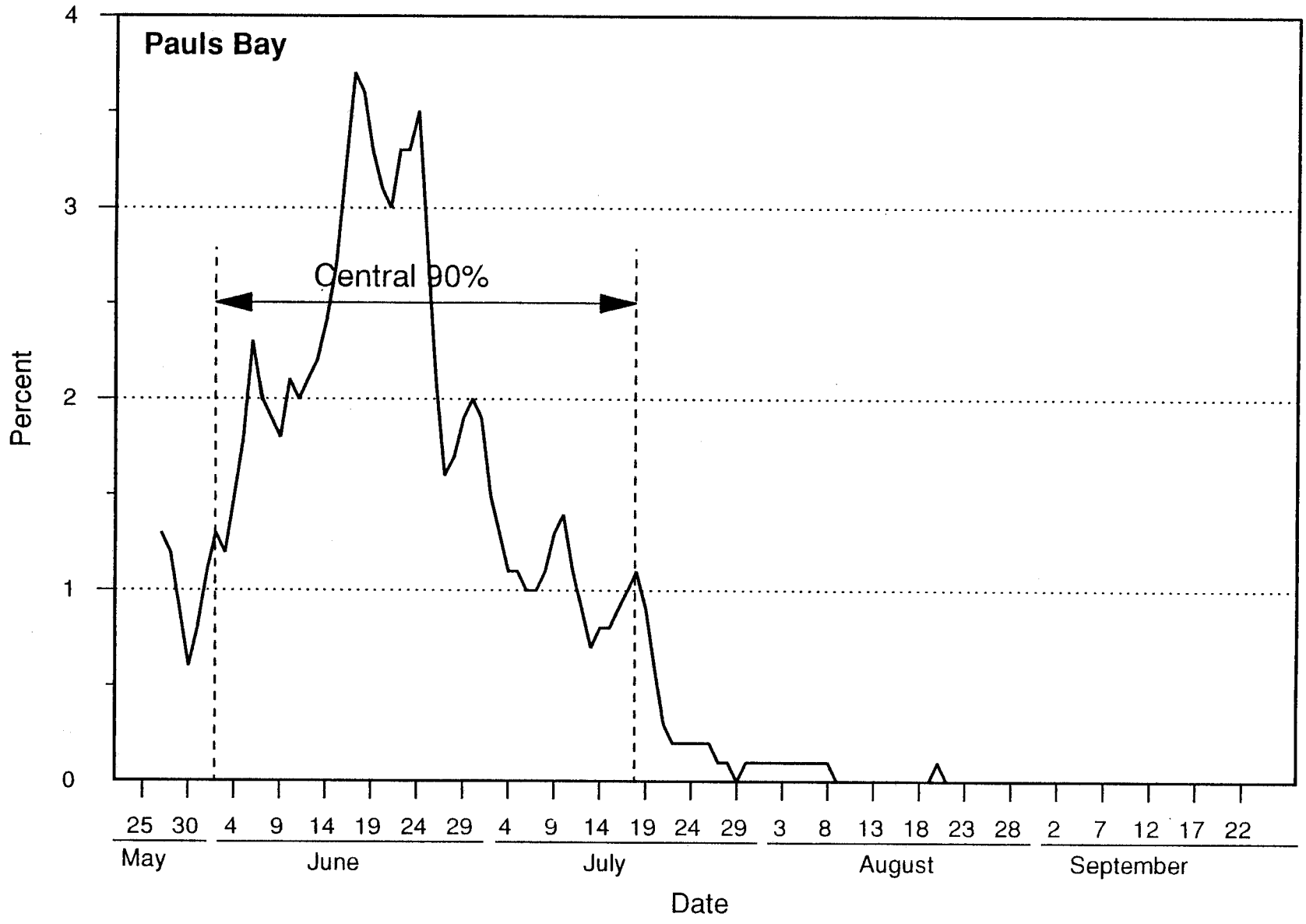


Figure 4. Estimated (A) percent of selected sockeye runs and (B) number of sockeye salmon by stock based on eastside Kodiak run timing, 6-25 July.

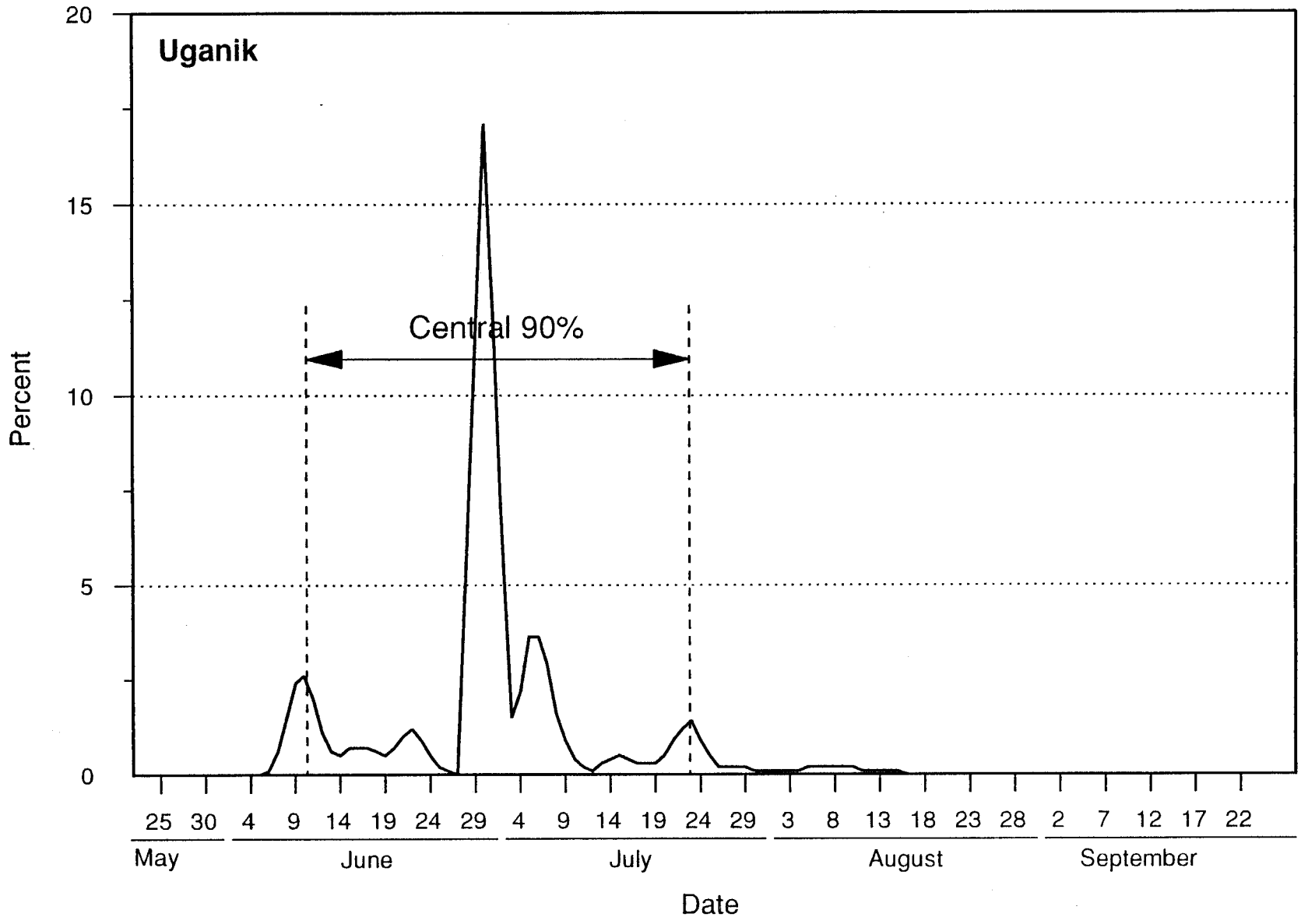
APPENDIX



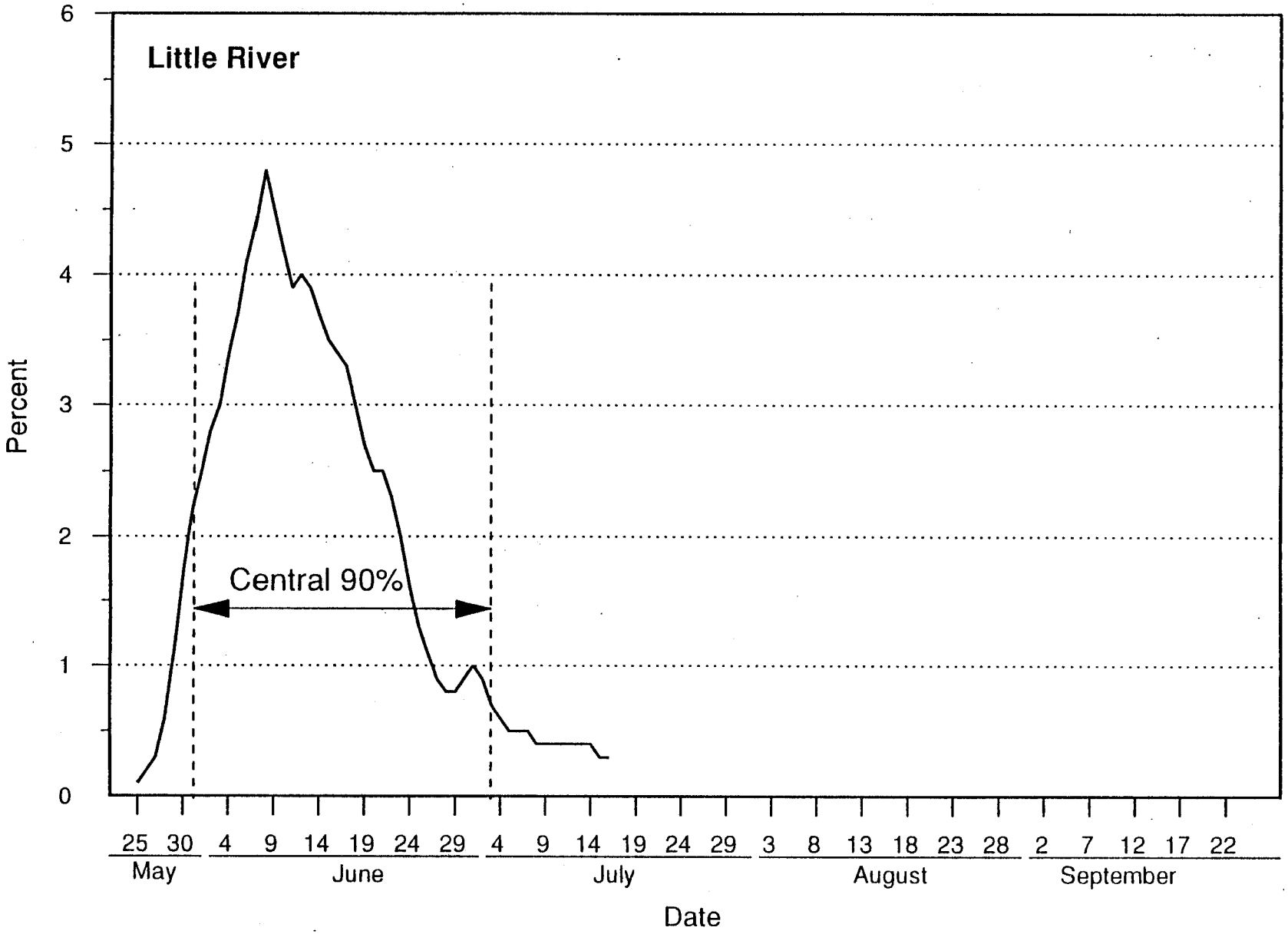
Appendix A.1. Estimated Litnik sockeye salmon escapement timing, post 1983.



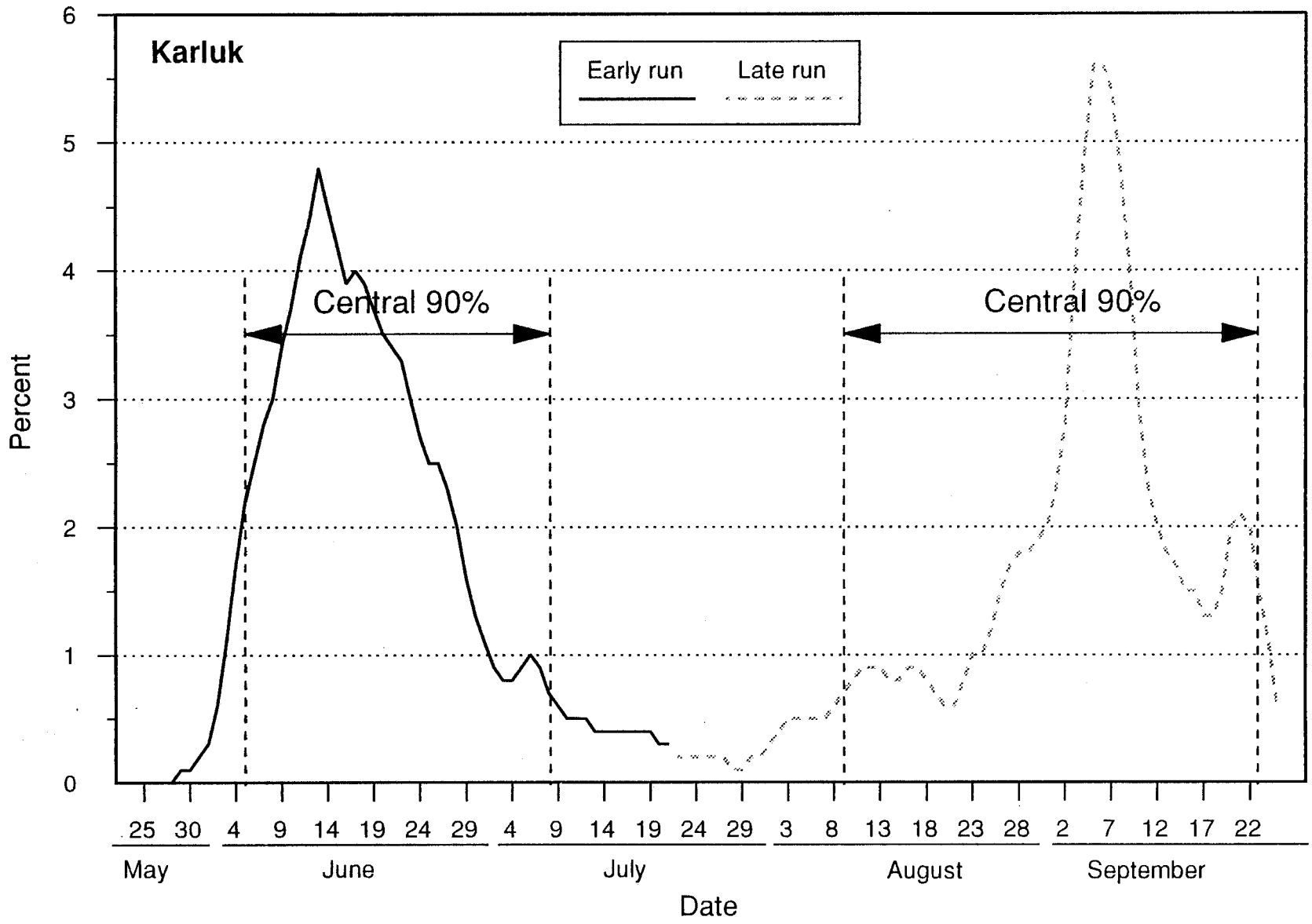
Appendix A.2. Estimated Pauls Bay sockeye salmon escapement timing, post 1983.



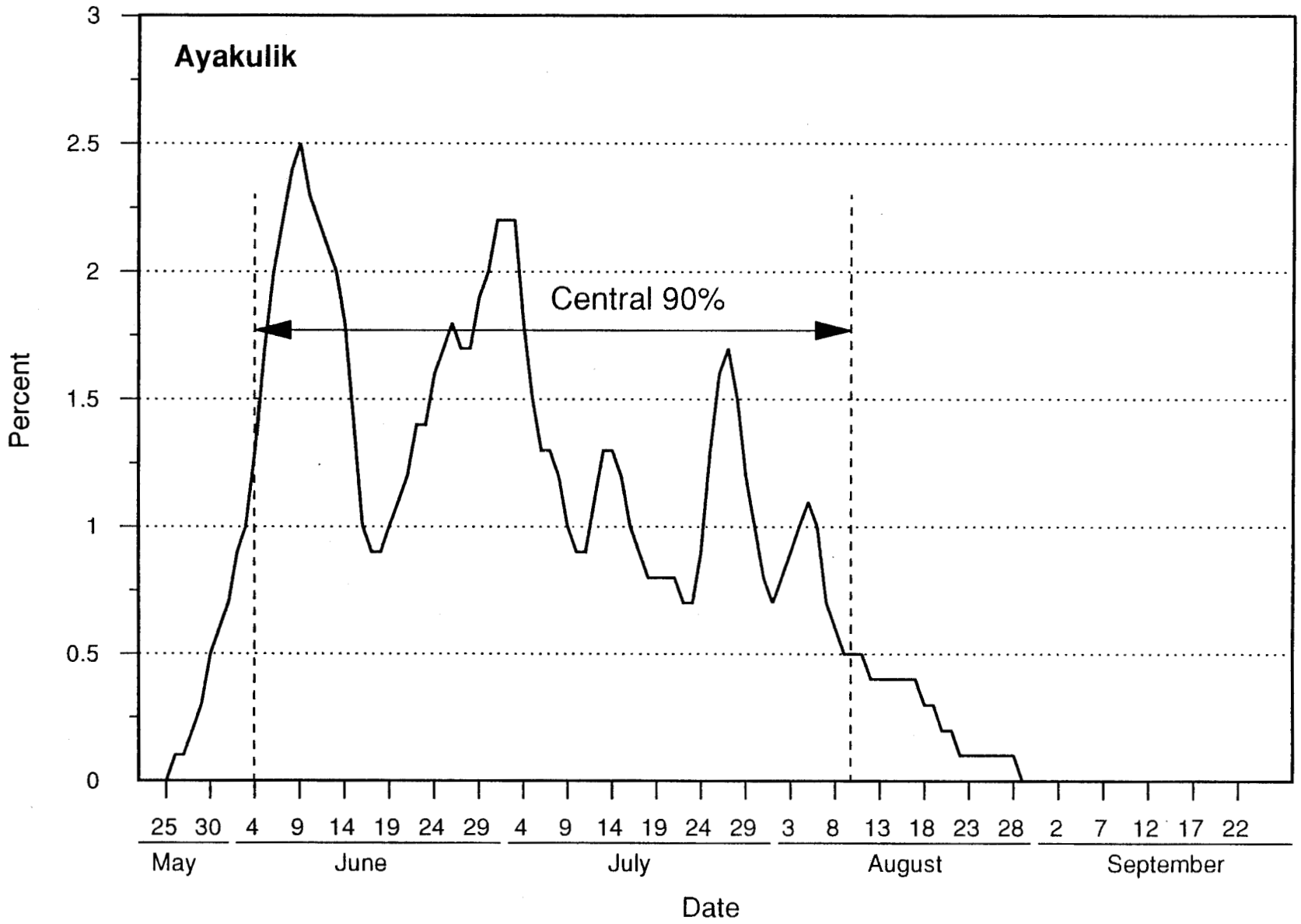
Appendix A.3. Estimated Uganik sockeye salmon escapement timing, post 1983.



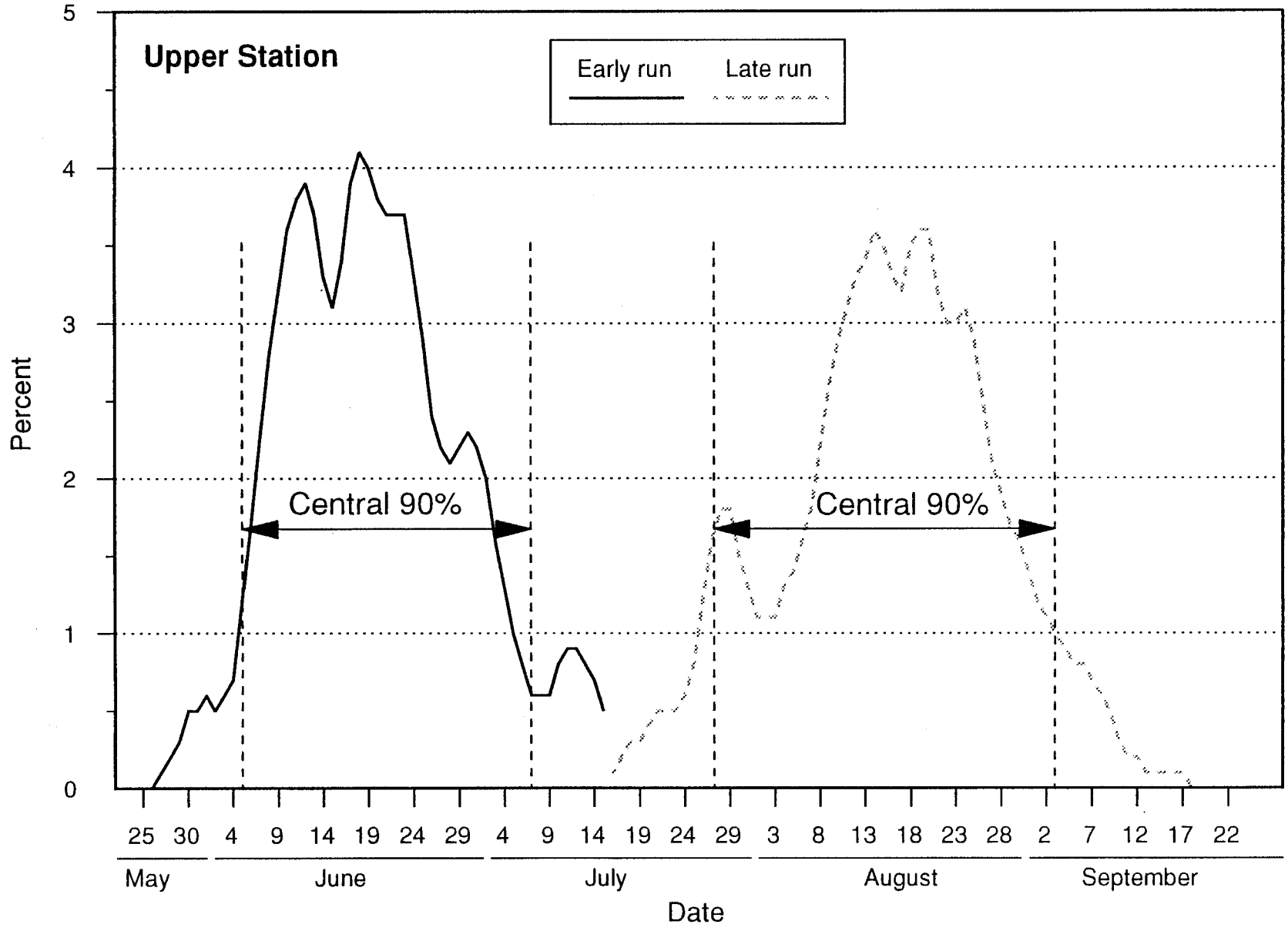
Appendix A.4. Estimated Little River sockeye salmon escapement timing, post 1983.



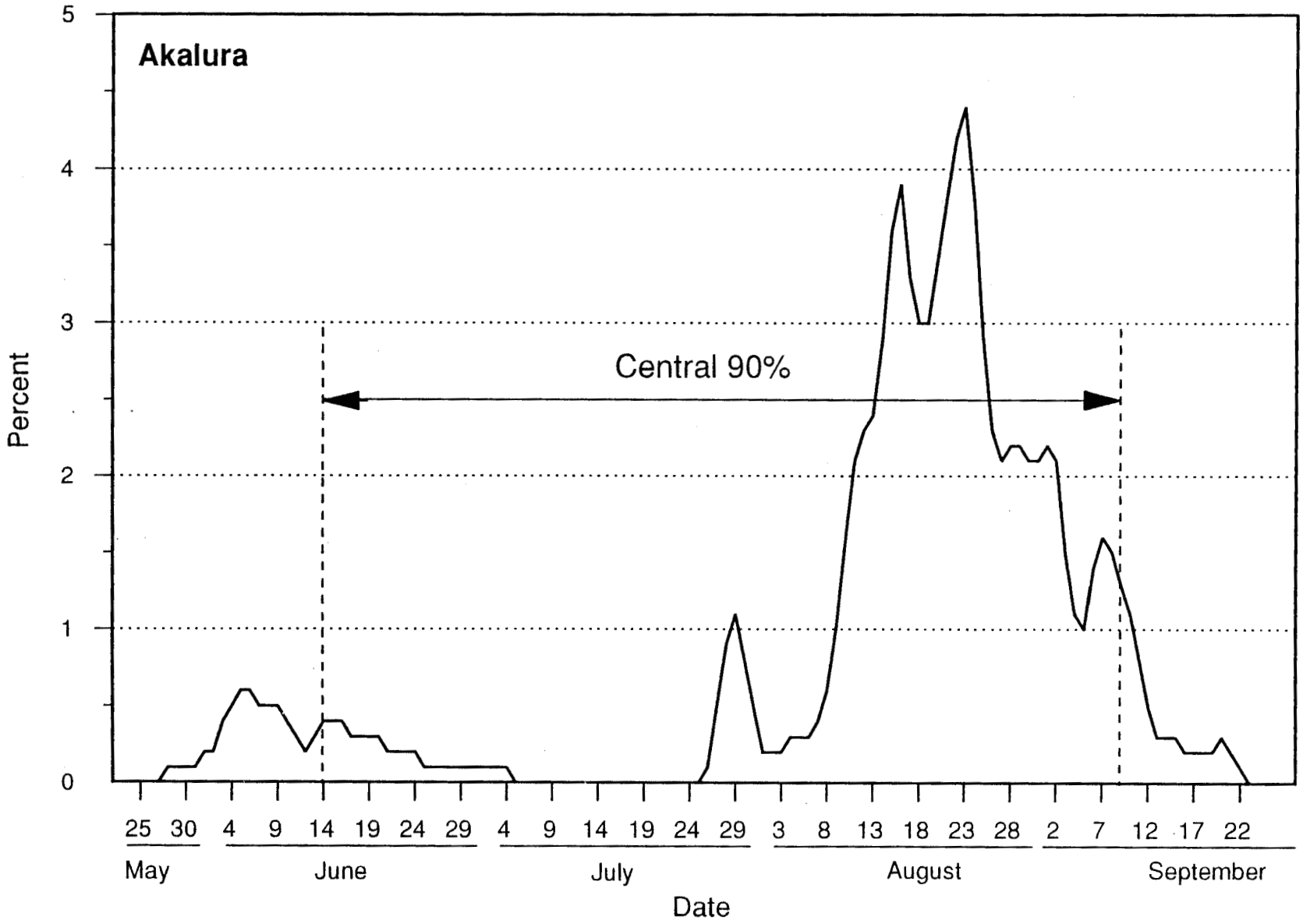
Appendix A.5. Estimated Karluk early and late run sockeye salmon escapement timing, post 1983.



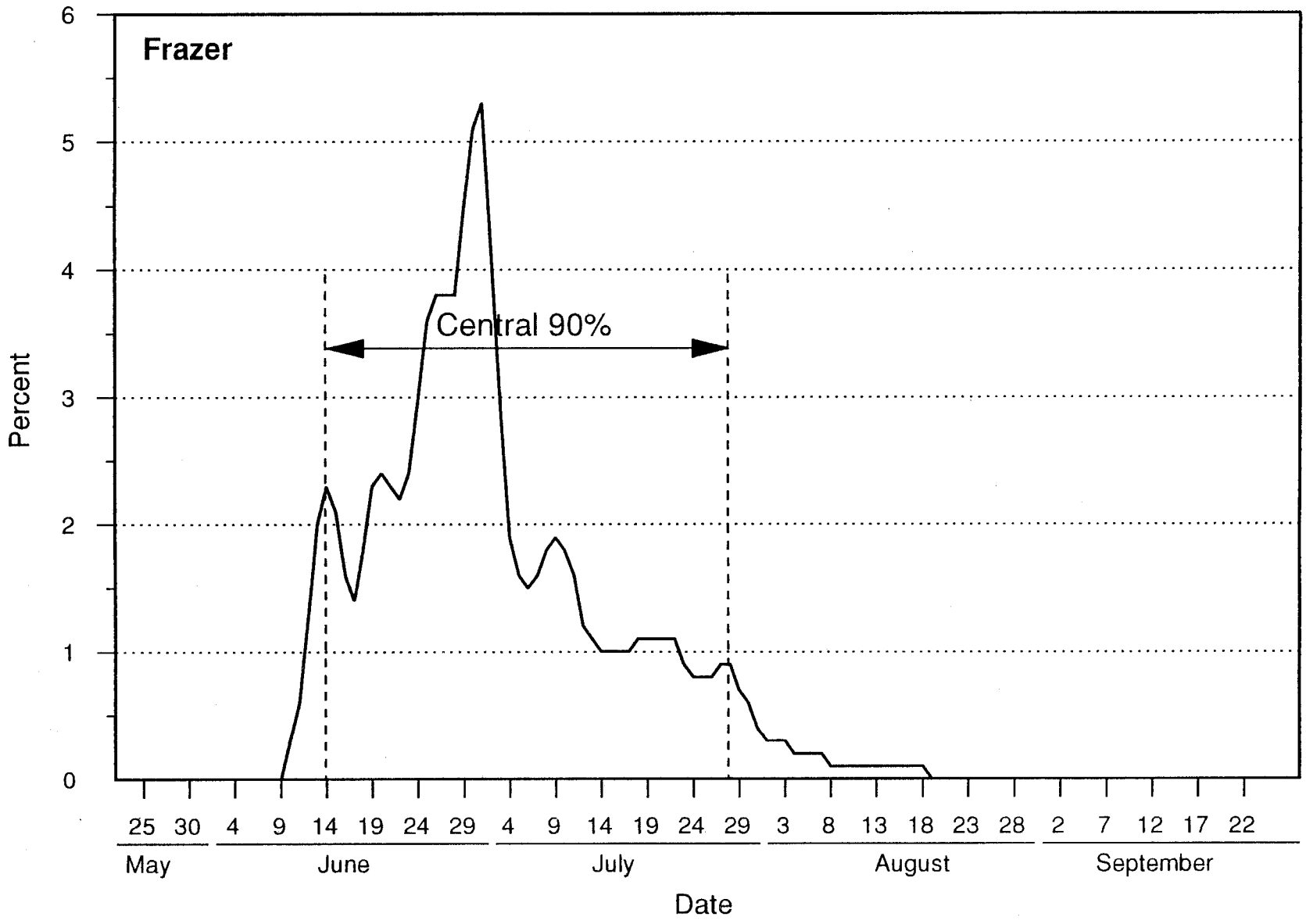
Appendix A.6. Estimated Ayakulik sockeye salmon escapement timing, post 1983.



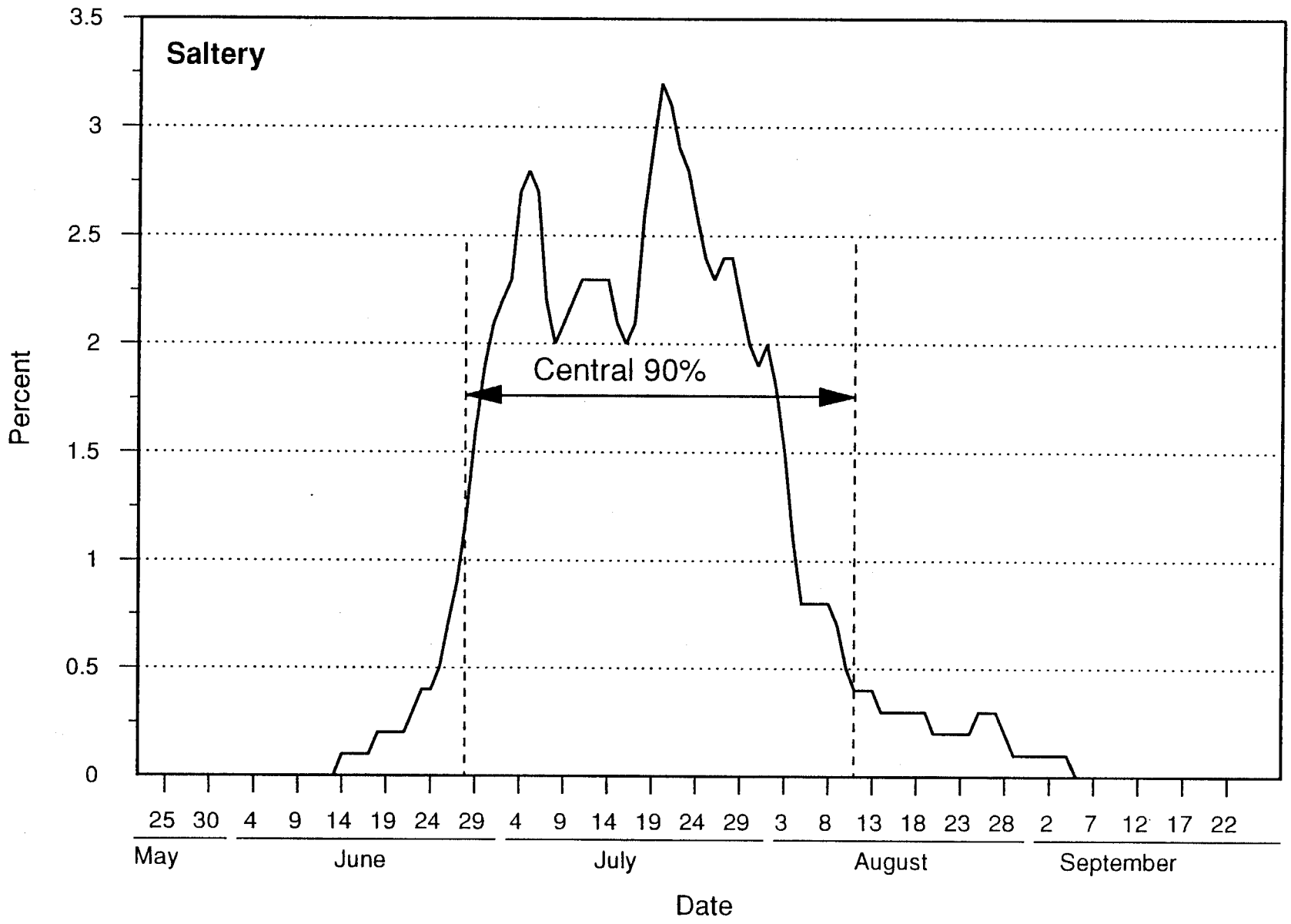
Appendix A.7. Estimated Upper Station early and late run sockeye salmon escapement timing, post 1983.



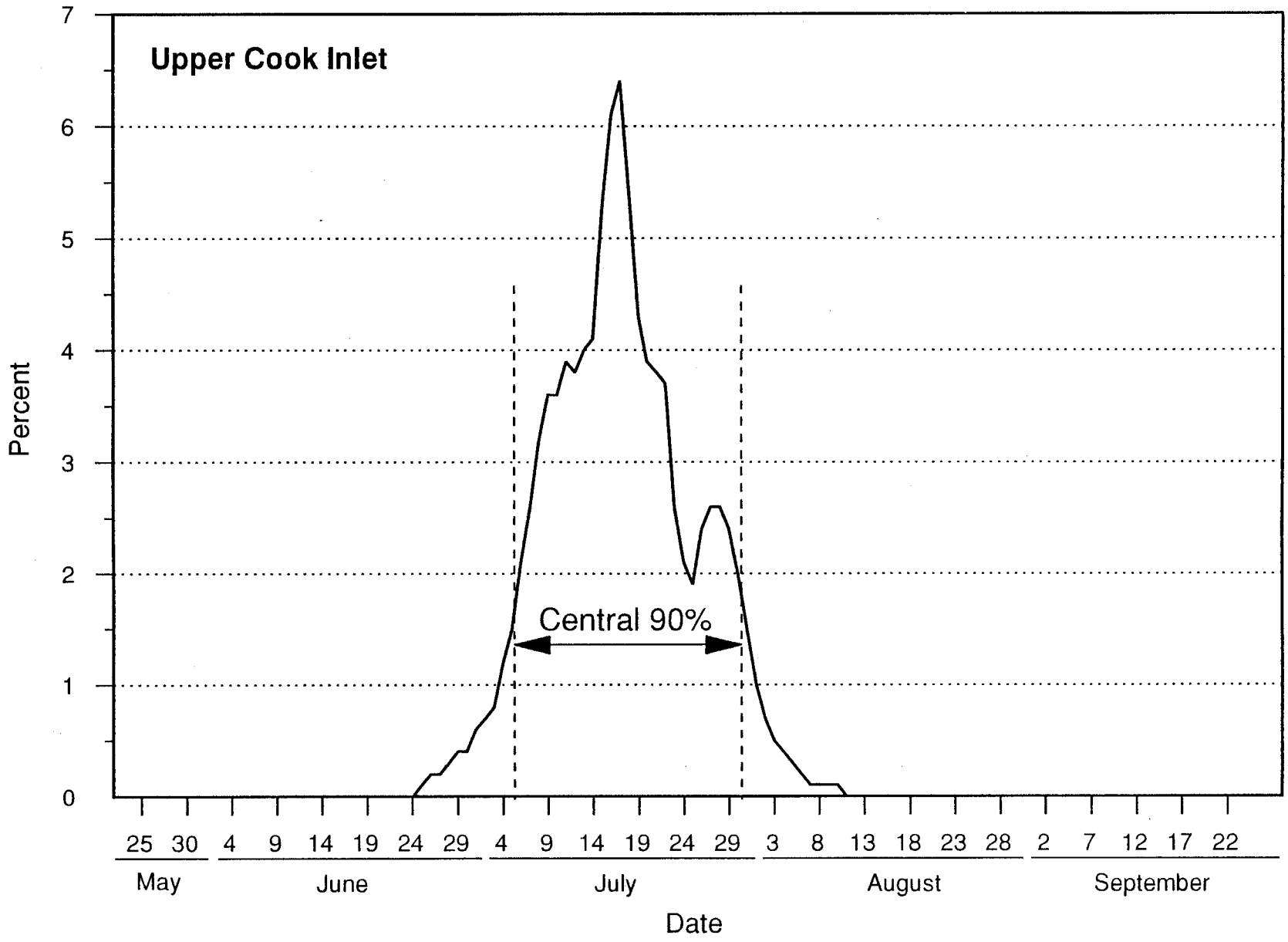
Appendix A.8. Estimated Akalura sockeye salmon escapement timing, post 1983.



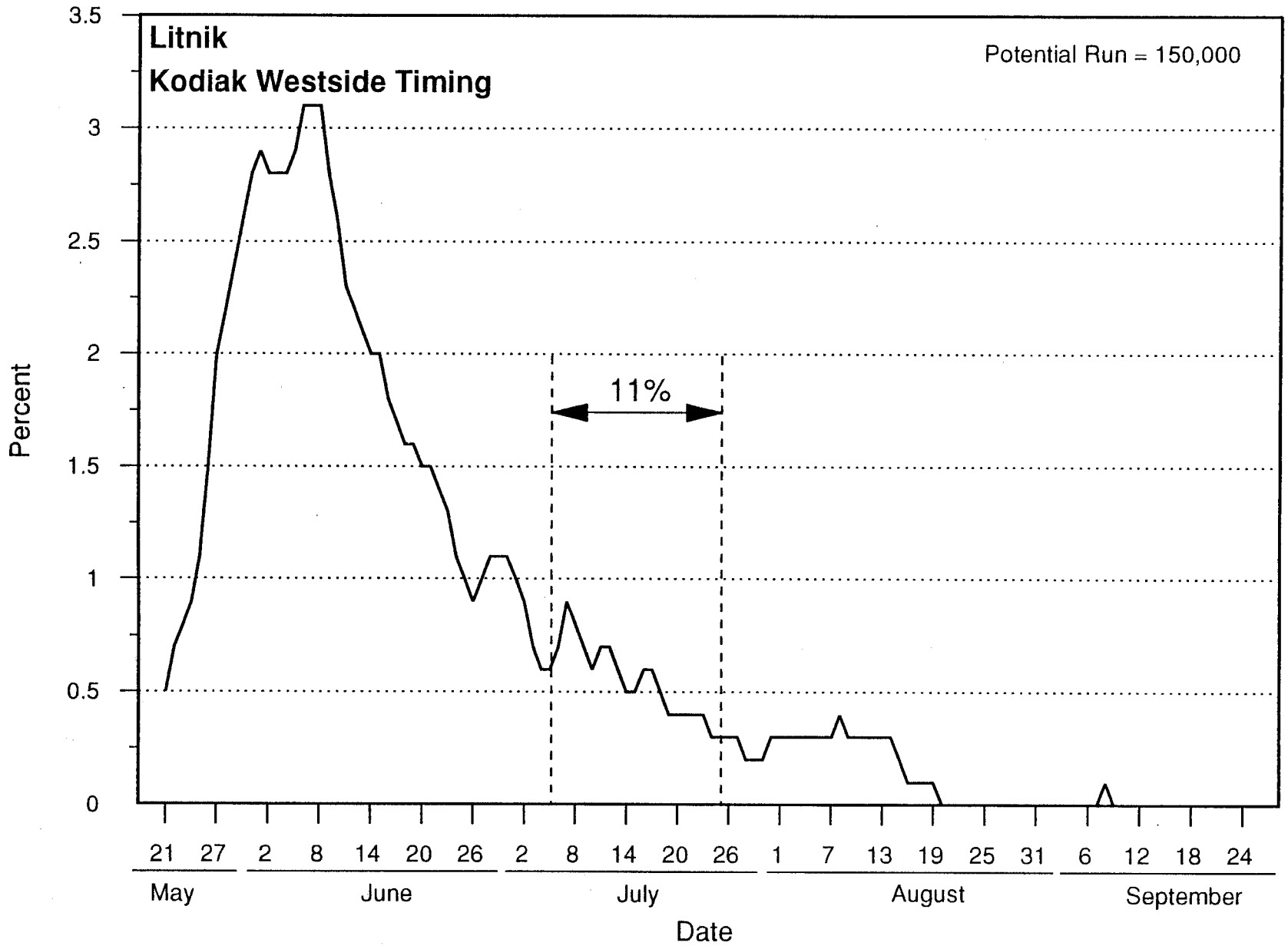
Appendix A.9. Estimated Frazer sockeye salmon escapement timing, post 1983.



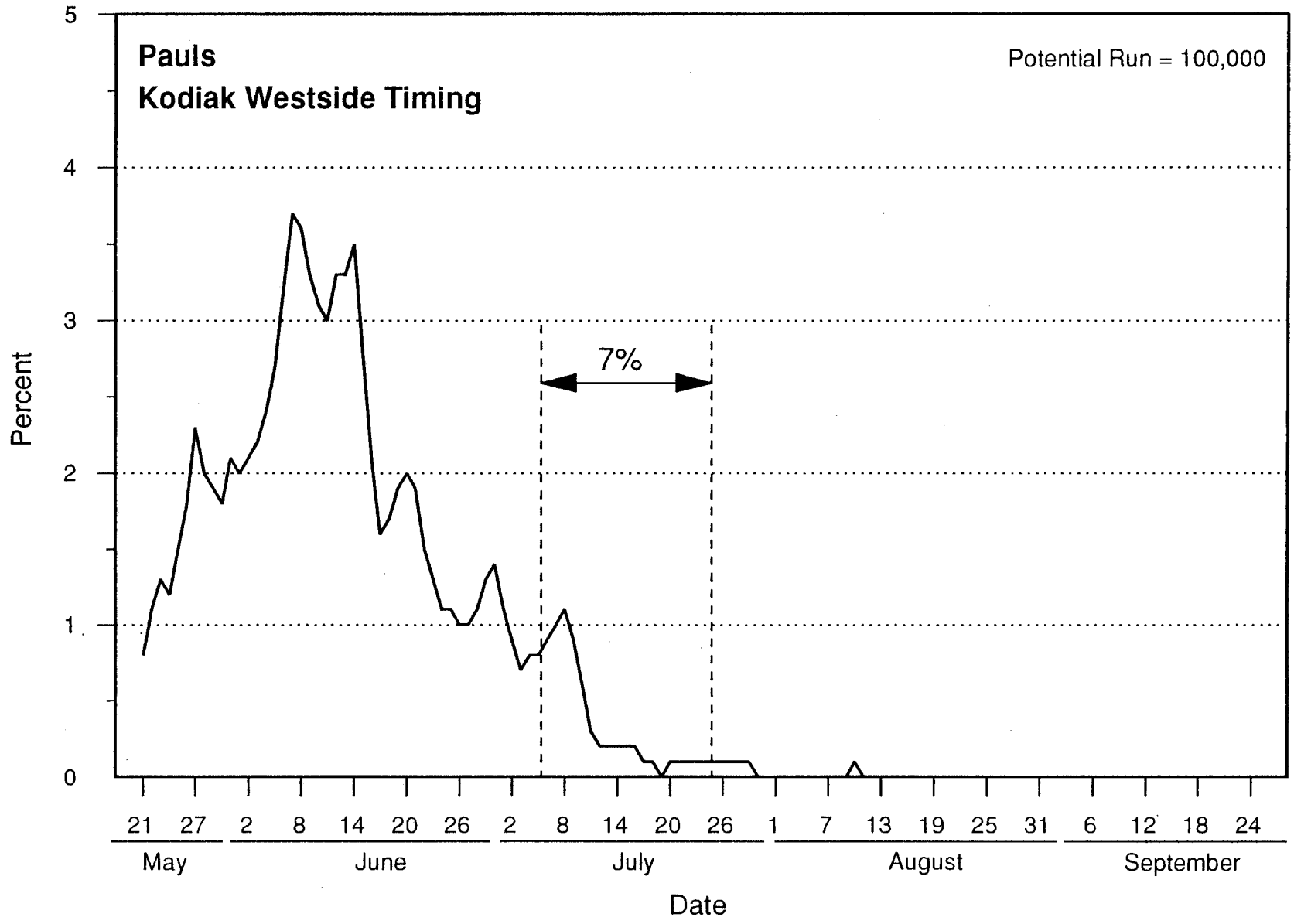
Appendix A.10. Estimated Saltery sockeye salmon escapement timing, post 1983.



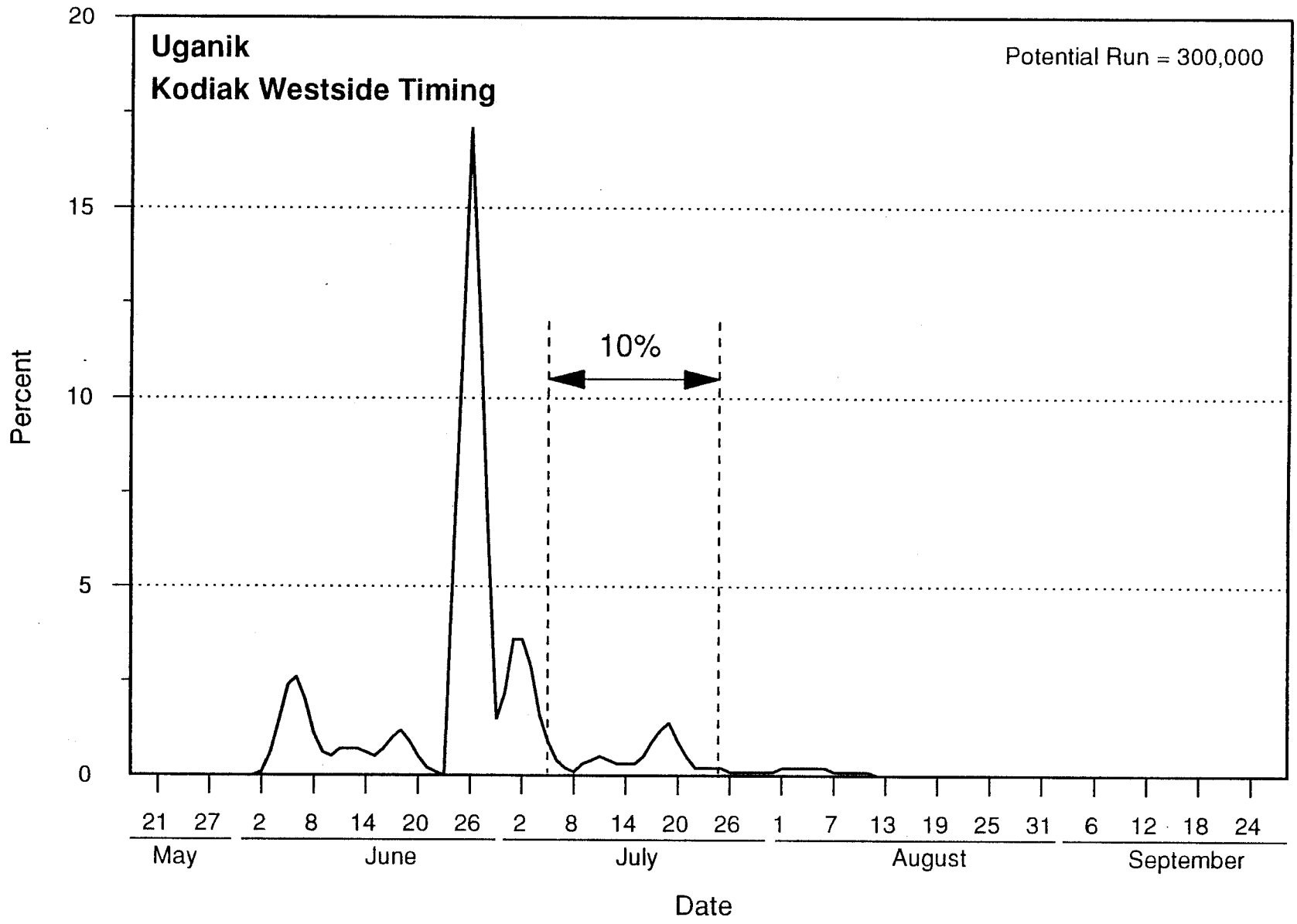
Appendix A.11. Estimated Upper Cook Inlet sockeye salmon run timing within Upper Cook Inlet, post 1983.



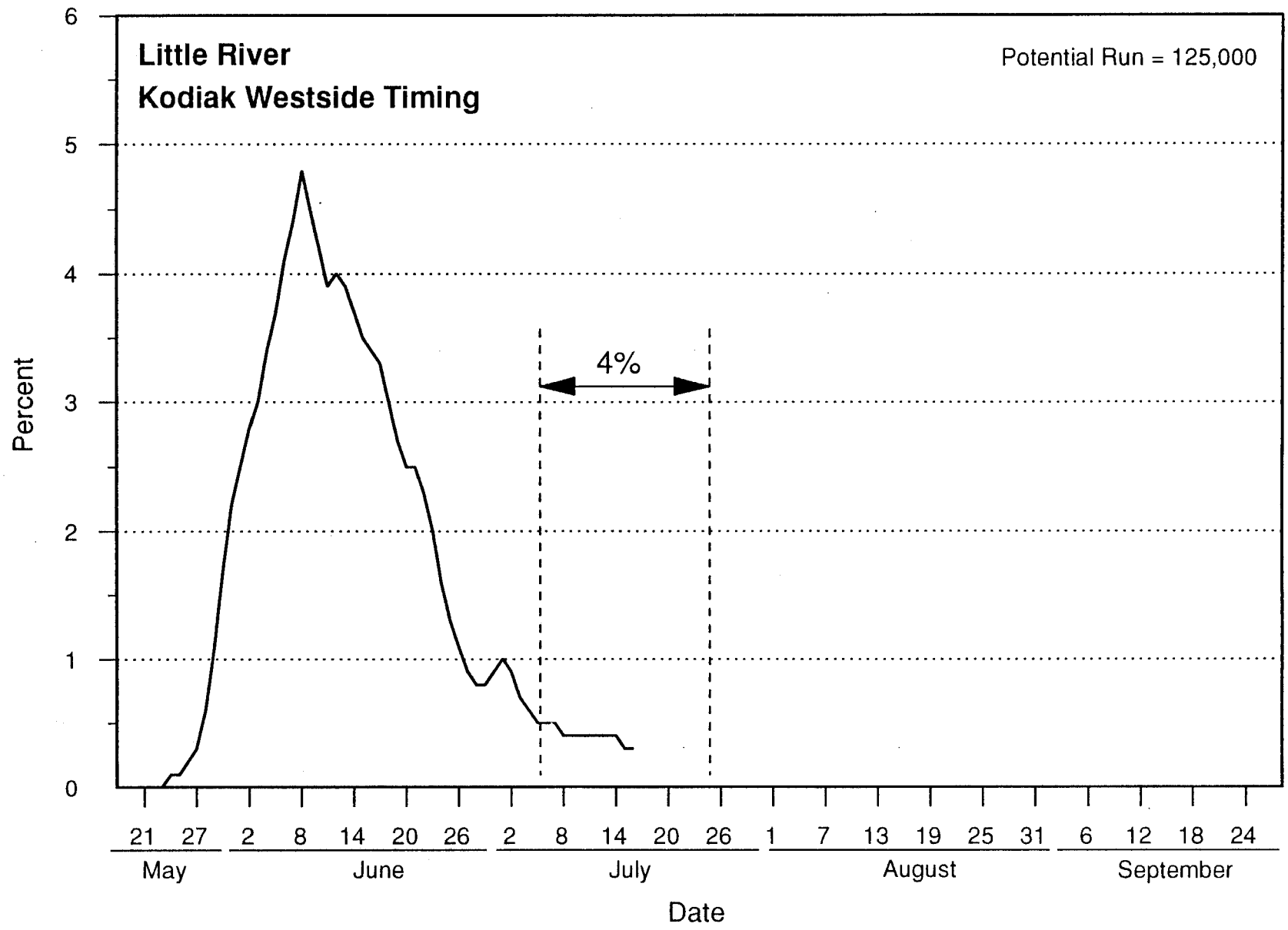
Appendix B.1. Estimated westside Kodiak Island run timing for Litnik sockeye salmon, post 1983.



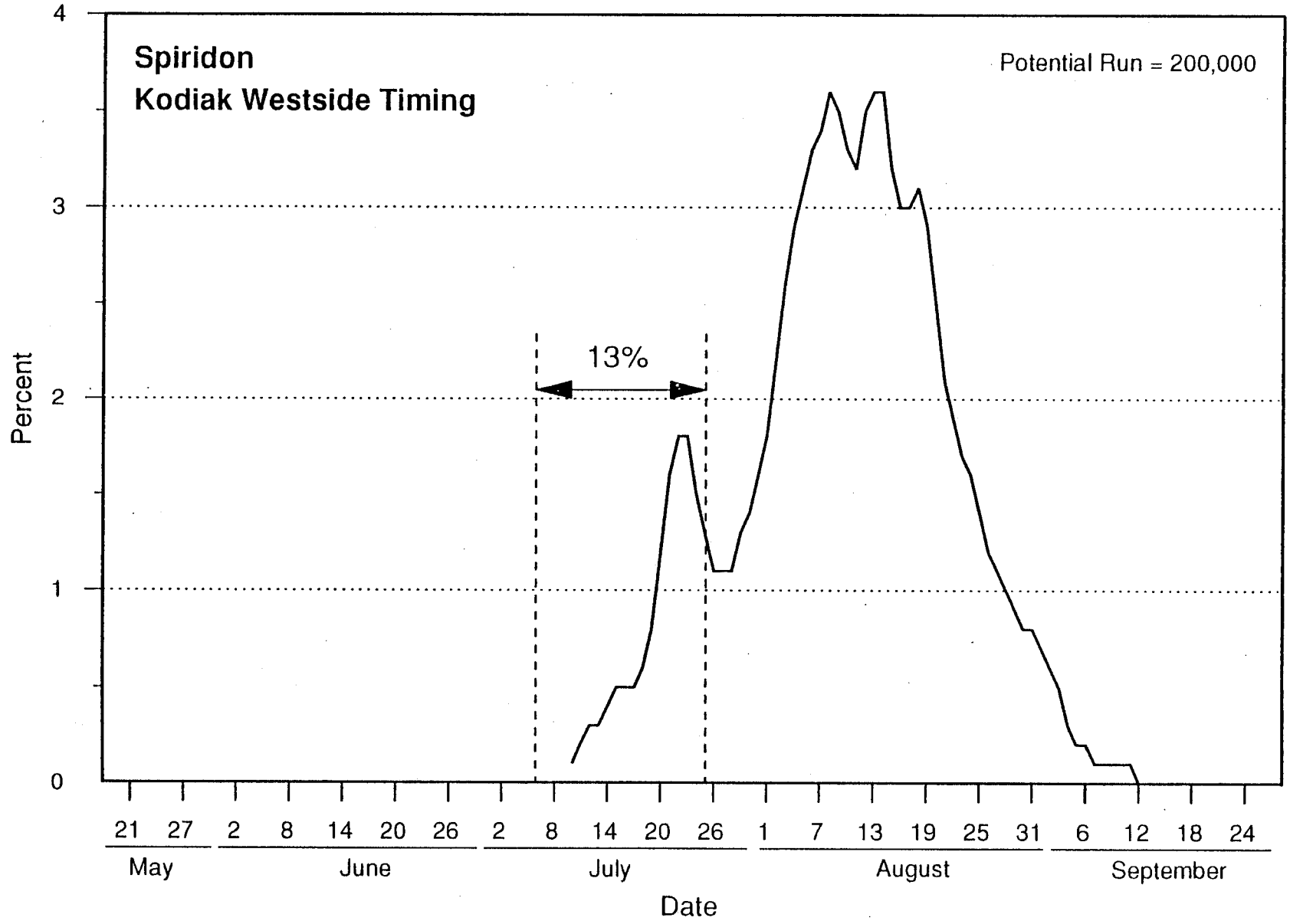
Appendix B.2. Estimated westside Kodiak Island run timing for Pauls Bay sockeye salmon, post 1983.



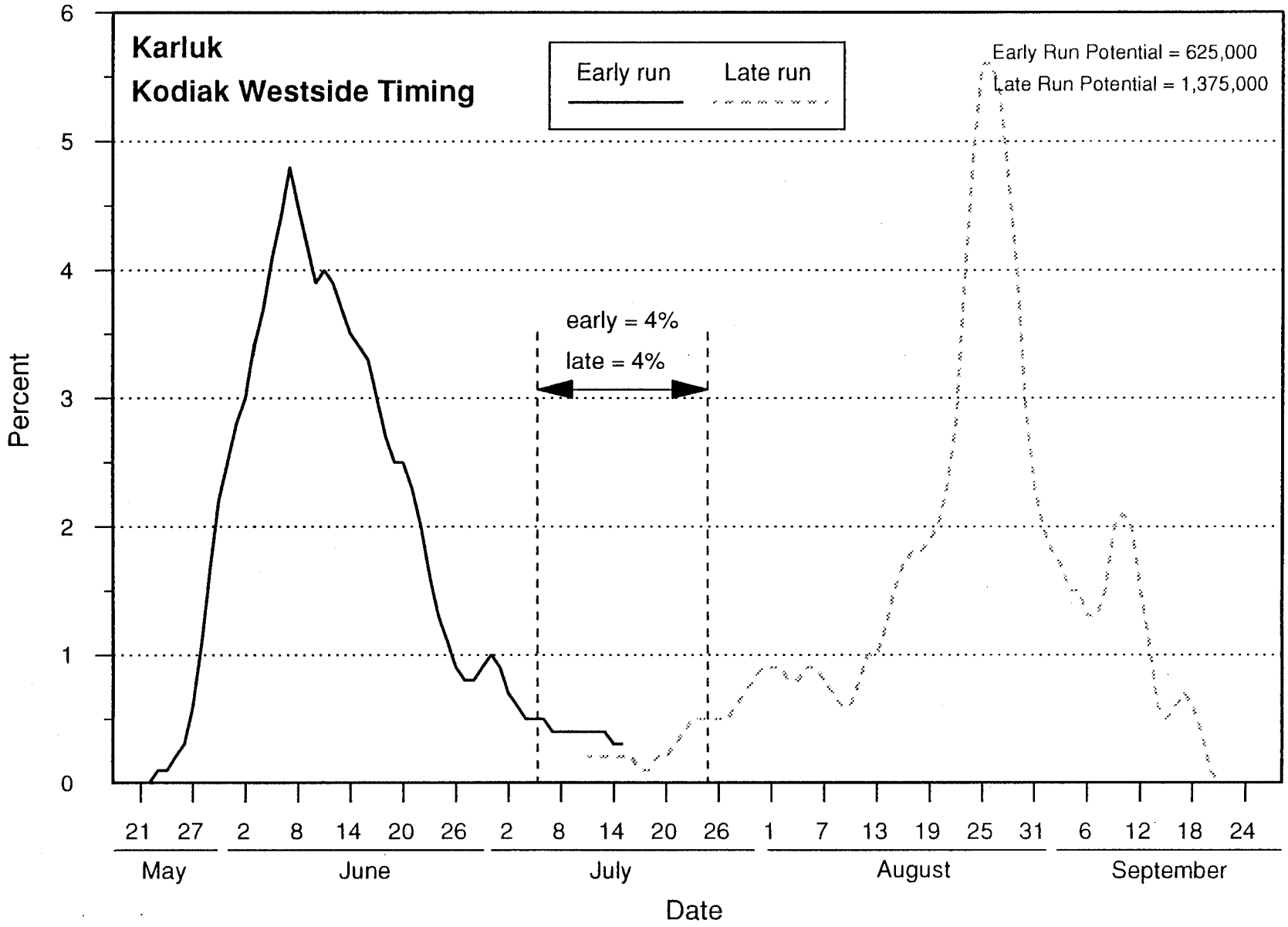
Appendix B.3. Estimated westside Kodiak Island run timing for Uganik sockeye salmon, post 1983.



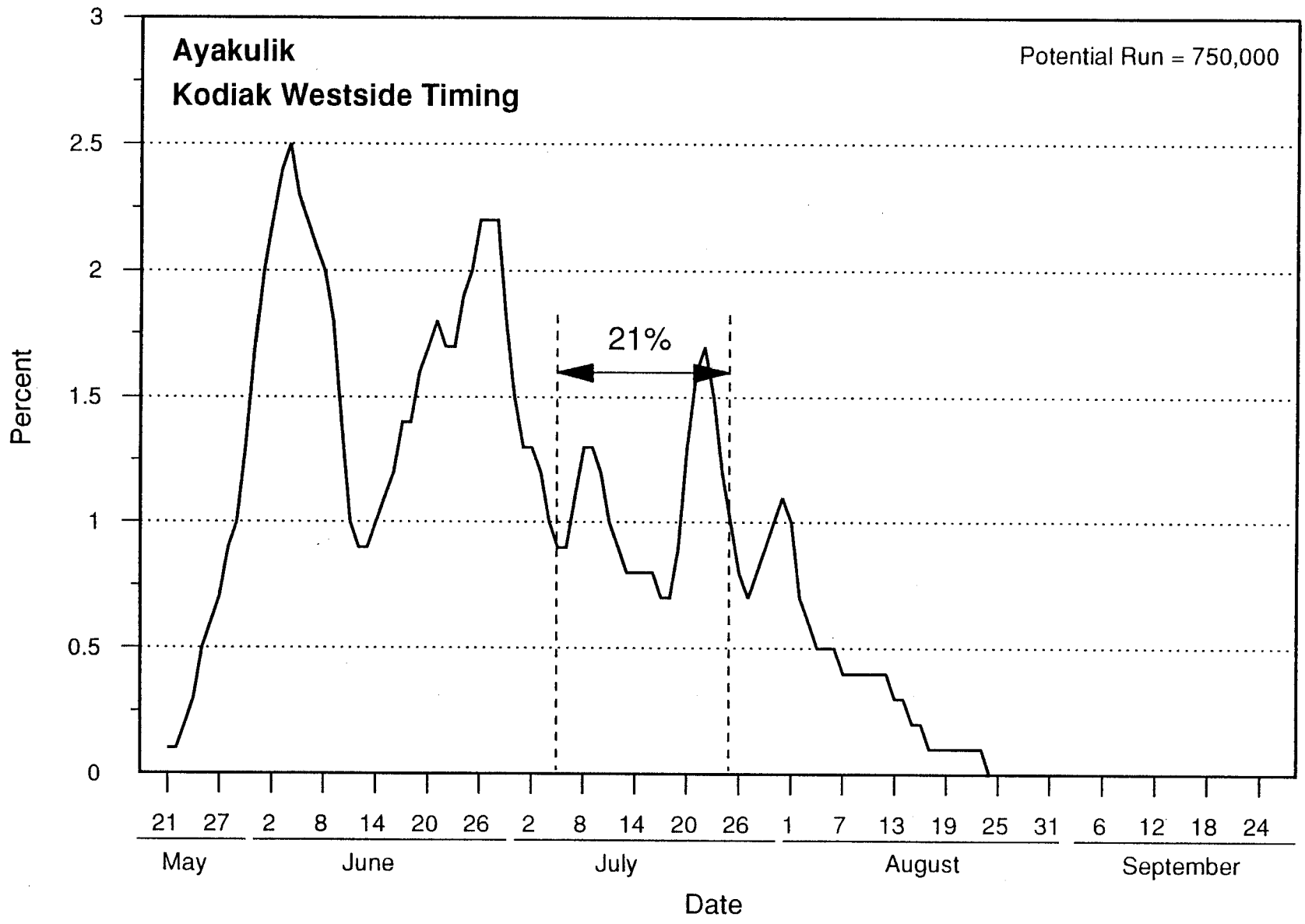
Appendix B.4. Estimated westside Kodiak Island run timing for Little River sockeye salmon, post 1983.



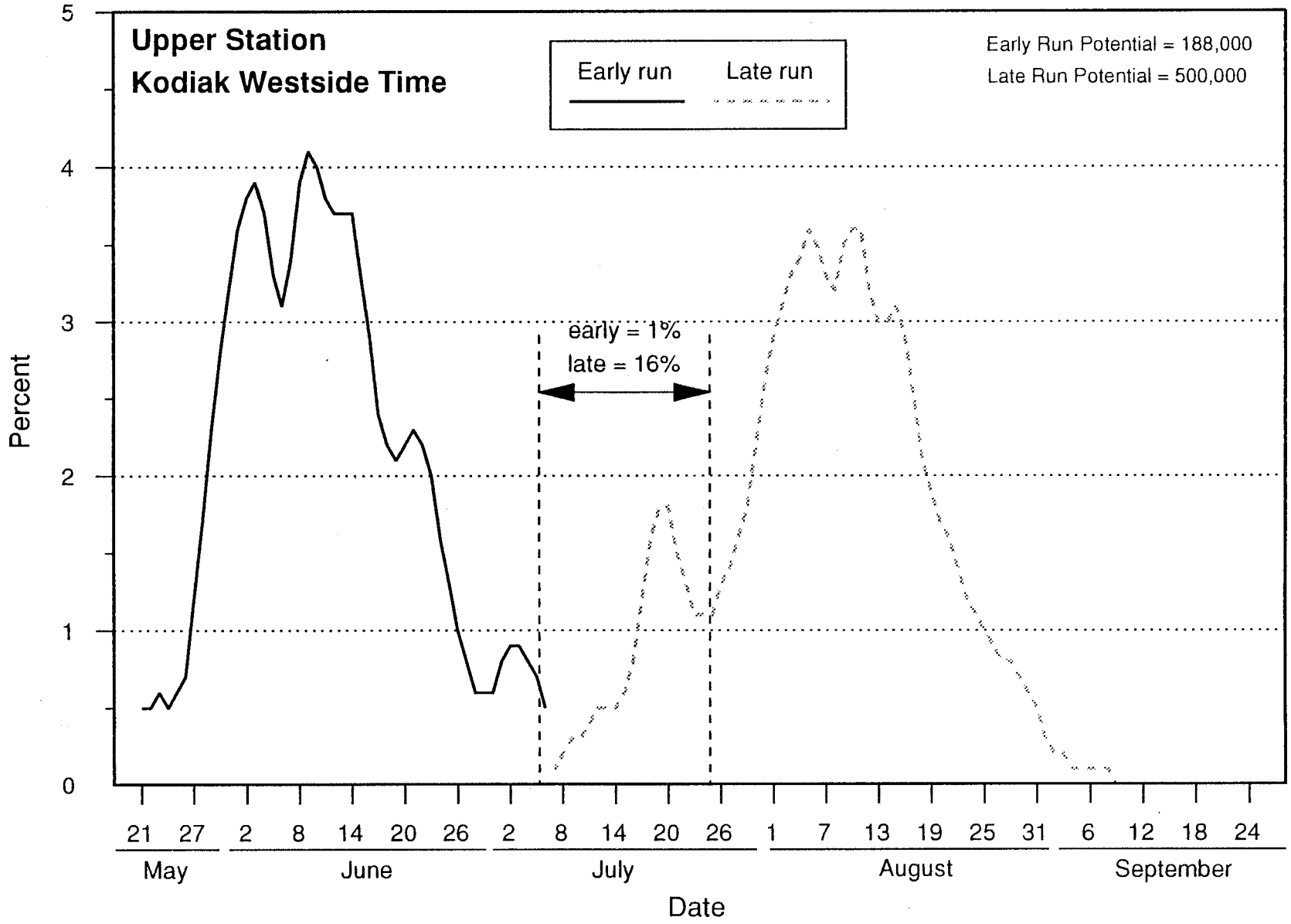
Appendix B.5. Estimated westside Kodiak Island run timing for Spiridon sockeye salmon, post 1983.



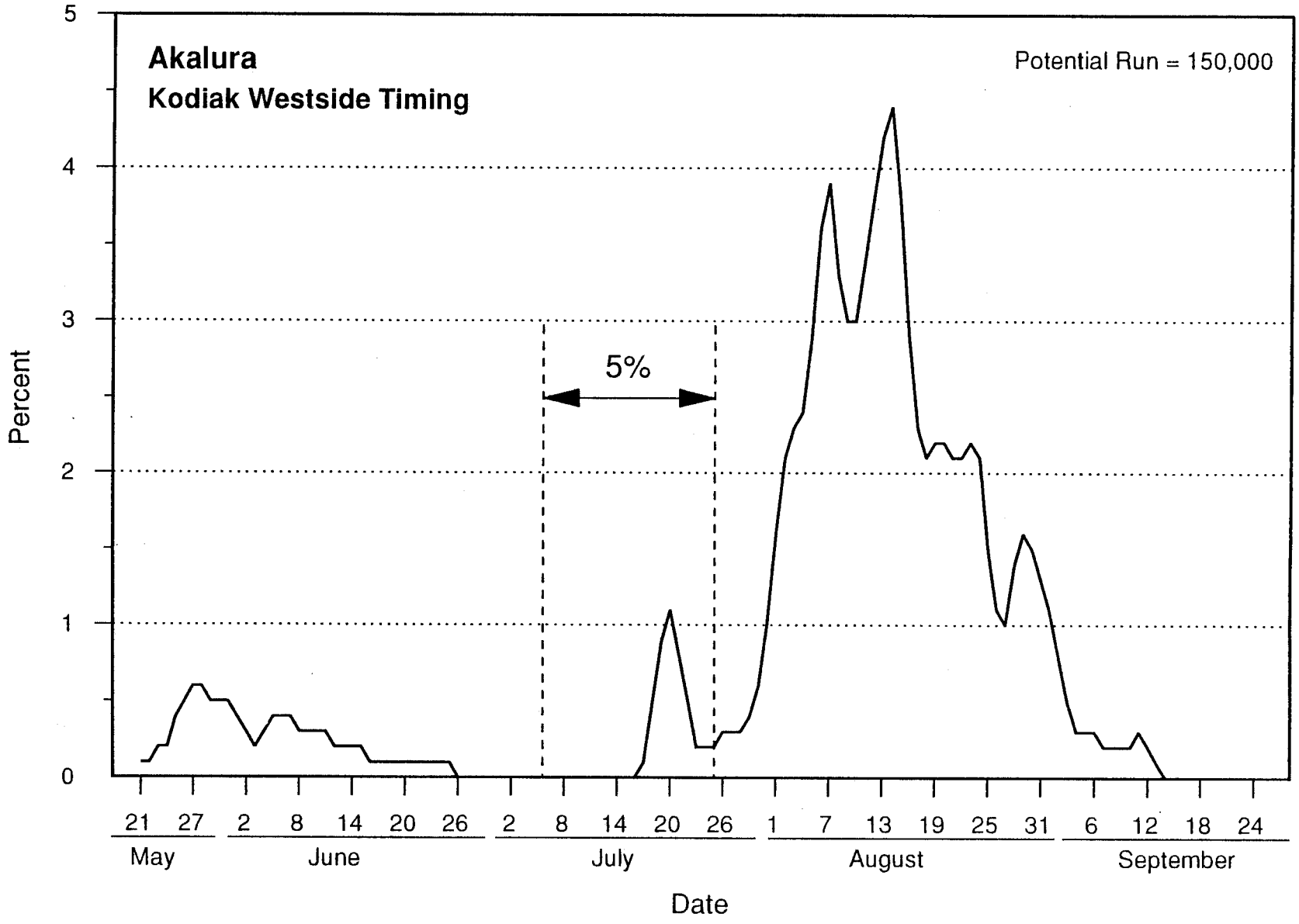
Appendix B.6. Estimated westside Kodiak Island run timing for Karluk early and late run sockeye salmon, post 1983.



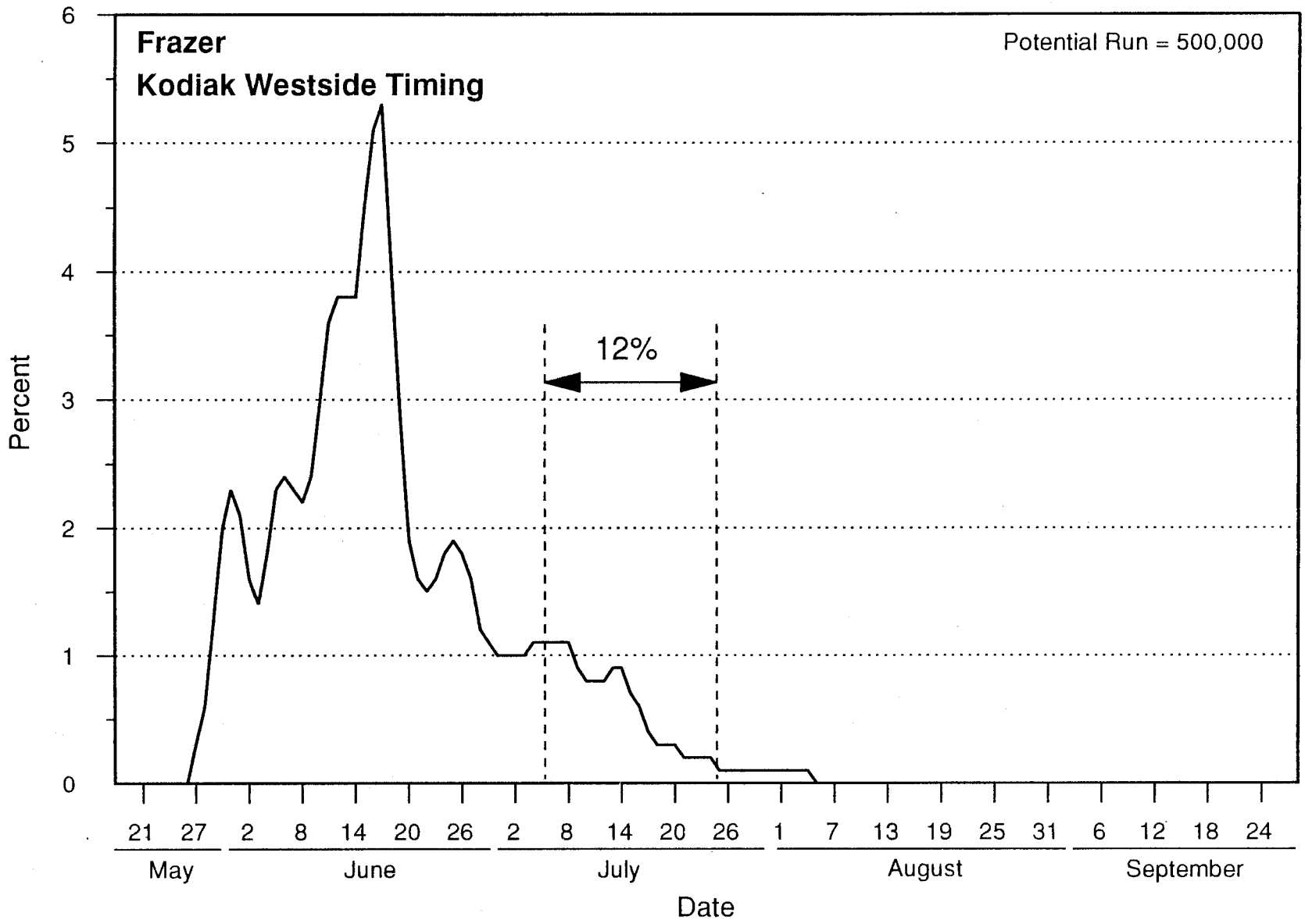
Appendix B.7. Estimated westside Kodiak Island run timing for Ayakulik sockeye salmon, post 1983.



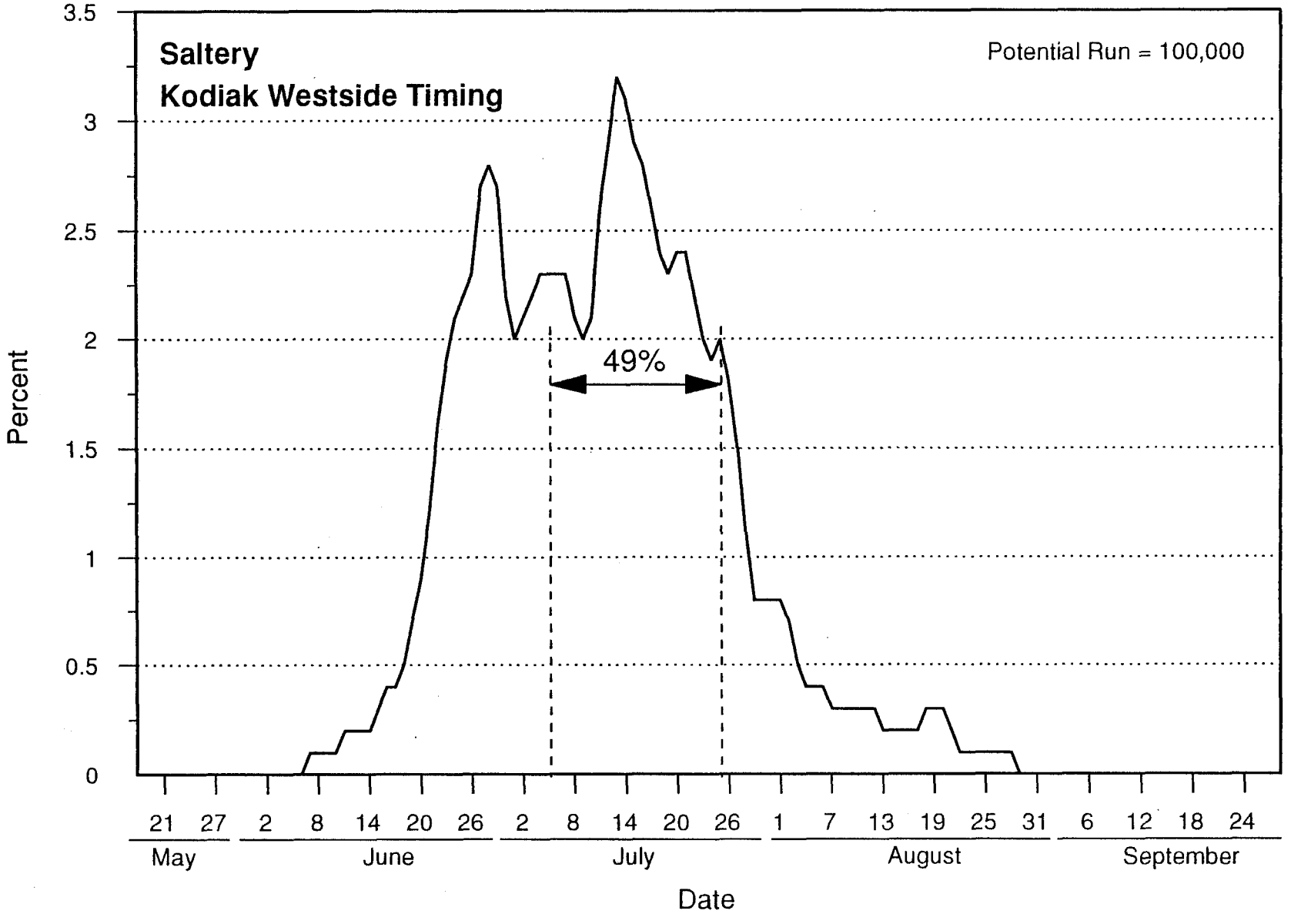
Appendix B.8. Estimated westside Kodiak Island run timing for Upper Station early and late run sockeye salmon, post 1983.



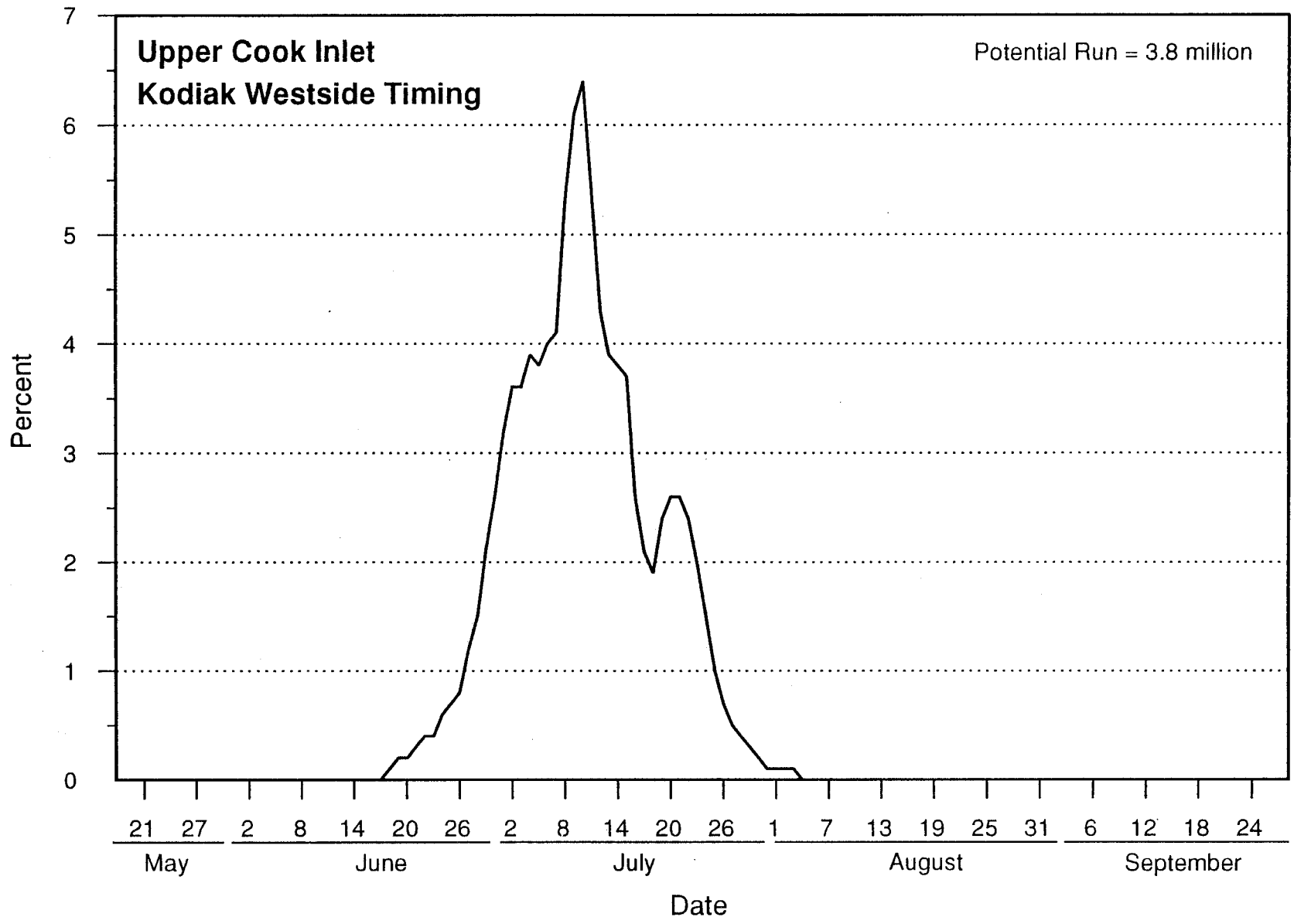
Appendix B.9. Estimated westside Kodiak Island run timing for Akalura sockeye salmon, post 1983.



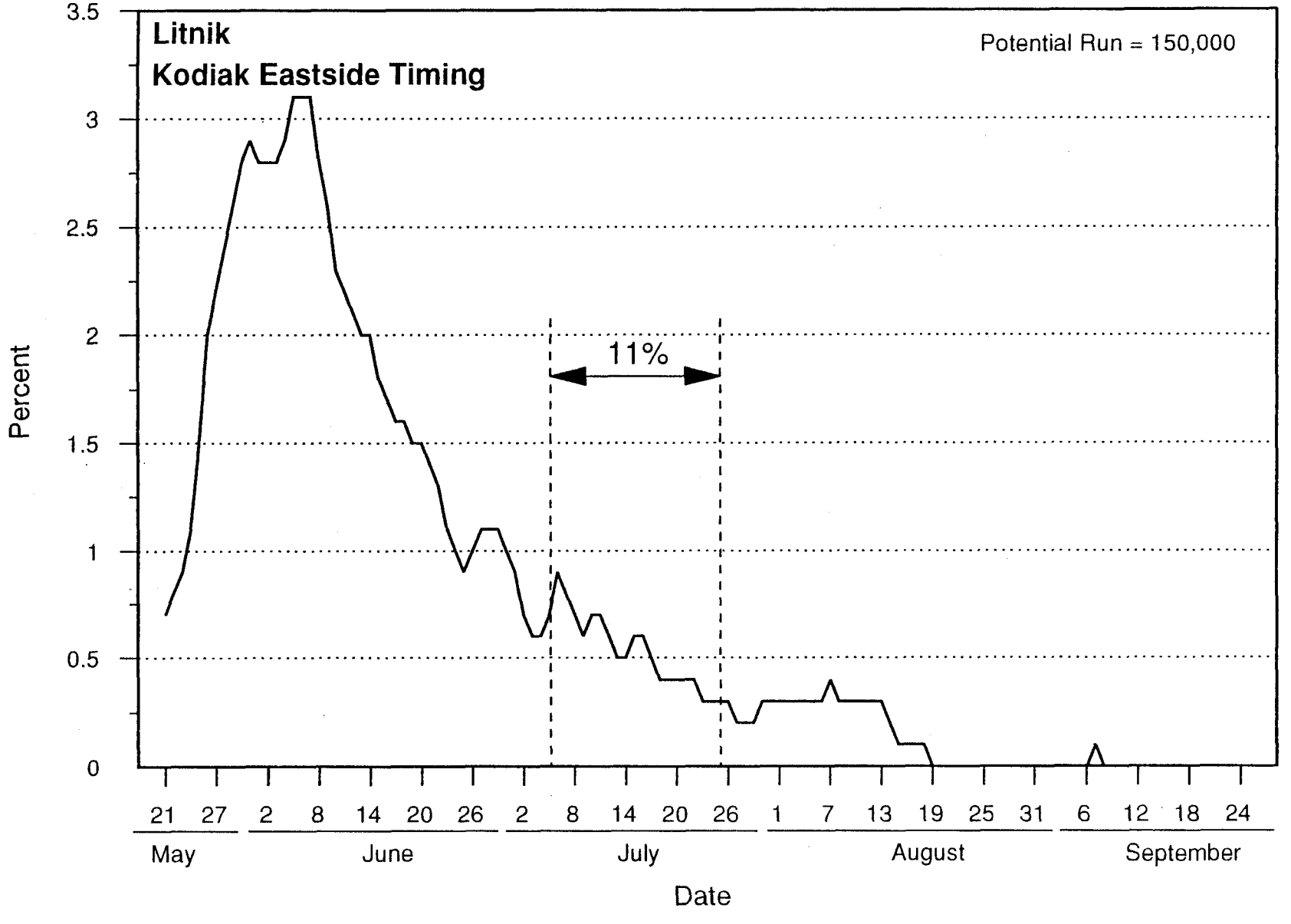
Appendix B.10. Estimated westside Kodiak Island run timing for Frazer sockeye salmon, post 1983.



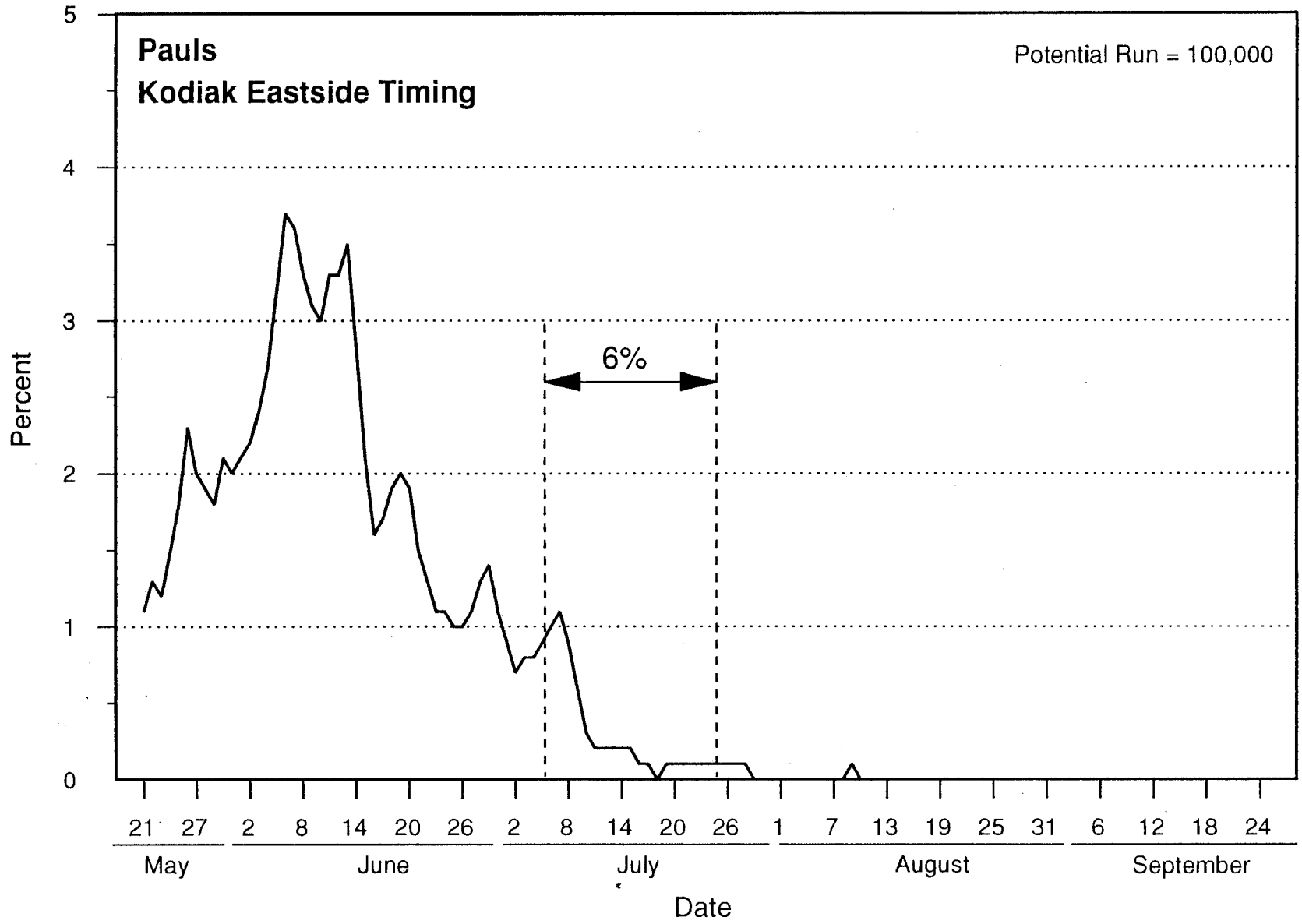
Appendix B.11. Estimated westside Kodiak Island run timing for Saltery sockeye salmon, post 1983.



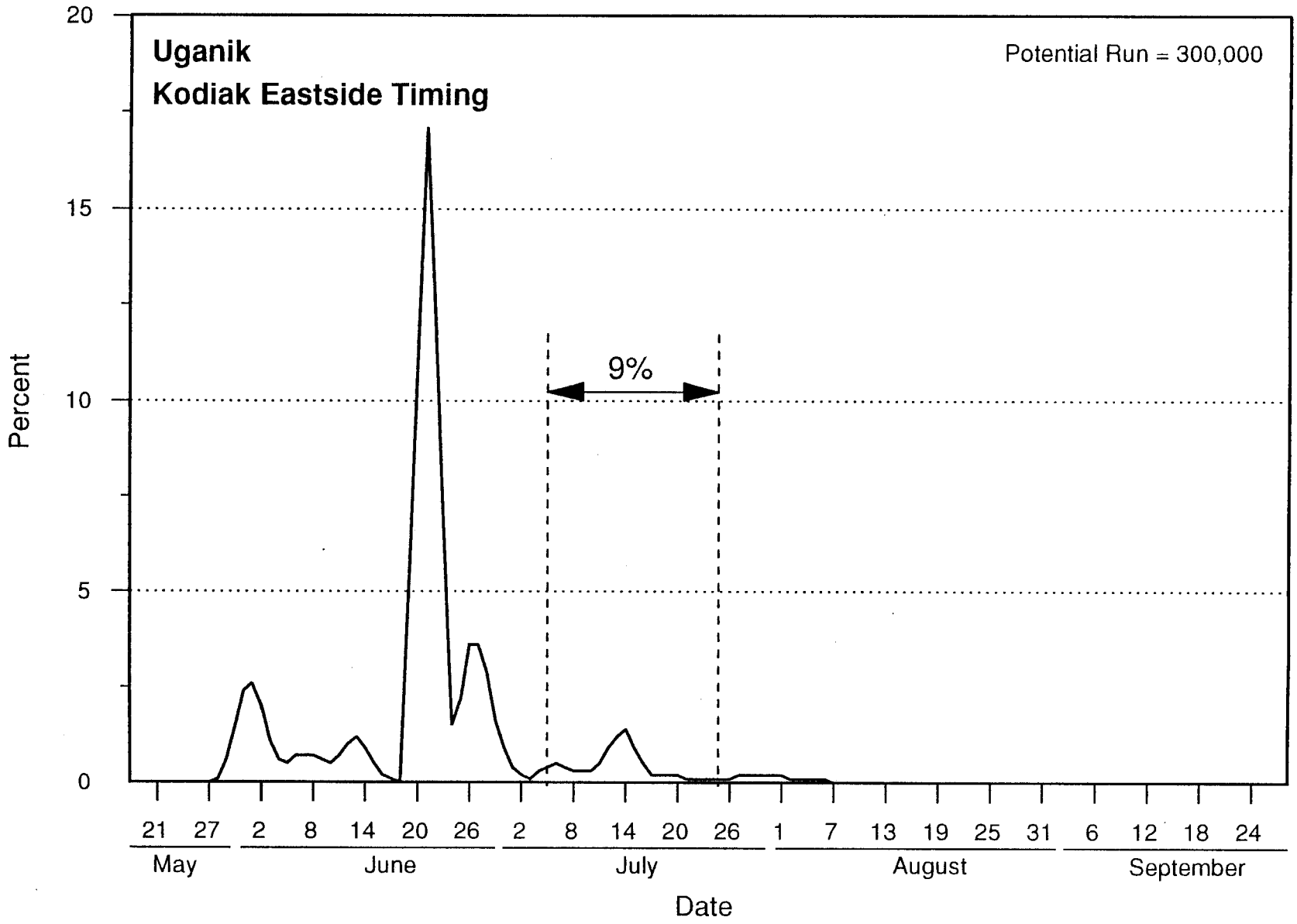
Appendix B.12. Estimated westside Kodiak Island run timing for Upper Cook Inlet sockeye salmon, post 1983.



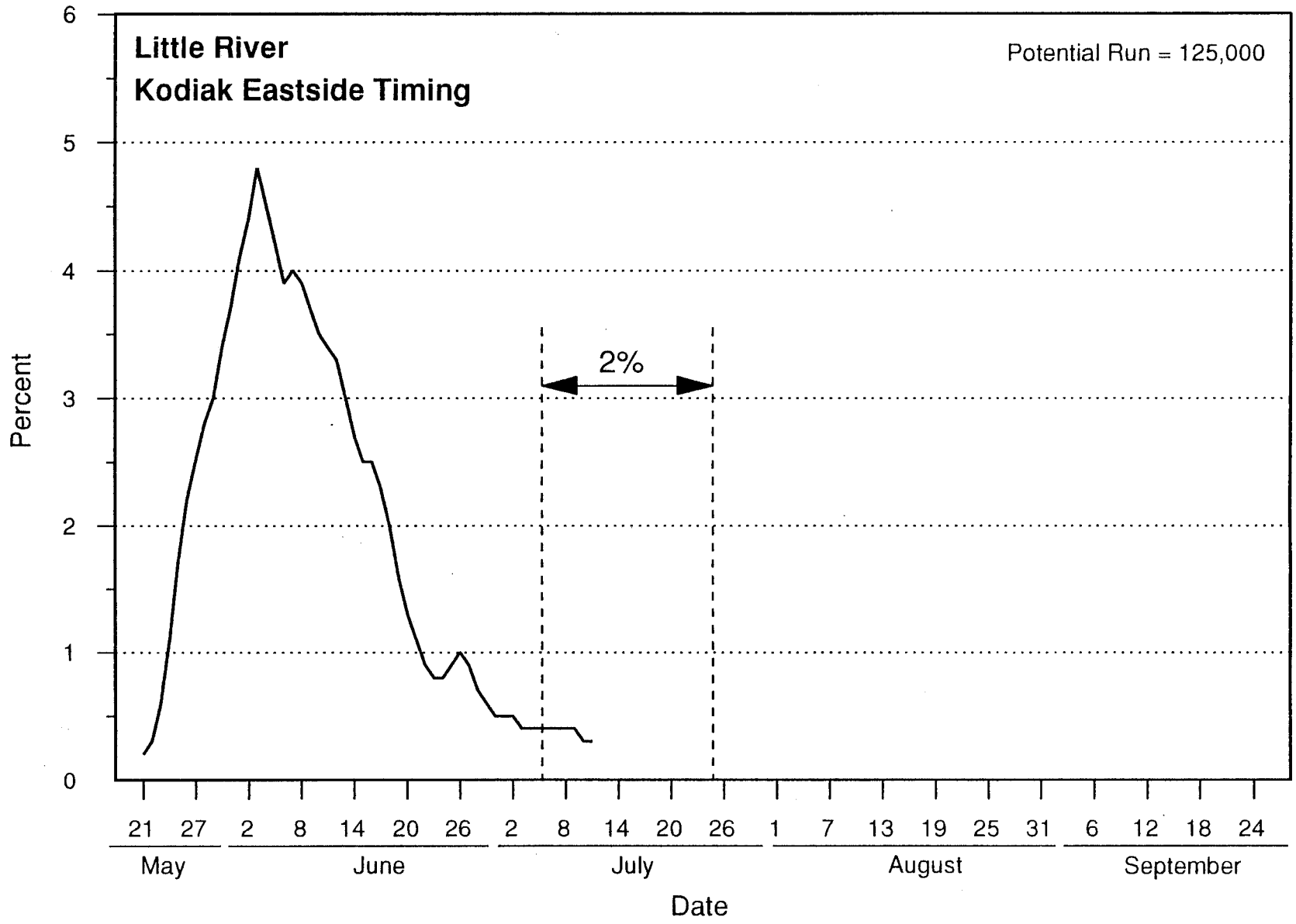
Appendix C.1. Estimated eastside Kodiak Island run timing for Litnik sockeye salmon, post 1983.



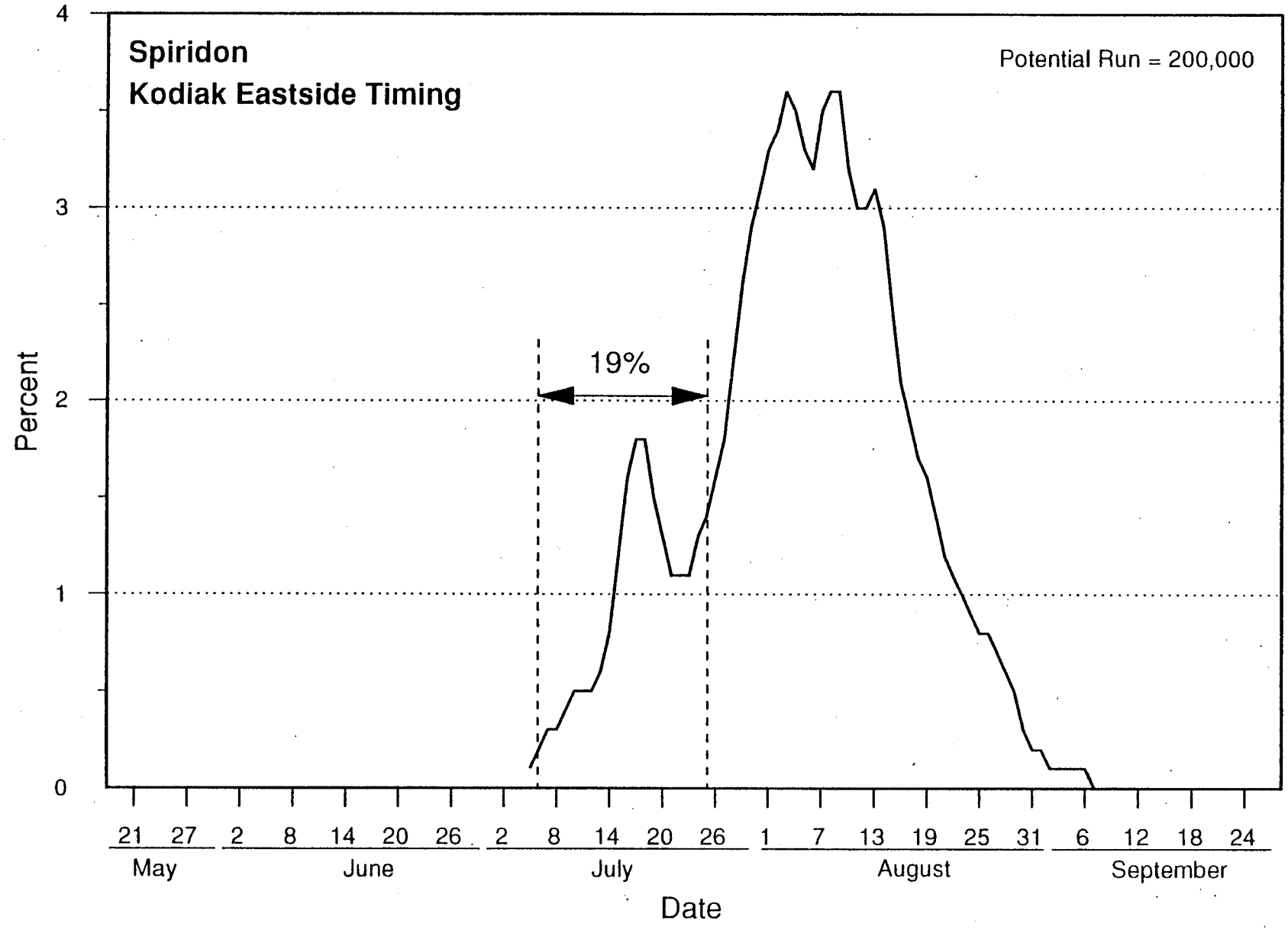
Appendix C.2. Estimated eastside Kodiak Island run timing for Pauls Bay sockeye salmon, post 1983.



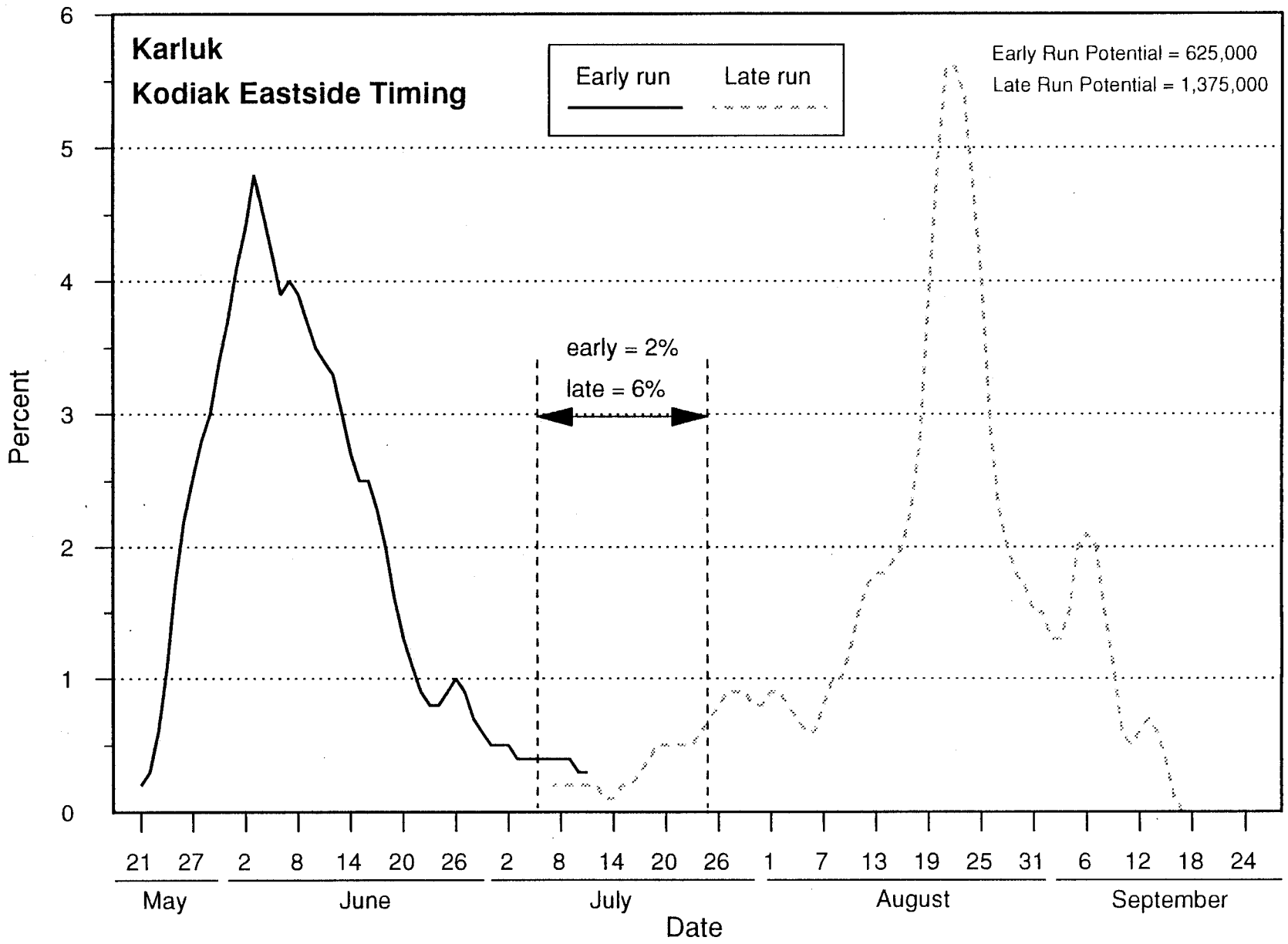
Appendix C.3. Estimated eastside Kodiak Island run timing for Uganik sockeye salmon, post 1983.



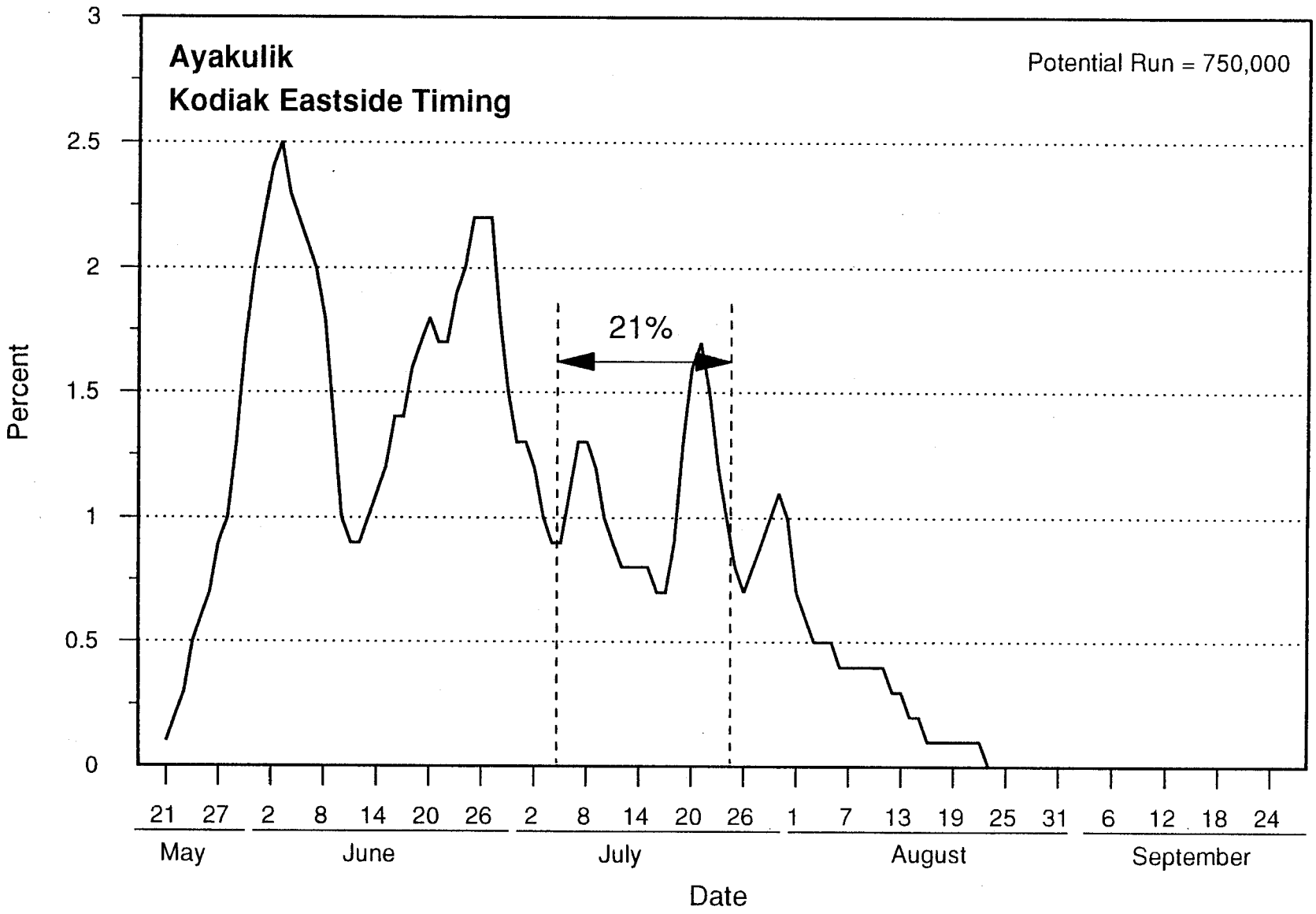
Appendix C.4. Estimated eastside Kodiak Island run timing for Little River sockeye salmon, post 1983.



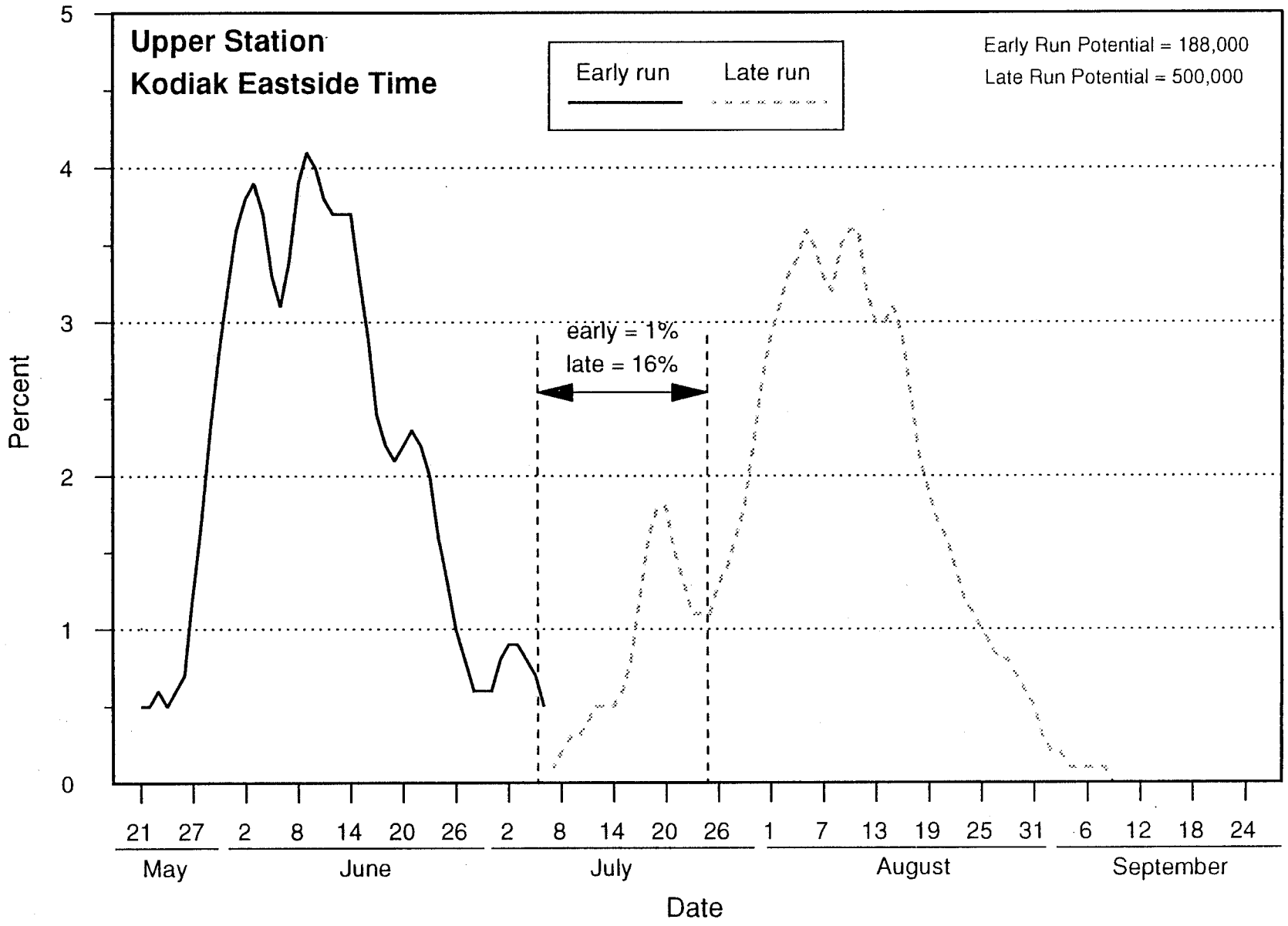
Appendix C.5. Estimated eastside Kodiak Island run timing for Spiridon sockeye salmon, post 1983.



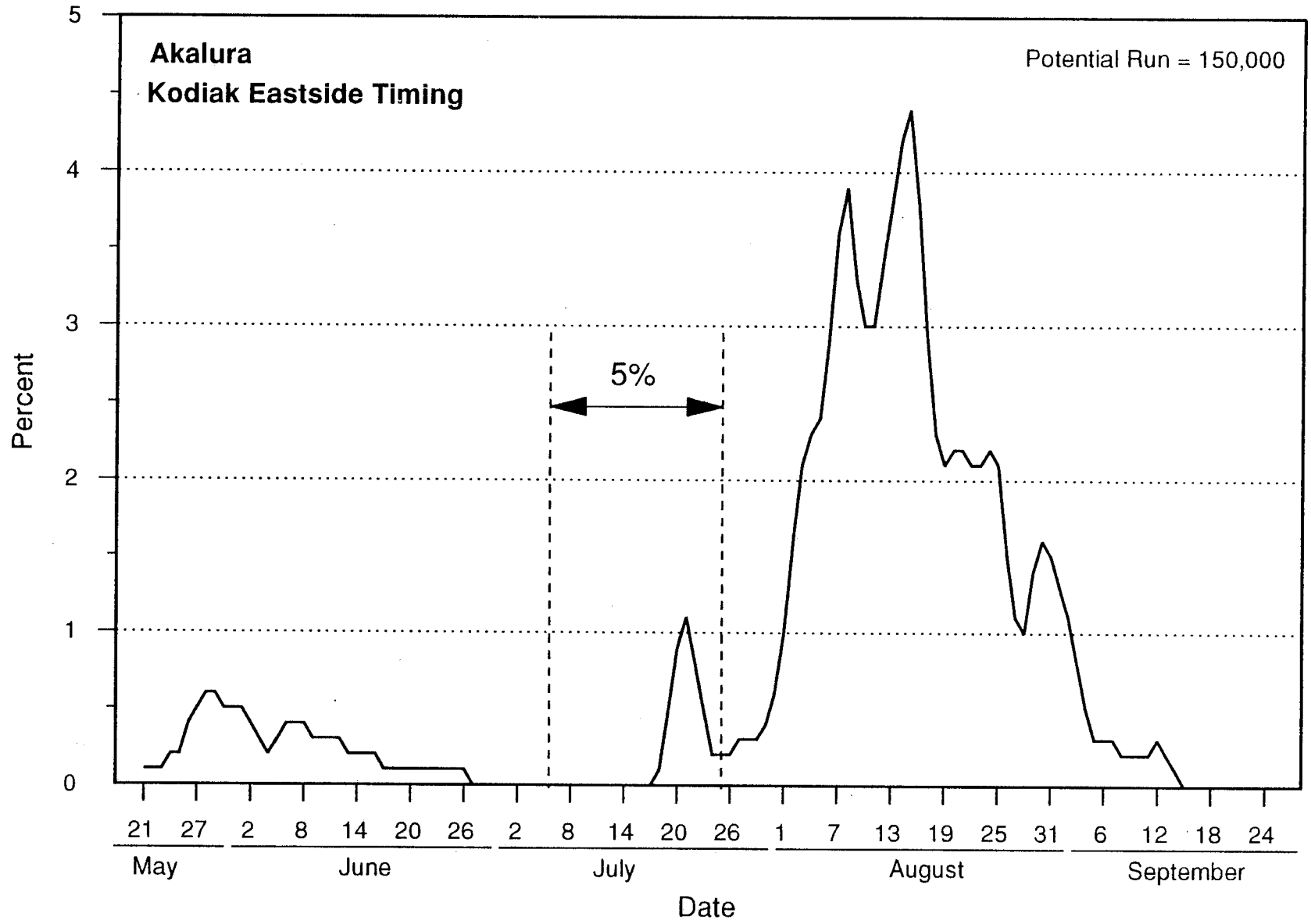
Appendix C.6. Estimated eastside Kodiak Island run timing for Karluk early and late run sockeye salmon, post 1983.



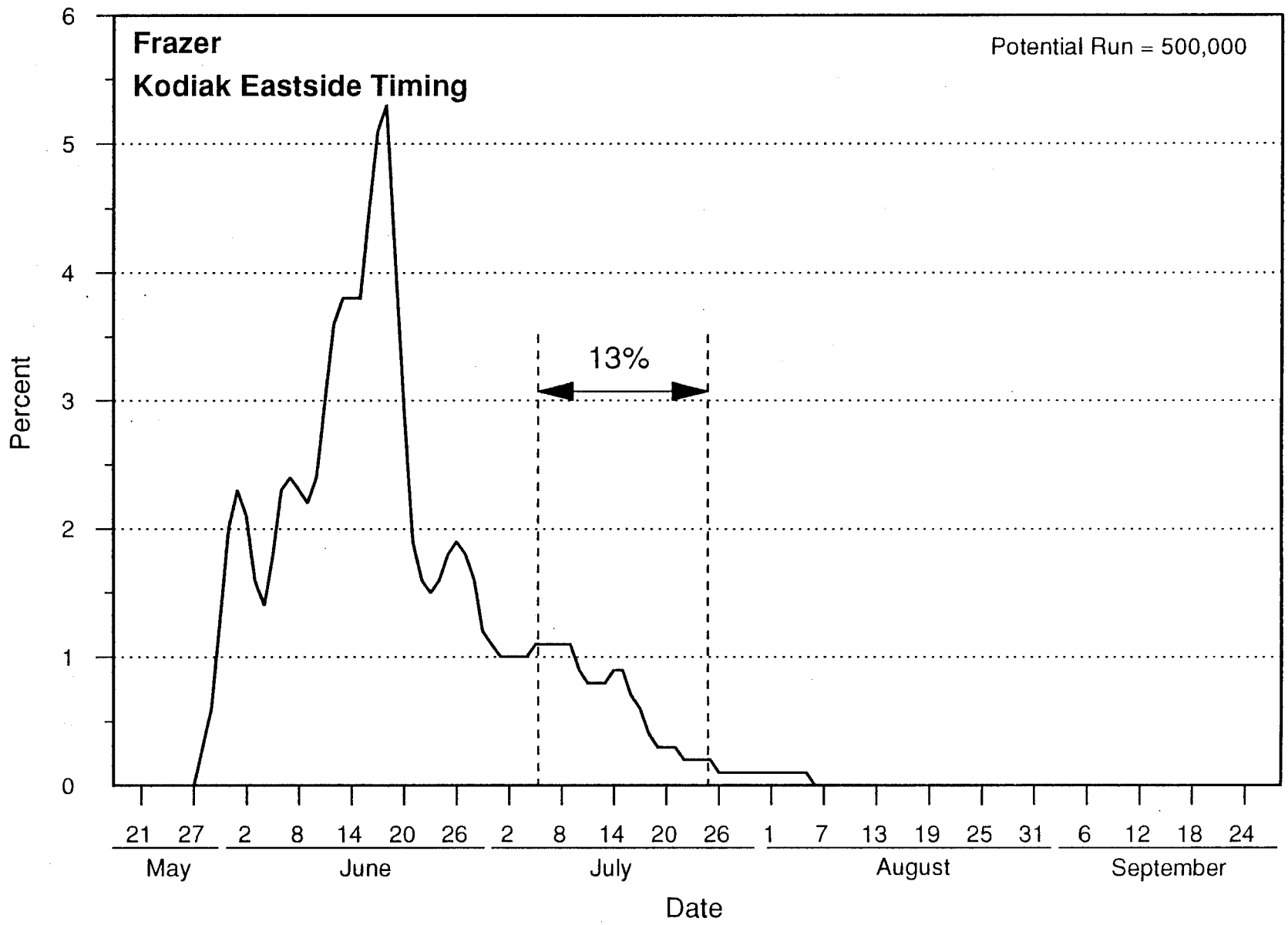
Appendix C.7. Estimated eastside Kodiak Island run timing for Ayakulik sockeye salmon, post 1983.



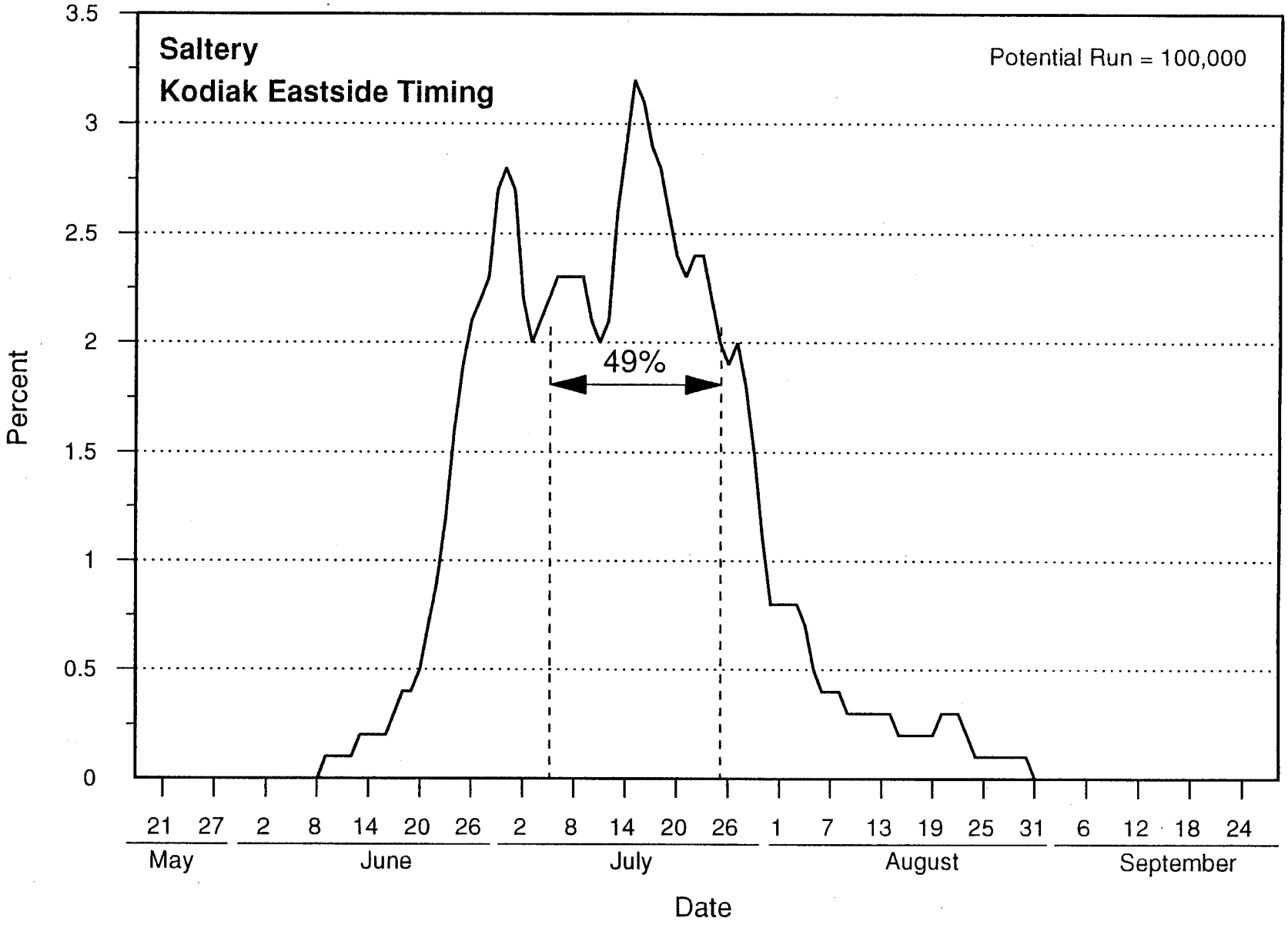
Appendix C.8. Estimated eastside Kodiak Island run timing for Upper Station early and late run sockeye salmon, post 1983.



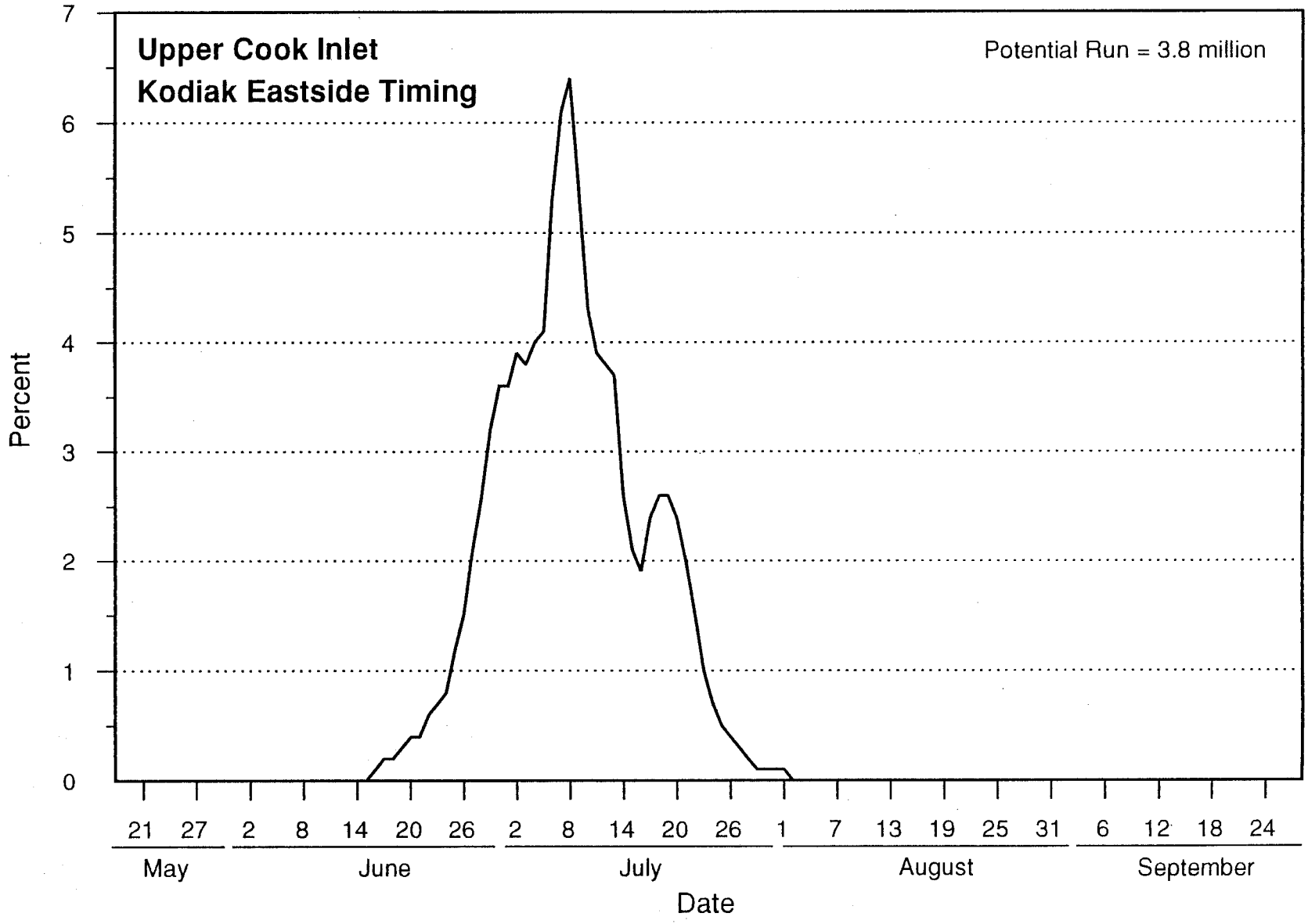
Appendix C.9. Estimated eastside Kodiak Island run timing for Akalura sockeye salmon, post 1983.



Appendix C.10. Estimated eastside Kodiak Island run timing for Frazer sockeye salmon, post 1983.



Appendix C.11. Estimated eastside Kodiak Island run timing for Saltery sockeye salmon, post 1983.



Appendix C.12. Estimated eastside Kodiak Island run timing for Upper Cook Inlet sockeye salmon, post 1983.

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