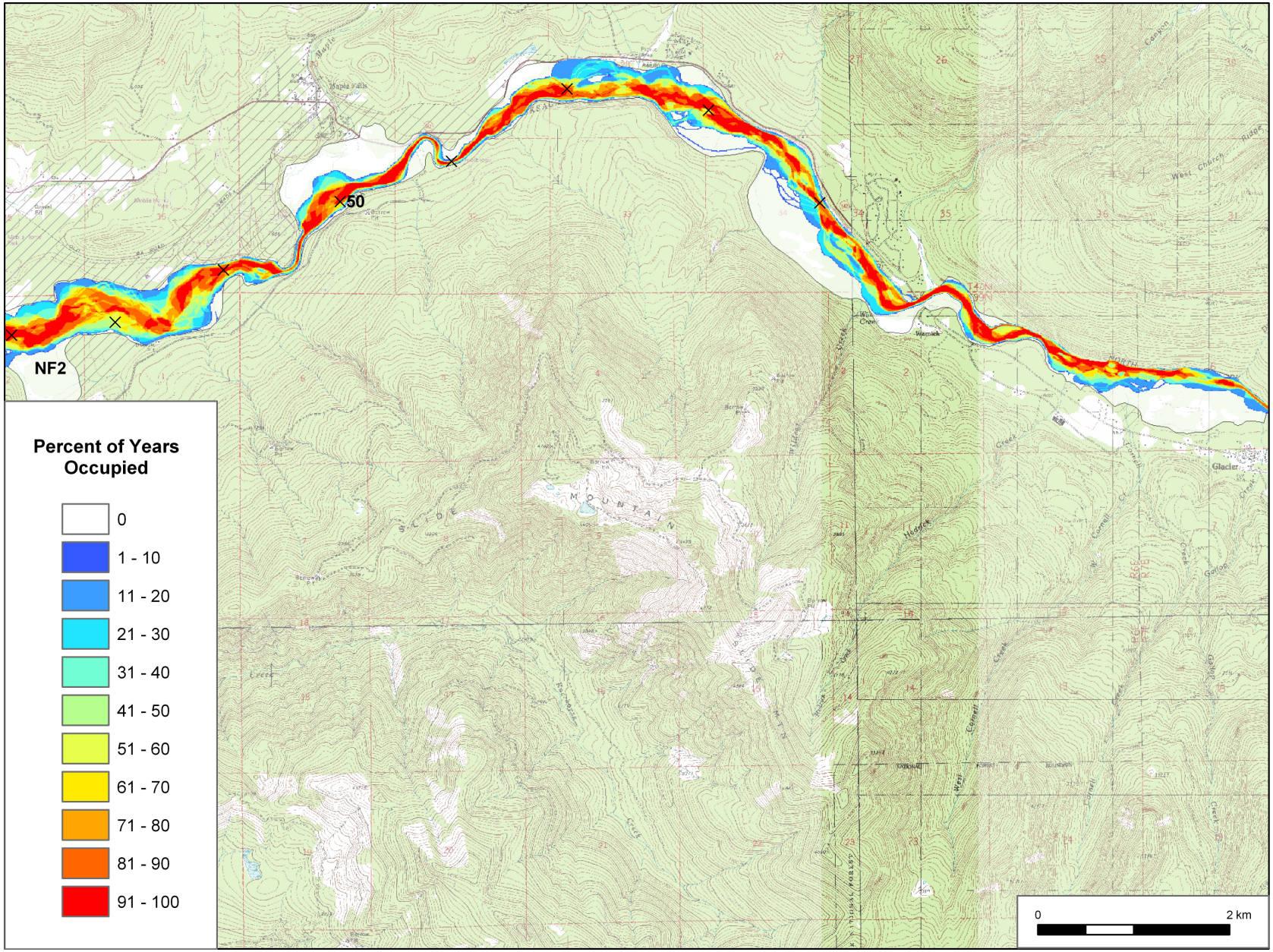
50
NF2
Percent of Years Occupied
0
1 - 10
11 - 20
21 - 30
31 - 40
41 - 50
51 - 60
61 - 70
71 - 80
81 - 90
91 - 100
0
2 km

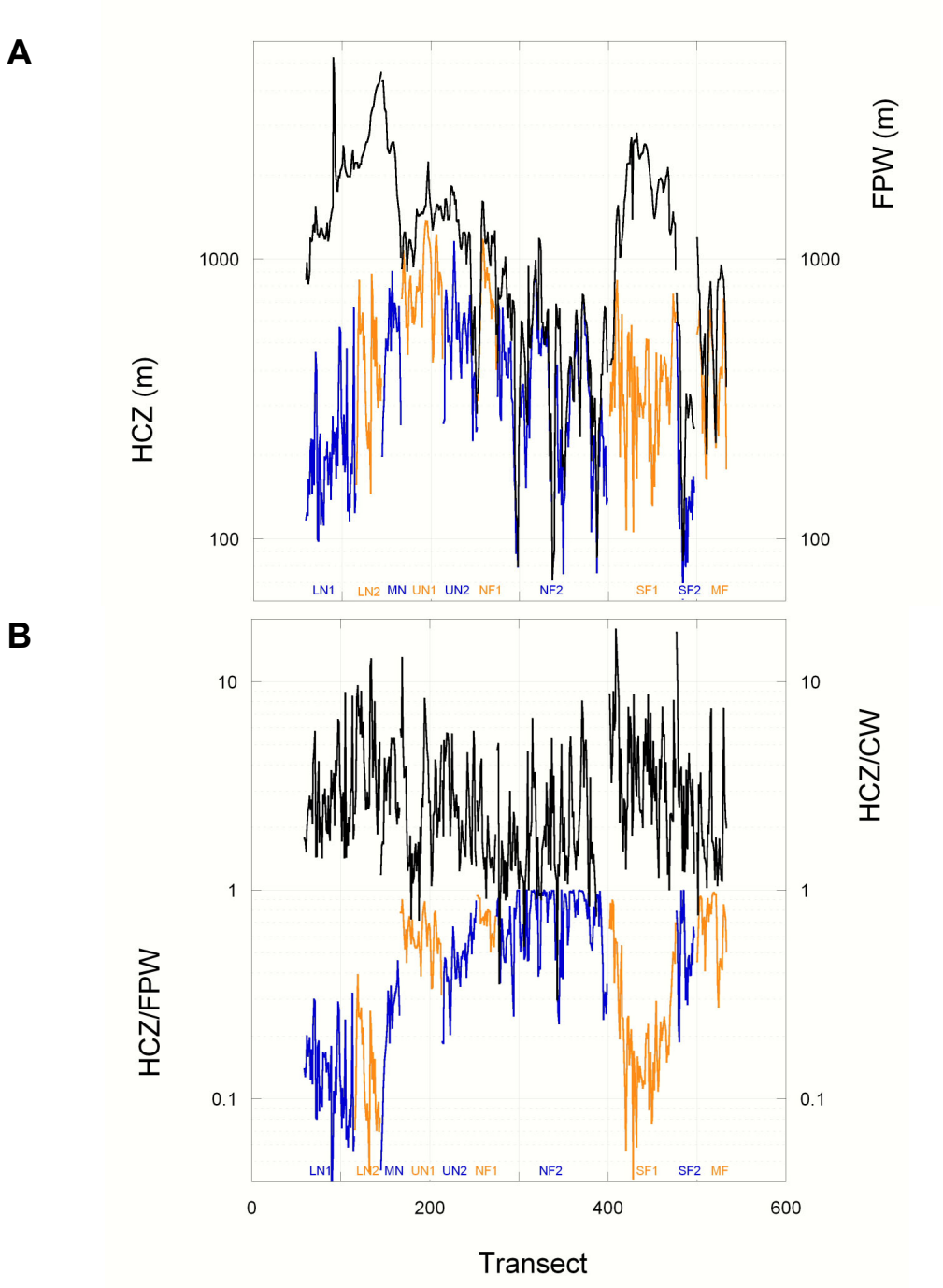

Figure 14. A: Floodplain width (upper, black line), and width of the historical channel zone (bottom line; segments are distinguished by alternating color), measured along transects, in meters. B: Ratio of the historical channel zone width to the floodplain width (upper, black line), and ratio of the historical channel zone width to the width of the active channel in 1998. The historical channel zone width includes channel positions for the period of record (1872-2002). Delta transects are excluded from both figures.

Table 6. Ratio between the width of the zone in which the channel has been located historically (HCZW) to the floodplain width (FPW) and to the channel width (CW) in 1998, averaged for study segments, and all in meters. The historical channel zone width (HCZW) is measured along transects and excludes floodplain sloughs; the 1998 channel width includes the low flow and high flow channels and is measured perpendicular to the 1998 channel at the intersection of transects. The ratios are dimensionless numbers; the HCZW/CW ratio is multiplied by 100 and expressed in percent for clarity. The two delta segments have been excluded.

SEGMENTS	HCZW (M)	FPW (M)	CW (M)	HCZW/FPW (PERCENT)	HCZW/CW
Lower Nooksack 1 (n=57)	219	1718	76	14.8	2.9
Lower Nooksack 2 (n=29)	432	3094	90	15.1	5.2
Middle Nooksack (n=22)	538	2546	172	24.3	3.3
Upper Nooksack 1 (n=47)	843	1374	378	61.4	3.0
Upper Nooksack 2 (n=39)	538	1215	215	47.7	2.9
North Fork 1 (n=82)	748	1053	461	73.5	1.9
North Fork 2 (n=125)	350	502	221	73.9	2.1
South Fork 1 (n=96)	374	1776	108	26.2	4.4
South Fork 2 (n=20)	161	327	51	53.7	3.7
Middle Fork (n=34)	412	624	222	70.4	2.3

SUMMARY

(1) We divided the study area into twelve segments having similar valley morphologies, river dynamics, and historical channel migration rates. We delineated the floodplain using published geological mapping and by use of a DEM made from Whatcom Public Works elevation data. The floodplains of the lower Nooksack and the South Fork are in broad, glacially influenced valleys. The upper Nooksack, and the upper parts of the North Fork and South Fork are relatively narrow and bounded by mountainsides. The widths of the floodplains of the three forks are narrowed in two locations by two large Holocene landslides (in the North Fork at RM 44 and the South Fork near the North Fork confluence), and bounded elsewhere by Holocene fluvial and Pleistocene glacio-fluvial terraces (North Fork and South Fork) and lahar terraces (Middle Fork). The meandering lower Nooksack River (RM 6-RM 20) has built a narrow meander belt several meters higher than the rest of the valley. The valley bottom of the historically anastomosing and currently braided upper Nooksack (RM 24-RM 37) has a "corrugated" cross-valley profile associated with multiple channels and sloughs. The other segments are generally similar in channel pattern and cross-valley topography to the upper Nooksack River, except for much of the South Fork, which combines characteristics of both the upper and lower Nooksack.

(2) The estimates of the "average annual migration rate" in this, and other studies, must be considered in light of an unavoidable methodological bias: the longer the time period between map or photo records, the more likely the estimate is to underestimate the actual average annual rate. This tendency is likely much greater in segments characterized by channel-switching type avulsion than in segments characterized by meander migration.

(3) Average annual migration rates varied greatly within the study area, being lowest in the delta (exclusive of several distributary channel avulsions) and the lower Nooksack (RM 6-RM 20), which were characterized by small amounts of meander migration, averaging only about 1 m/yr in the delta and lower part of the lower Nooksack (RM 6-RM 15) and about 4 m/yr in the upper part of the lower Nooksack

(RM 15-RM 20). Rates were also relatively low in the South Fork, averaging 5 m/yr (in the segment downstream of the canyon, SF RM 0-SF RM 13), and 3 m/yr (4 m/yr since 1933) in the South Fork canyon (SF RM 13-SF RM 16). In contrast, rates in the upper Nooksack (RM 24-RM 37), and especially the lower part of the upper Nooksack (RM 24-RM 31) were much higher, averaging 13 m/yr for the entire period of record, or 17 m/yr for the period since 1933. Rates were also high in the lower North Fork (RM 37-RM 40), averaging 13 m/yr for the entire period of record, or 18 m/yr for the period since 1933. The upper North Fork (RM 40-RM 58) and the Middle Fork had rates of 7 m/yr (8 m/yr and 9 m/yr for the post-1933 period, respectively). The variation in rate among these different segments is reduced when rates are normalized by the channel width in each segment.

(4) While migration in some segments was greater in some time increments than in other time increments, there were few systematic trends in migration rate through time in the various segments. Greater rates earlier in the record in the delta reflect individual distributary avulsion events. An overall reduction in rate in the lower part of the lower Nooksack segment (RM 6-RM 24) may reflect the effects of levee building in this segment, but the rates have been low throughout the period of record, averaging 2-3 m/yr in individual time increments prior to 1933 (and prior to widespread or effective levees) and 0-2 m/yr in increments after 1933. Lateral migration in the Middle Fork has systematically increased through time.

(5) There is a very large variation among segments in the amount of the floodplain the channel has historically used. The historical channel zone is only about one-seventh (15%) of the floodplain width in the lower Nooksack, while it is about three-fourths (74%) in the North Fork. The channel has also used a relatively large portion of the Middle Fork and upper Nooksack, and a relatively small percentage of the South Fork. There is also variation among segments in the ratio of the historical channel zone and the active channel width, which is between about two and five channel widths in the different segments, a reflection of variation in channel size and variation in the nature of the migration and avulsion processes.

ACKNOWLEDGMENTS

This project was completed under contract with the Whatcom County Public Works Department and coordinated by Paul Pittman of the Public Works Department. We thank Jeremy Bunn, Isabelle Sarakhan, Soleil Kelley, and Charles Kiblinger for digitizing assistance, and Charles Kiblinger for orthorectifying photos used in this study. Most source materials used in this analysis (georeferenced T-sheets and GLO plat maps, and orthorectified, mosaiced aerial photos) are available online at http://riverhistory.ess.washington.edu. This project is a contribution of the Puget Sound River History Project, supervised by Dr. David Montgomery, in the Quaternary Research Center and Department of Earth & Space Sciences at the University of Washington. More information on the Puget Sound River History Project can be found at http://riverhistory.ess.washington.edu.

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