

APPENDIX D

Habitat:Flow Relationships and Time Series Analysis

APPENDIX D1

Weighted Useable Area (ft²/1000 ft) Versus Flow (cfs) Relationships for Target Fish Species for Upper and Lower Study Sites within Three Operational Reaches of the Sultan River, Washington

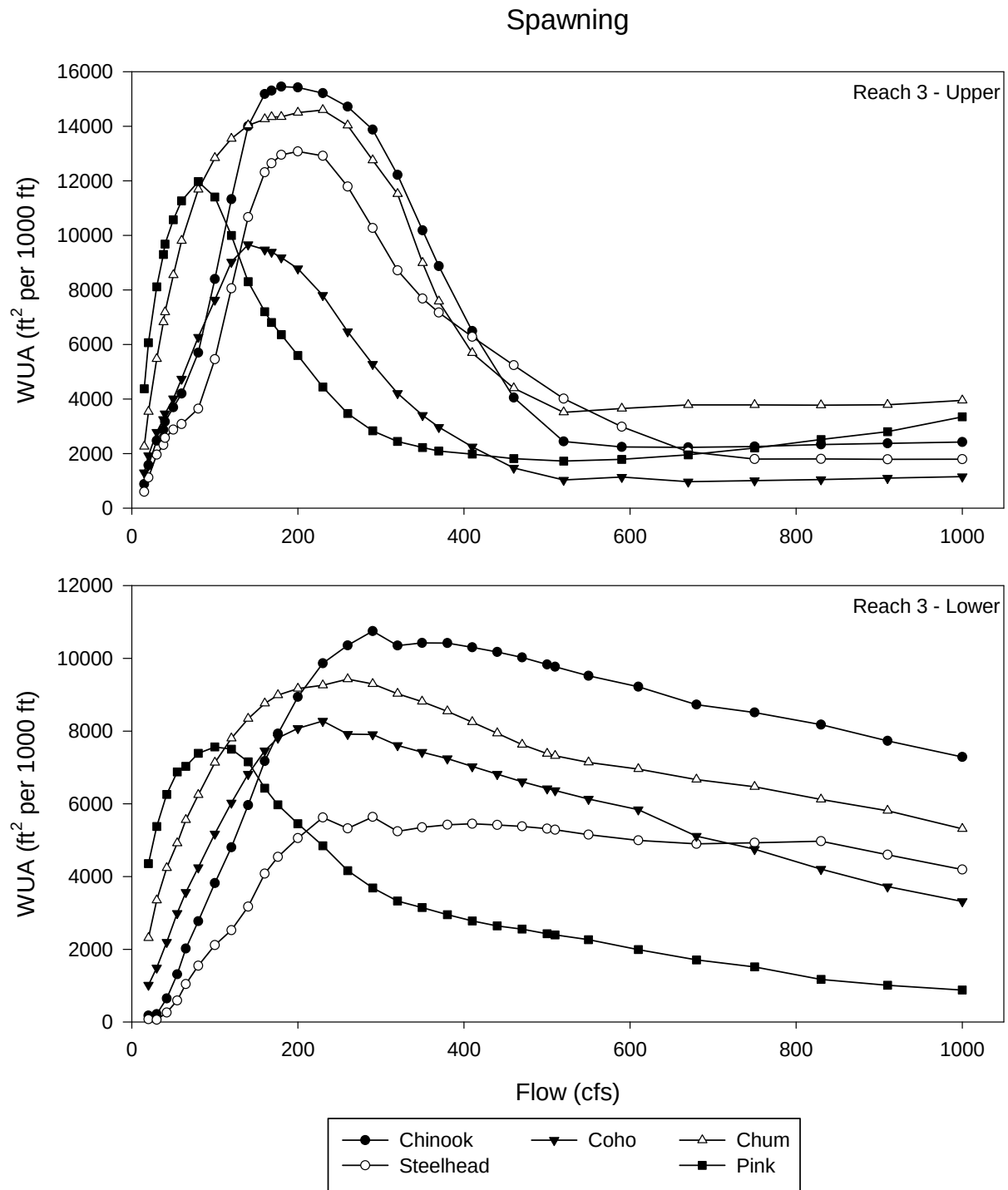


Figure D1-1. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook and coho salmon and steelhead trout spawning habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

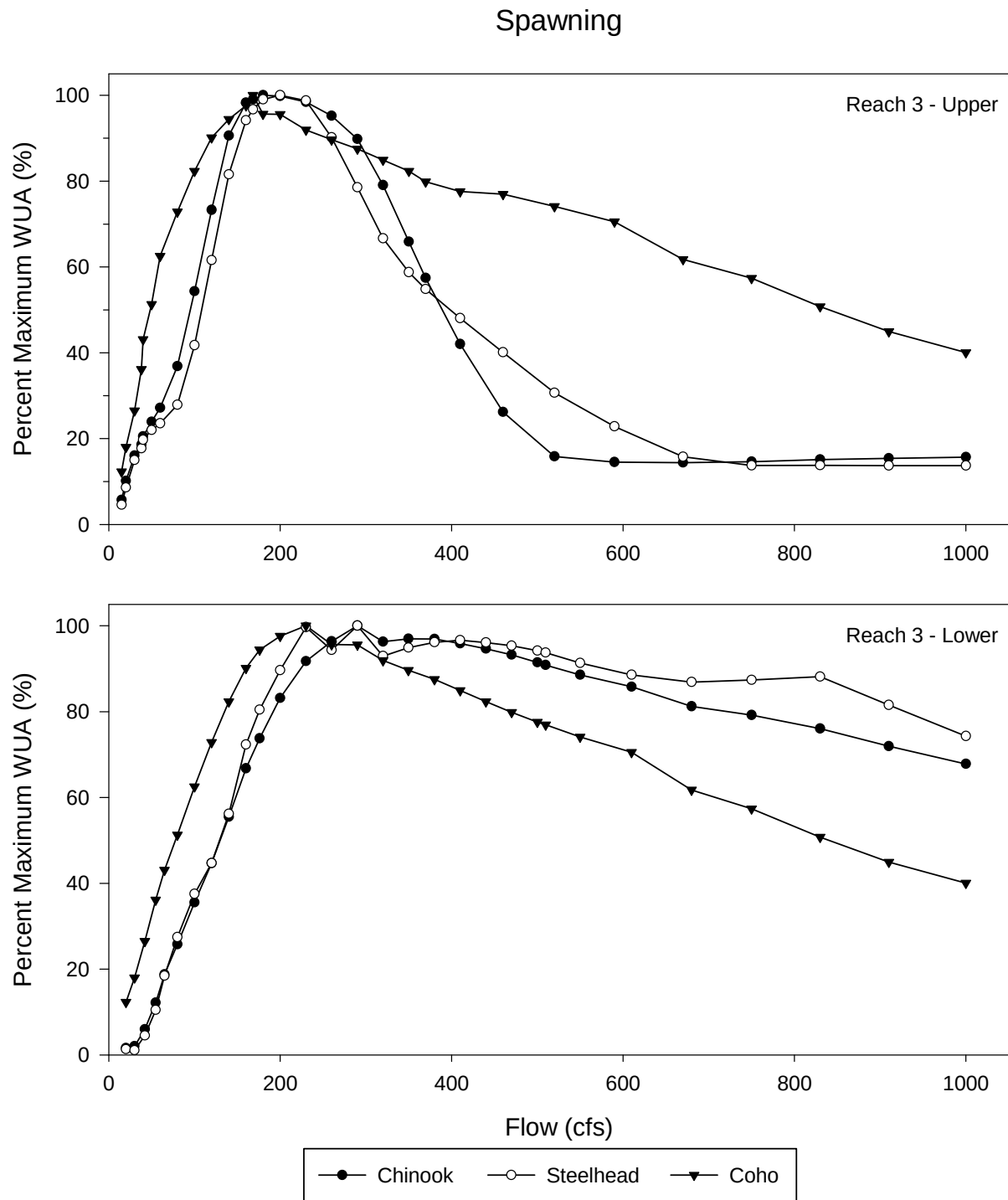


Figure D1-2. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook and coho salmon and steelhead trout spawning habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

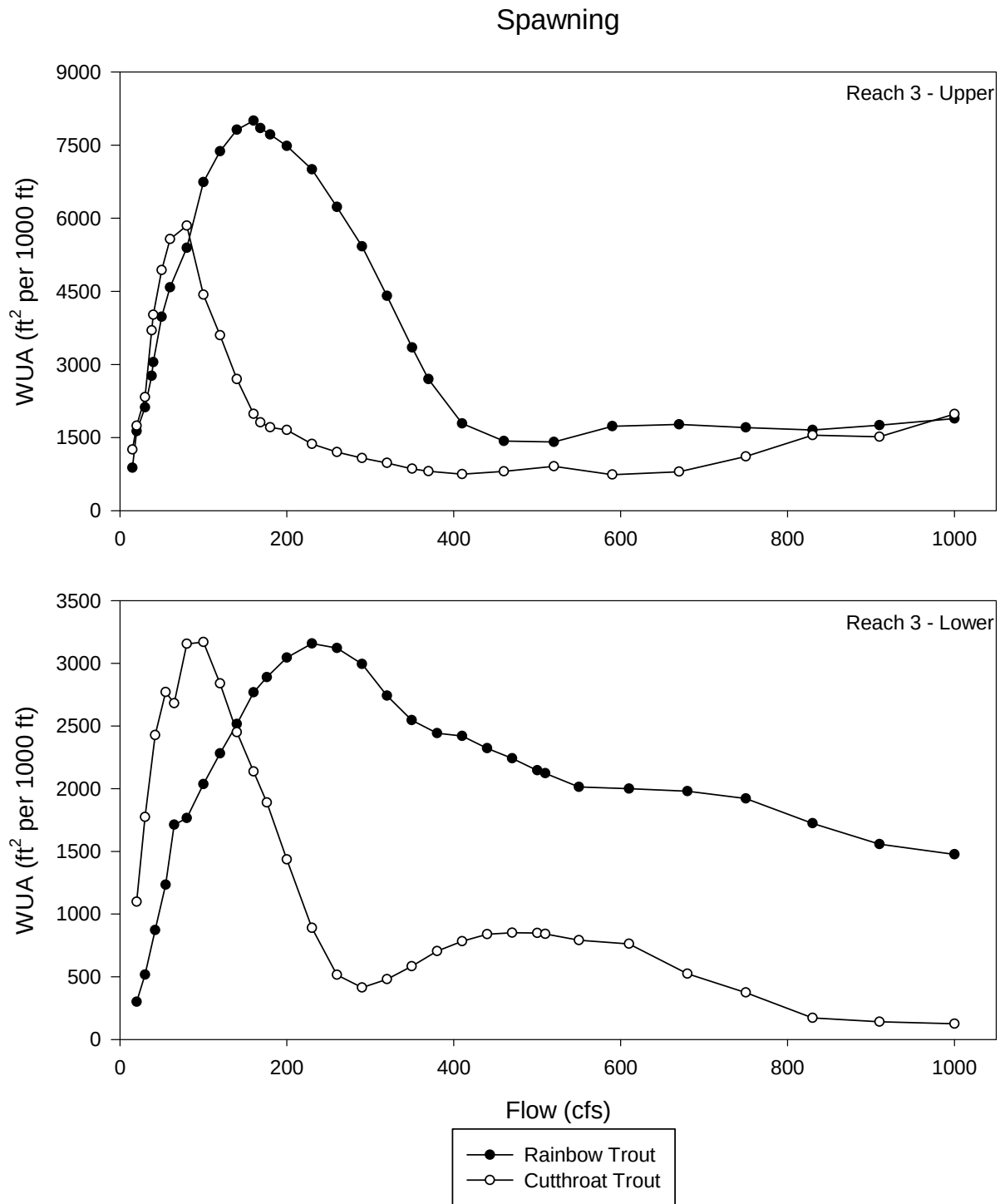


Figure D1-3. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

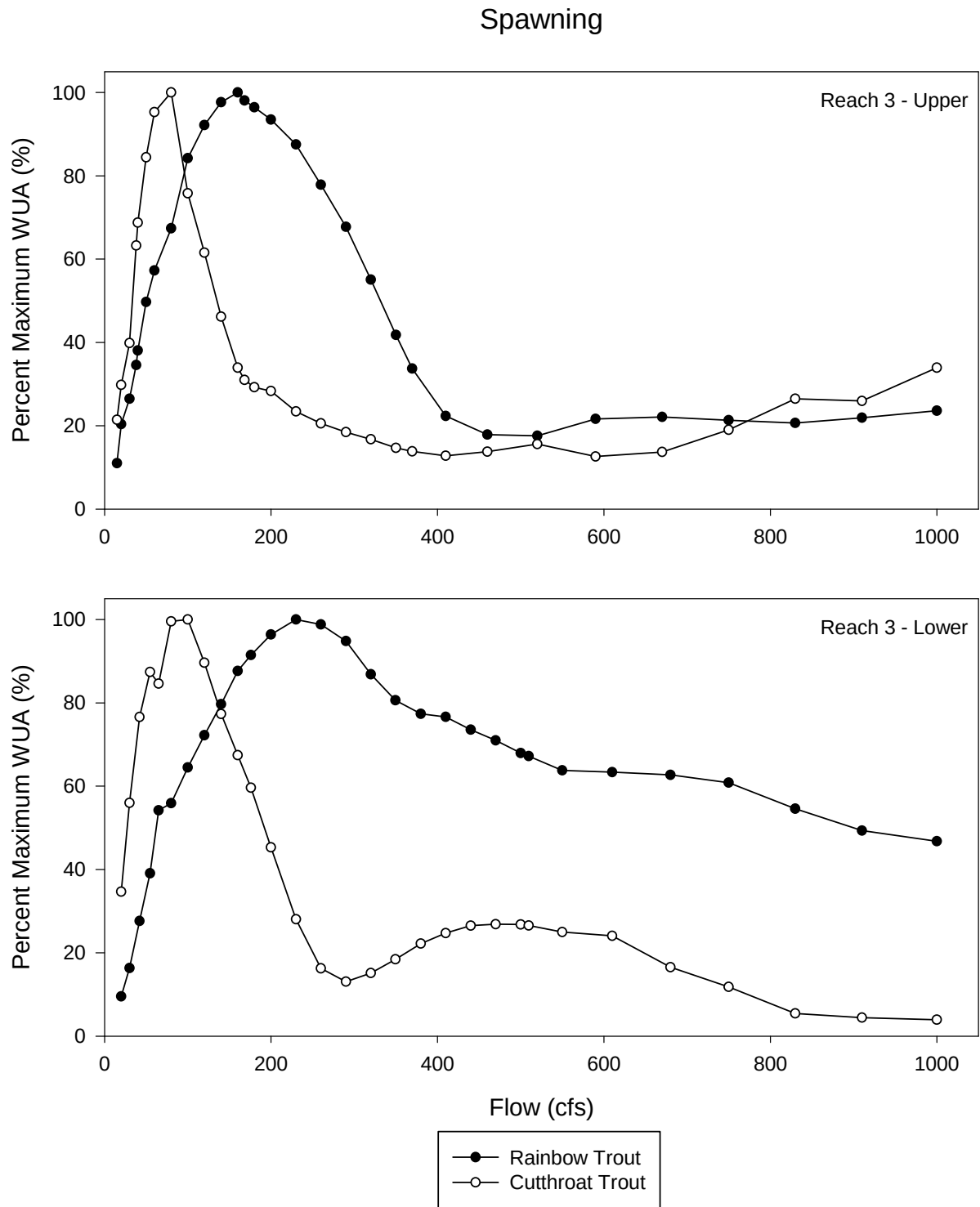


Figure D1-4. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

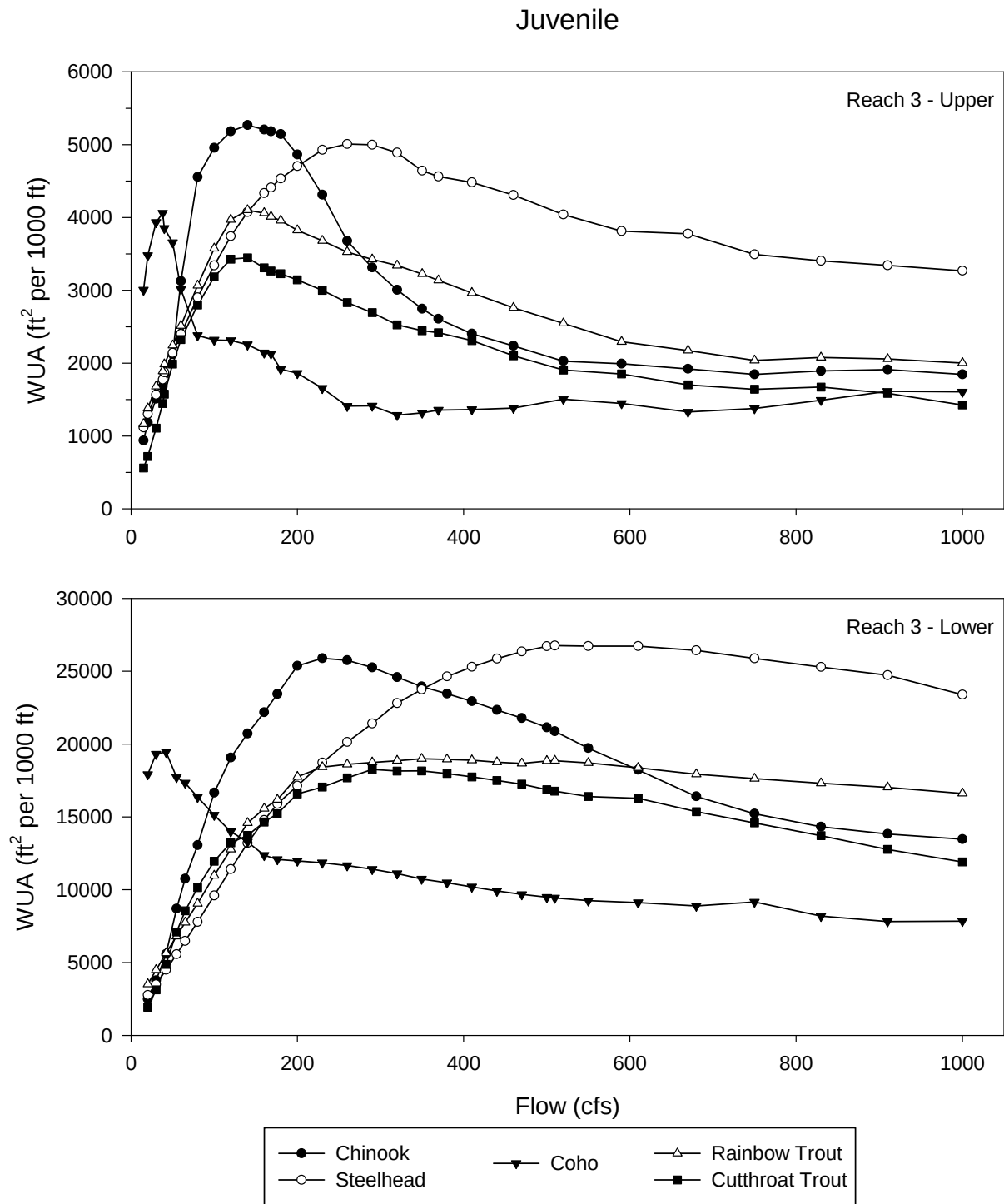


Figure D1-5. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook and coho salmon and steelhead, rainbow and cutthroat trout juvenile habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

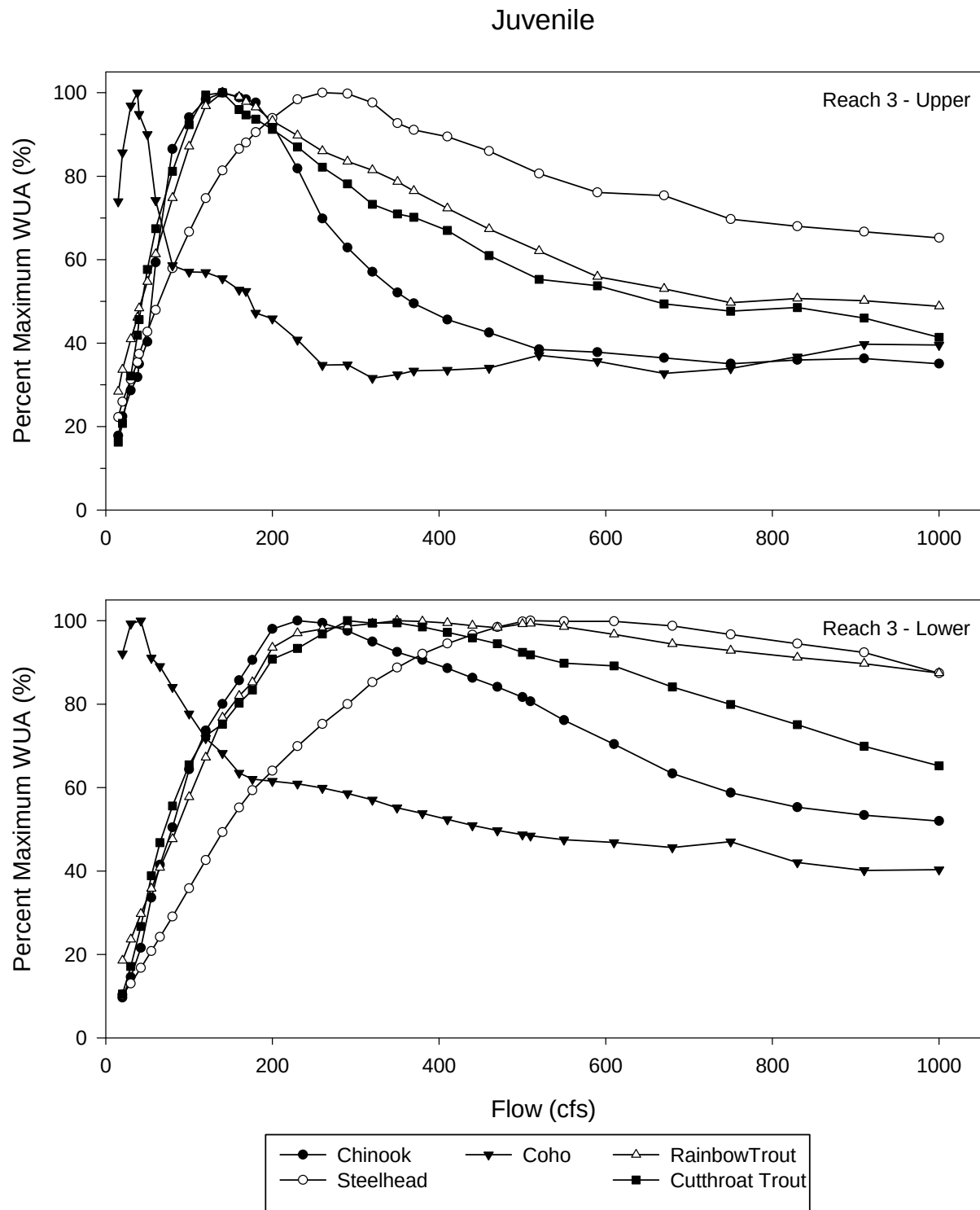


Figure D1-6. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook and coho salmon and steelhead, rainbow and cutthroat trout juvenile habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

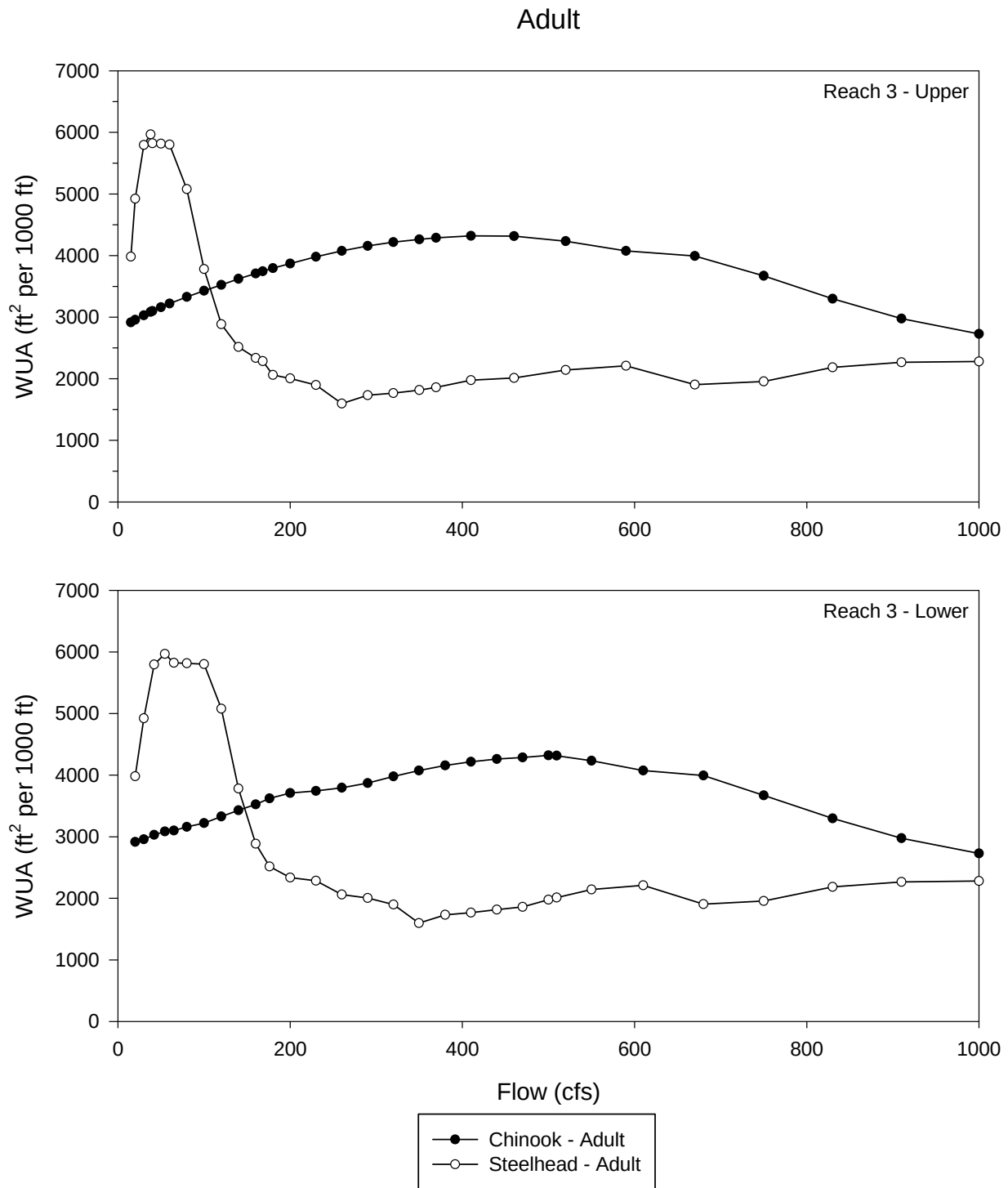


Figure D1-7. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

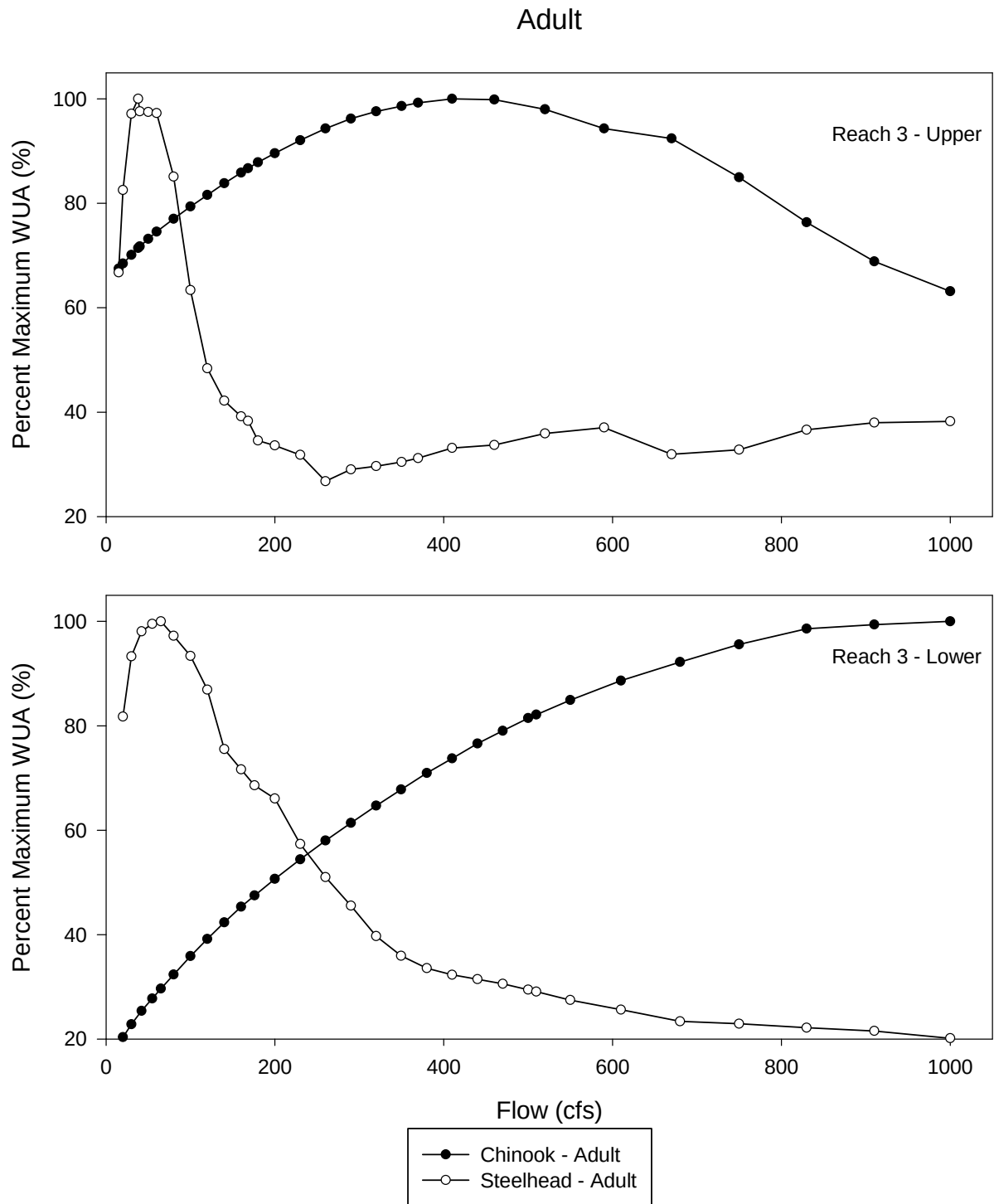


Figure D1-8. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat as defined for the Upper and Lower study sites within Reach 3 of the Sultan River, Washington (see Figure 3-1 for reach locations).

Spawning

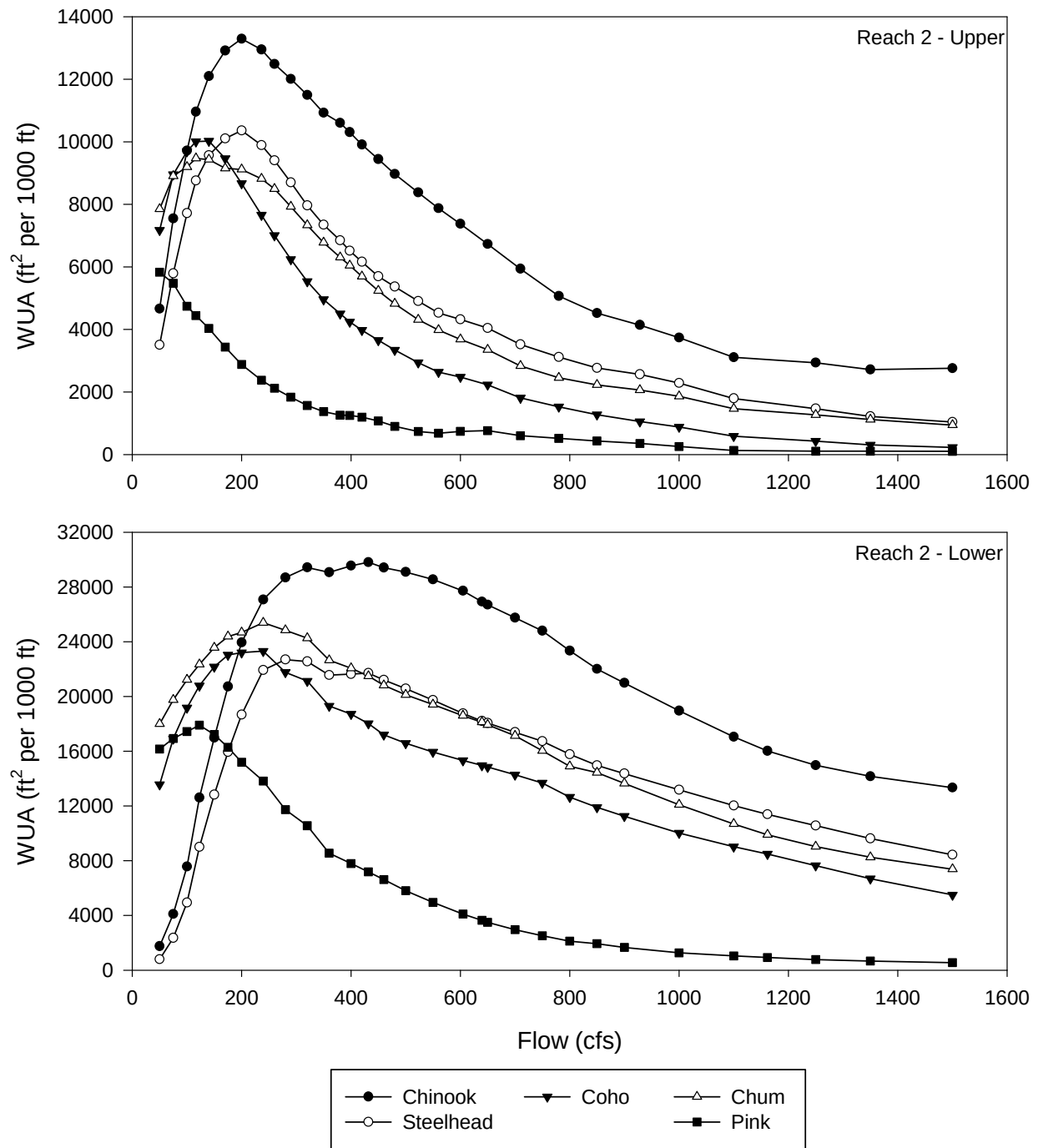


Figure D1-9. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook, coho, chum and pink salmon and steelhead trout spawning habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

Spawning

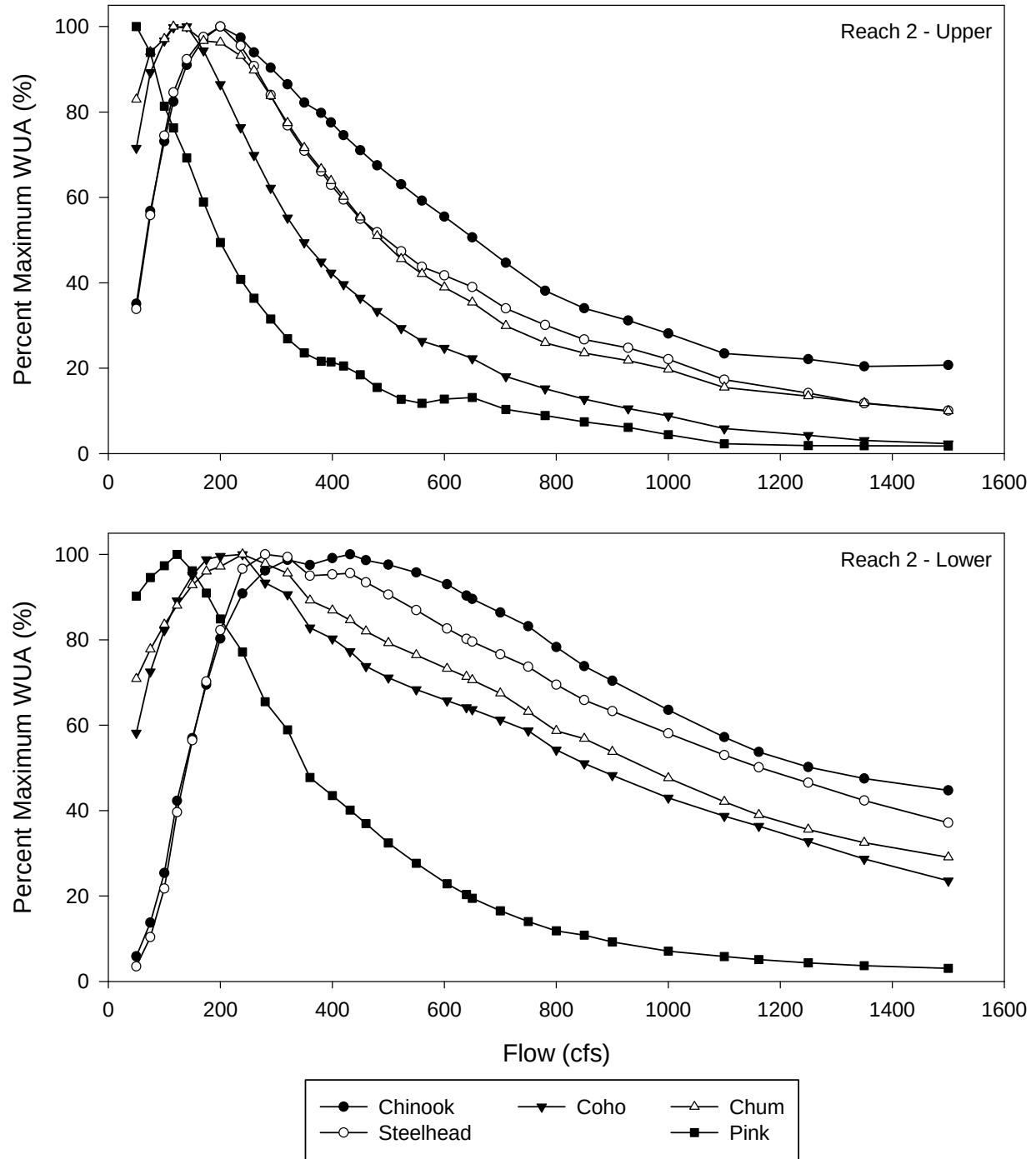


Figure D1-10. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook, coho, chum and pink salmon and steelhead trout spawning habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

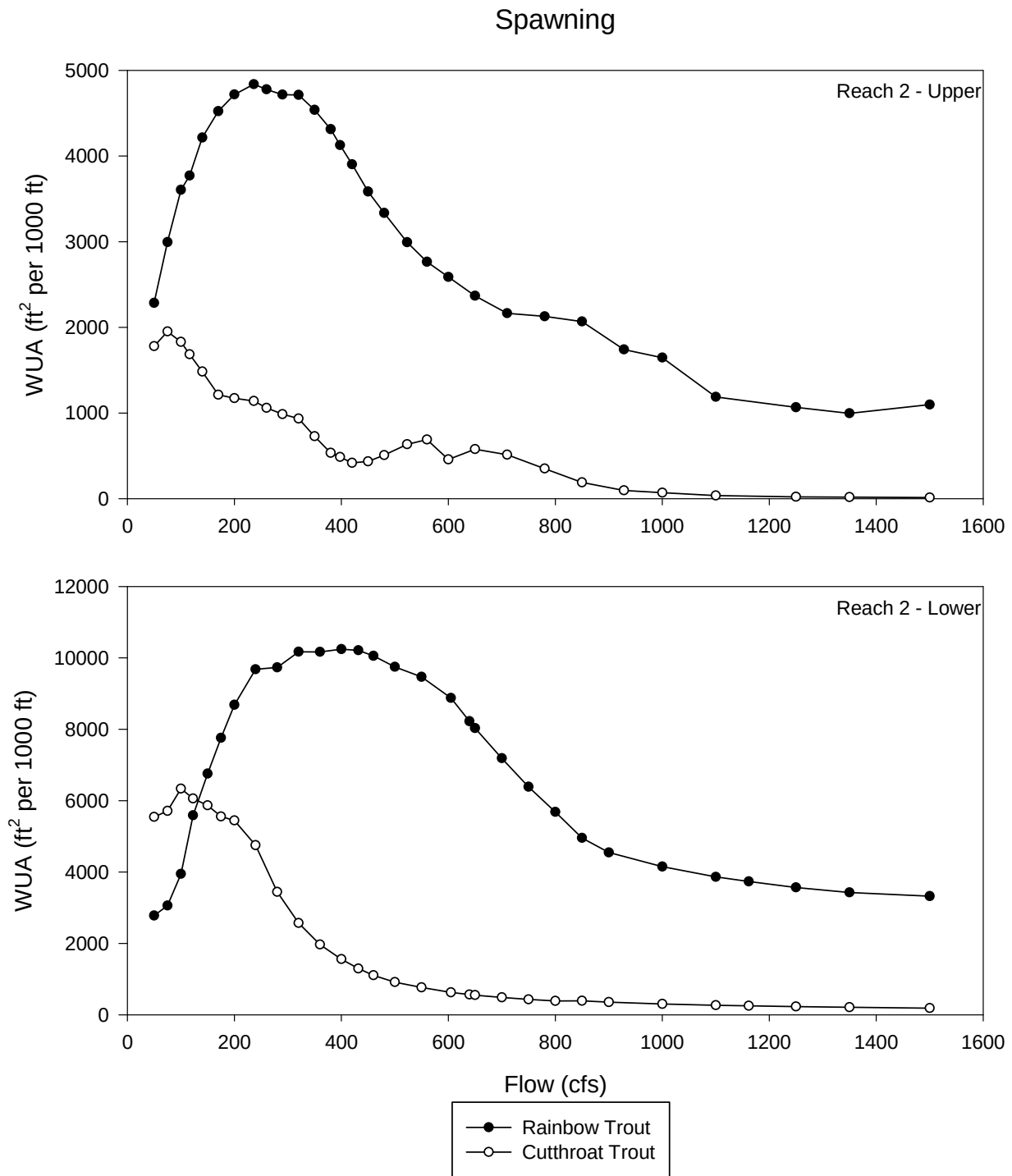


Figure D1-11. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

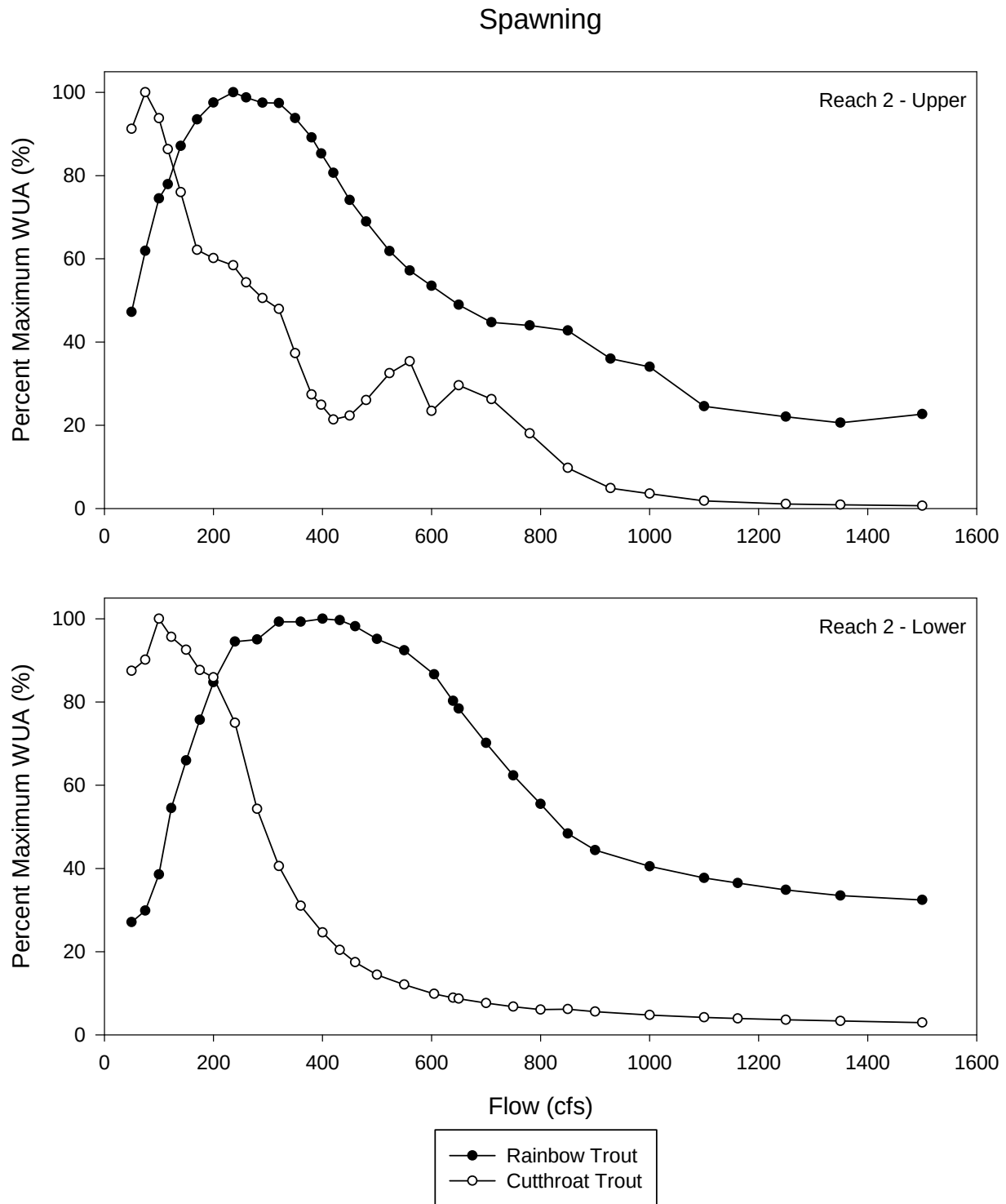


Figure D1-12. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

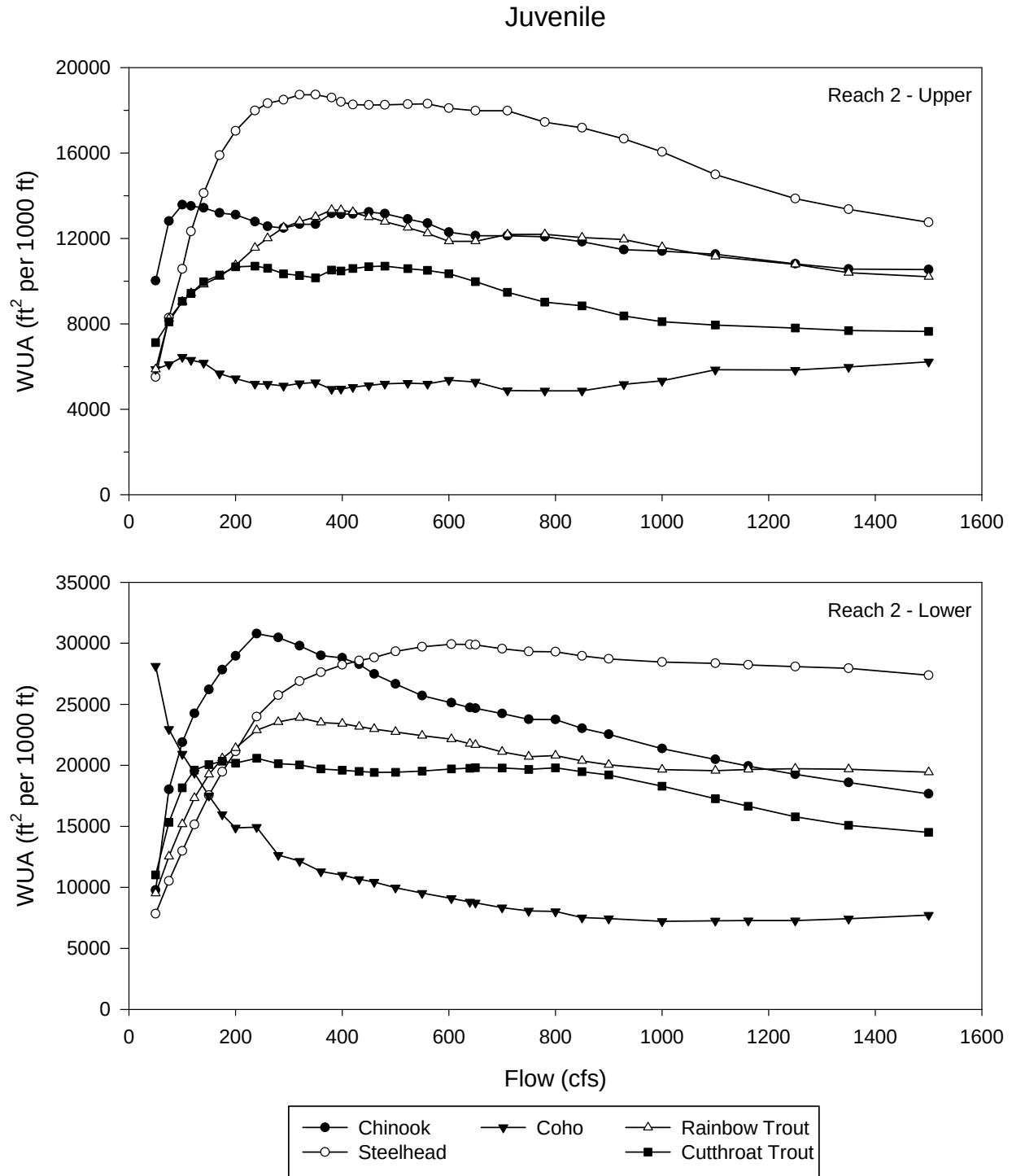


Figure D1-13. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook and coho salmon and steelhead, rainbow and cutthroat trout juvenile habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

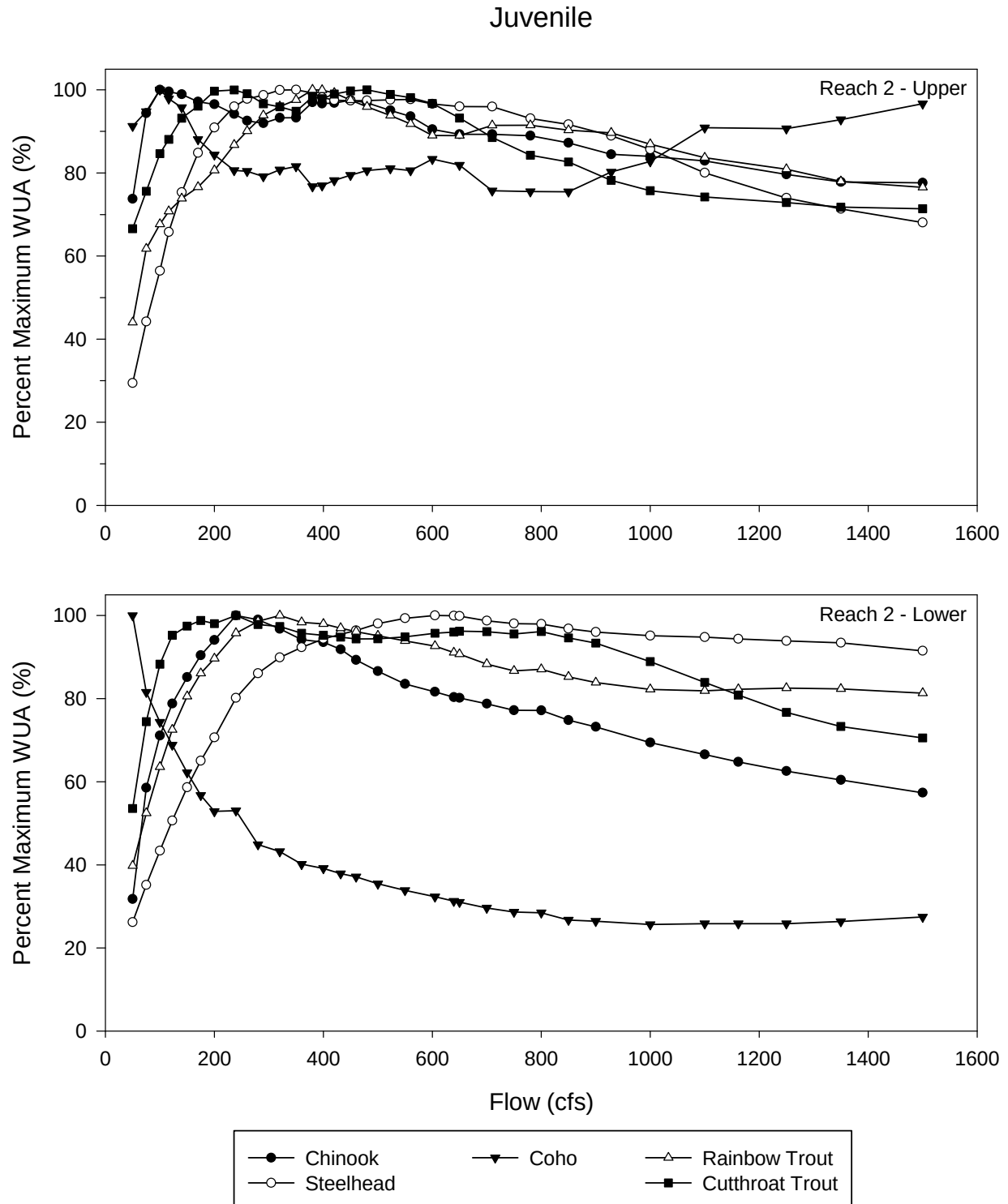


Figure D1-14. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook and coho salmon and steelhead, rainbow and cutthroat trout juvenile habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

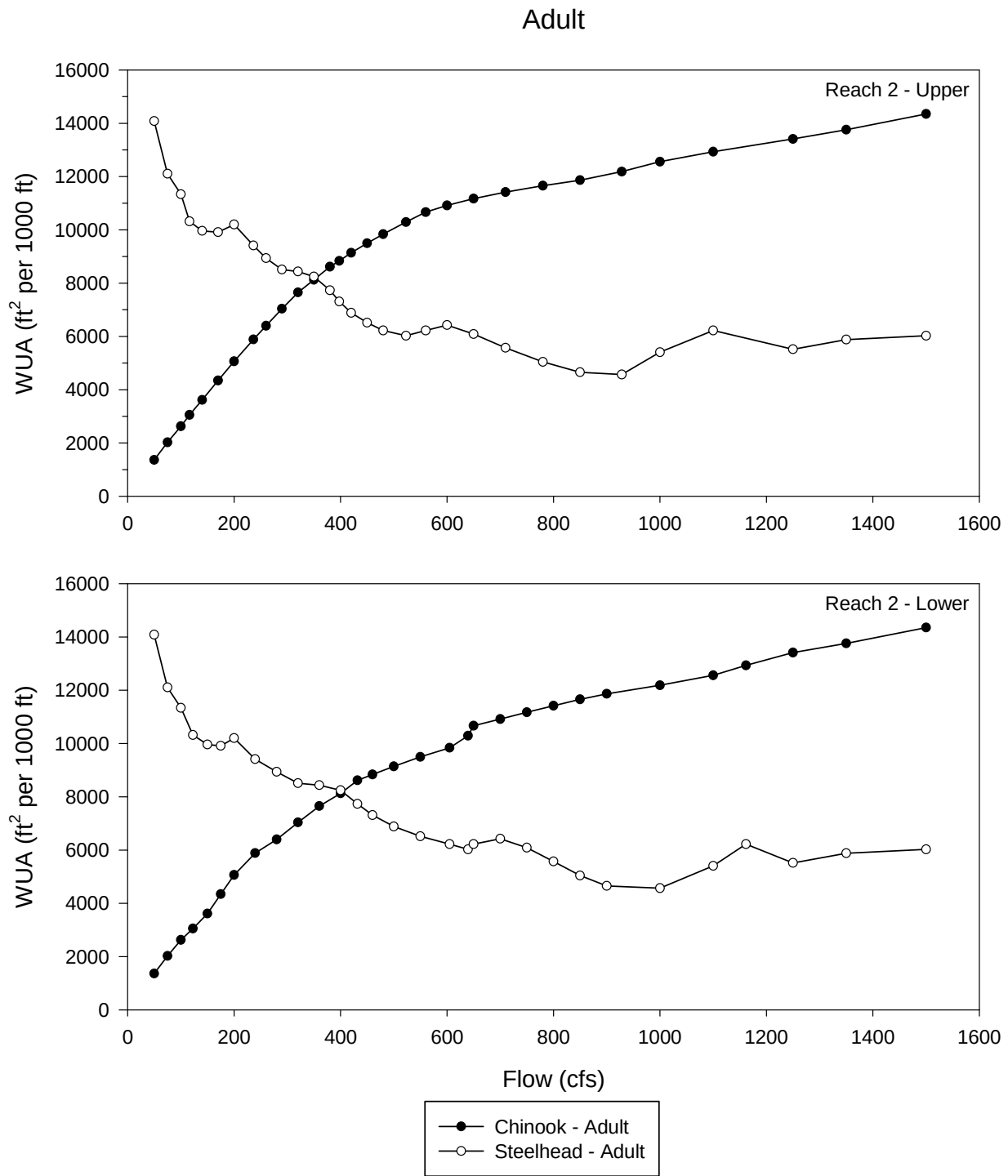


Figure D1-15. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

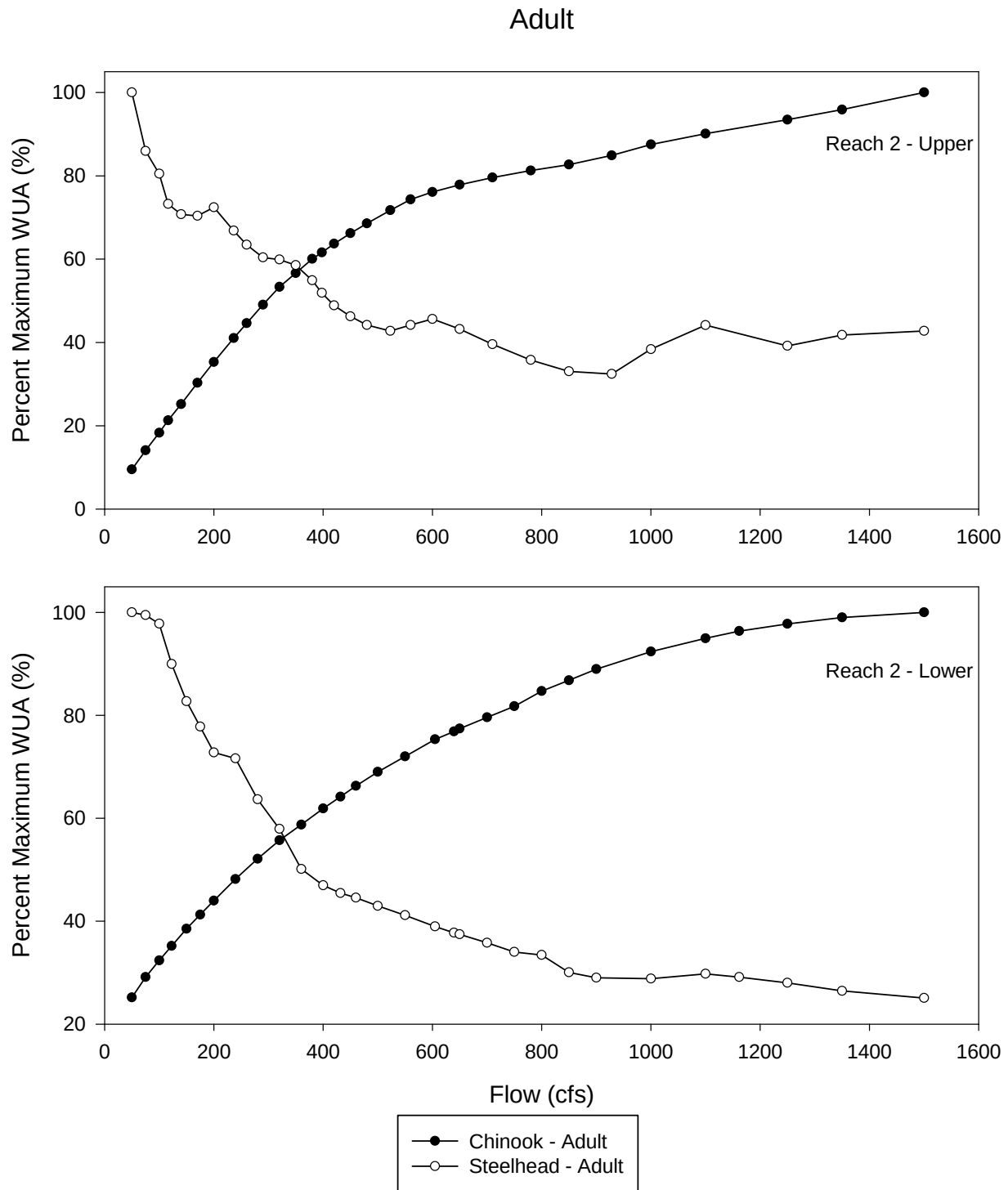


Figure D1-16. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat as defined for the Upper and Lower study sites within Reach 2 of the Sultan River, Washington (see Figure 3-1 for reach locations).

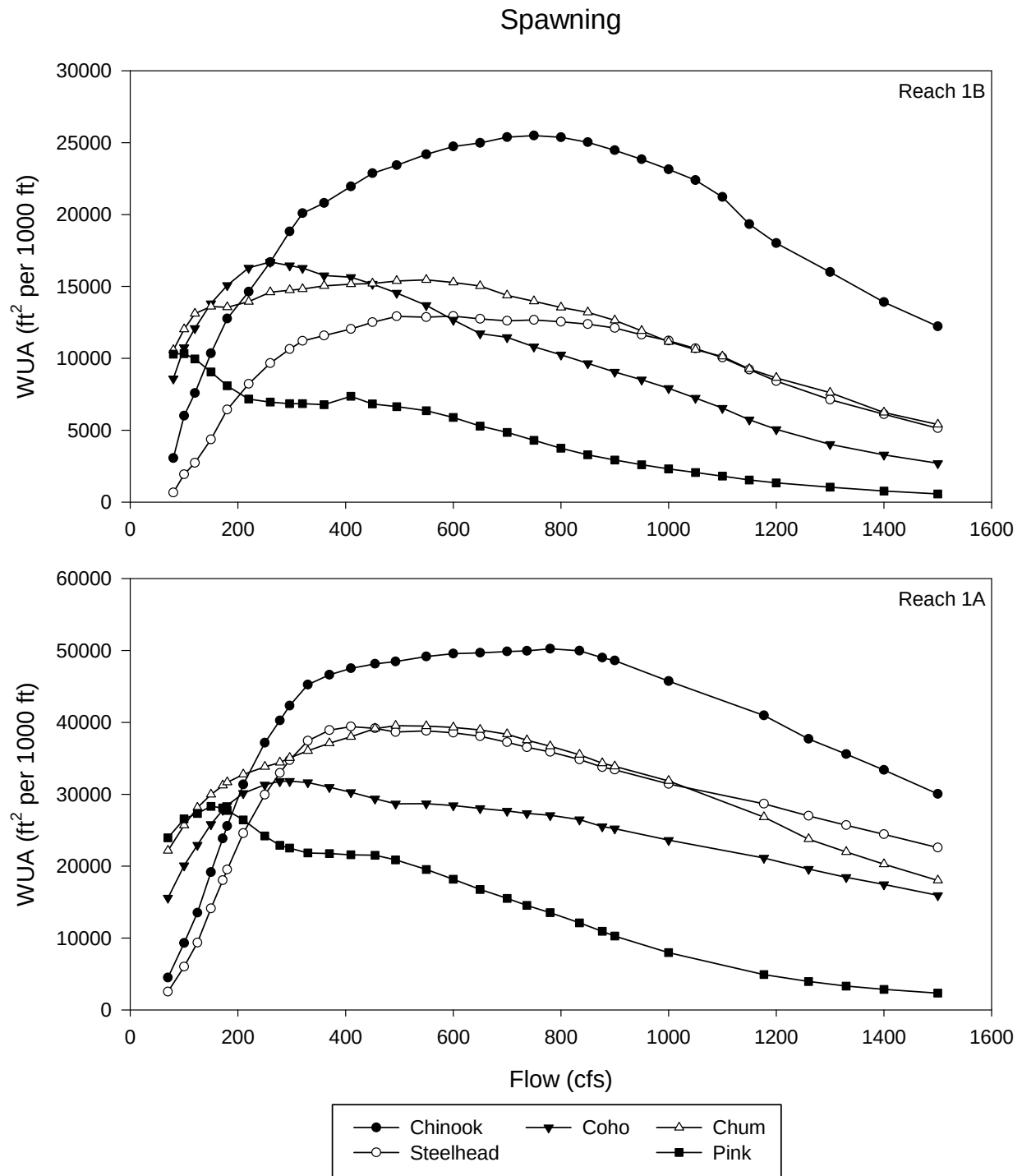


Figure D1-17. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook, coho, chum and pink salmon and steelhead trout spawning habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

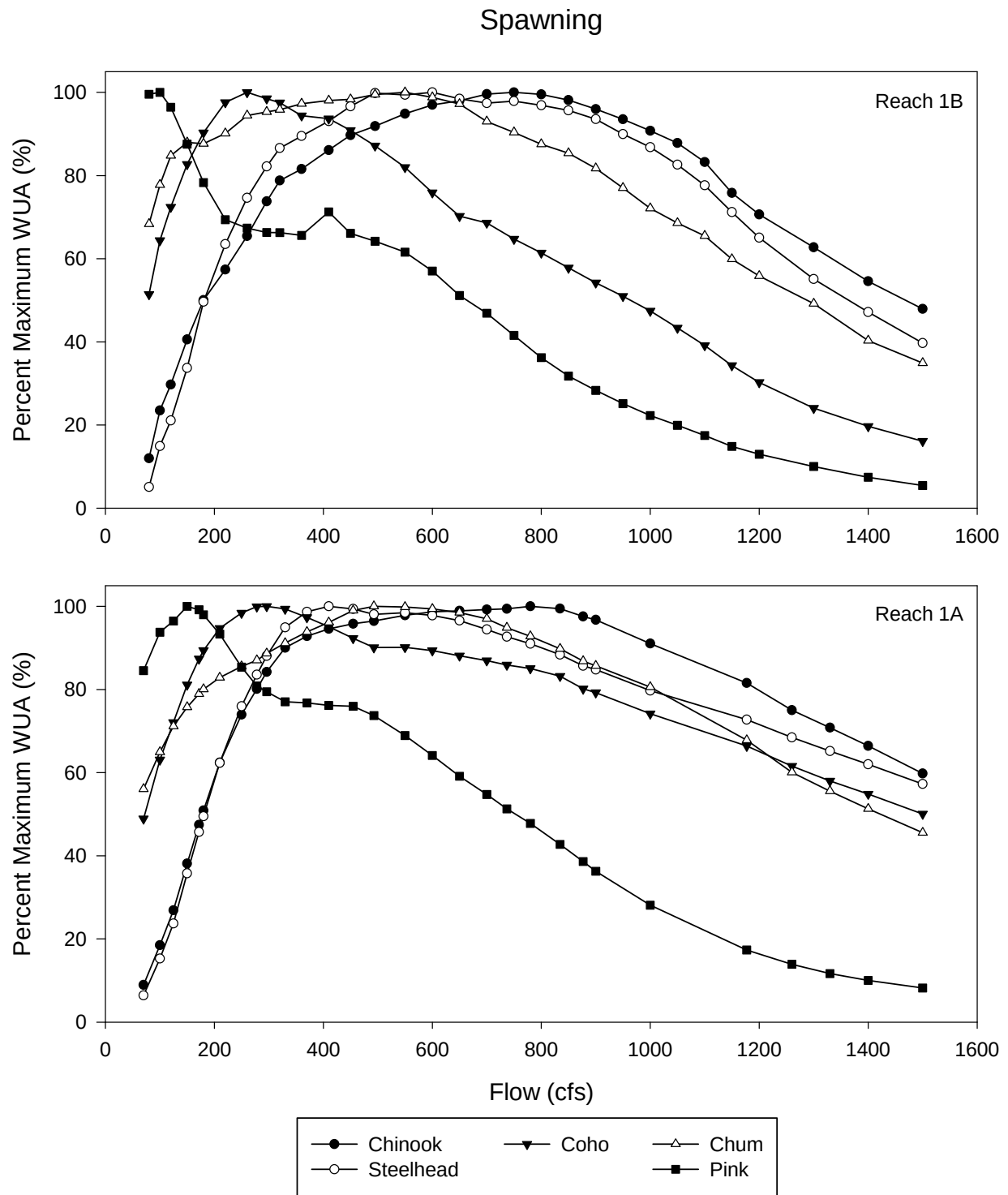


Figure D1-18. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook, coho, chum and pink salmon and steelhead trout spawning habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

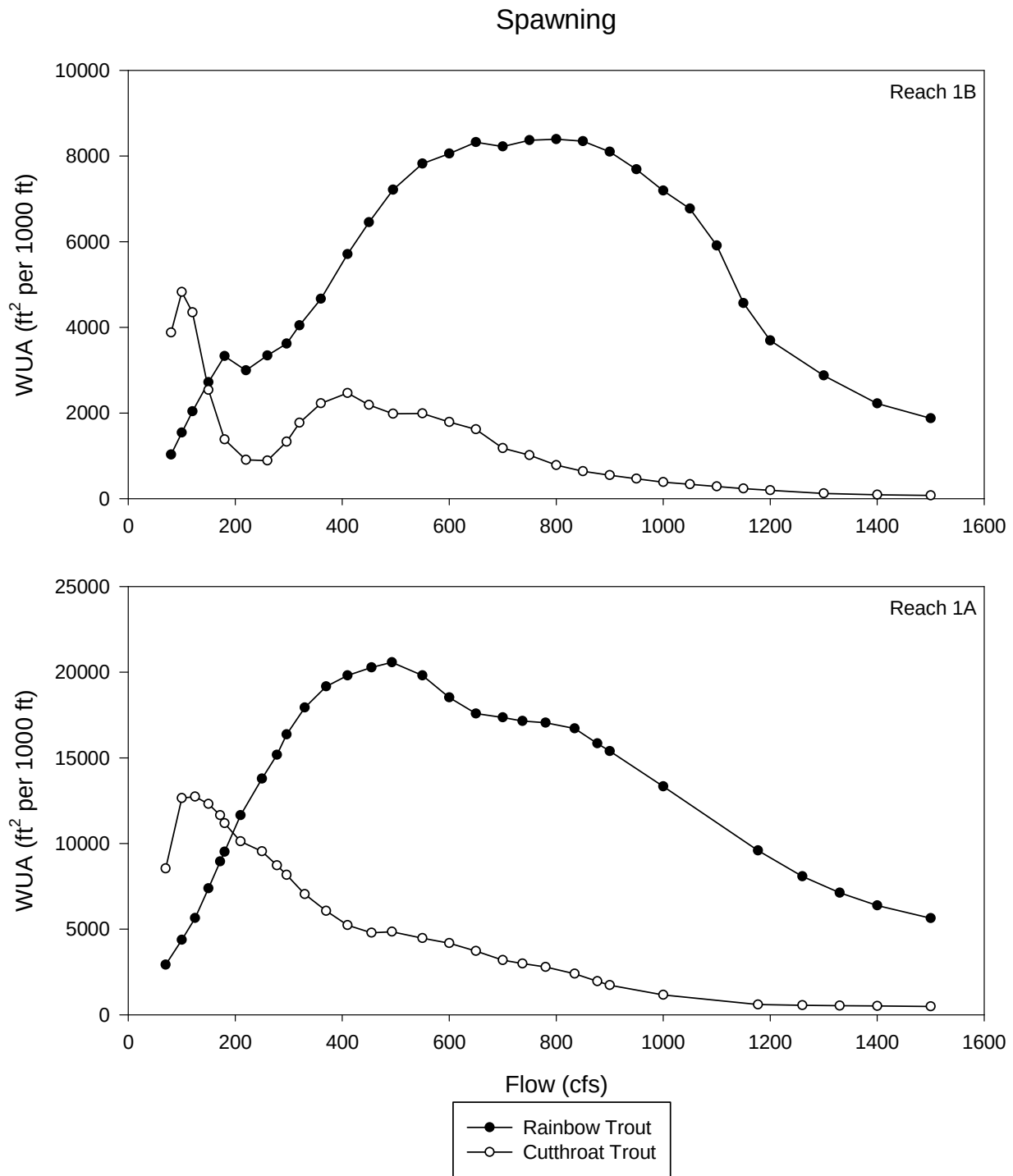


Figure D1-19. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

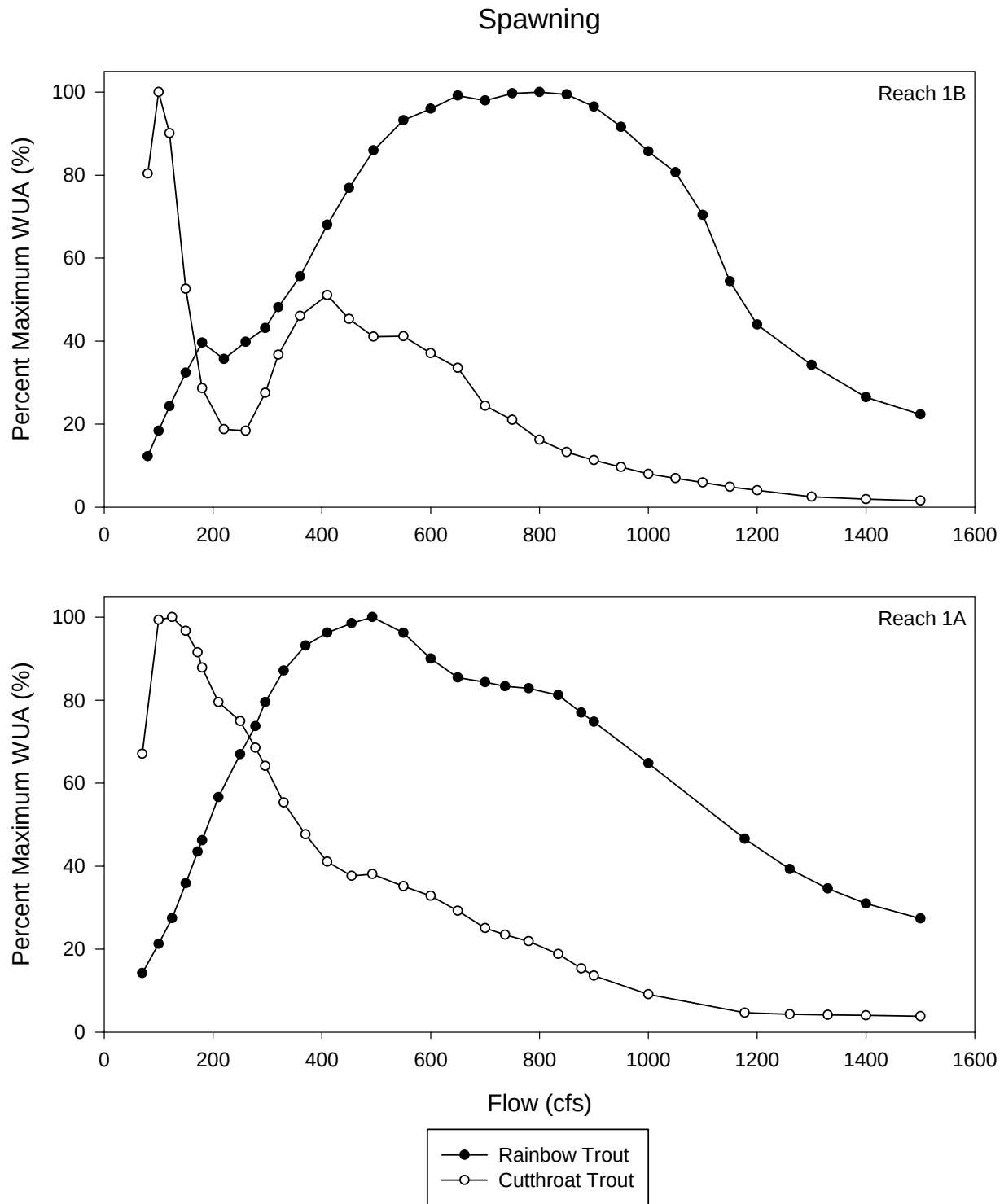


Figure D1-20. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

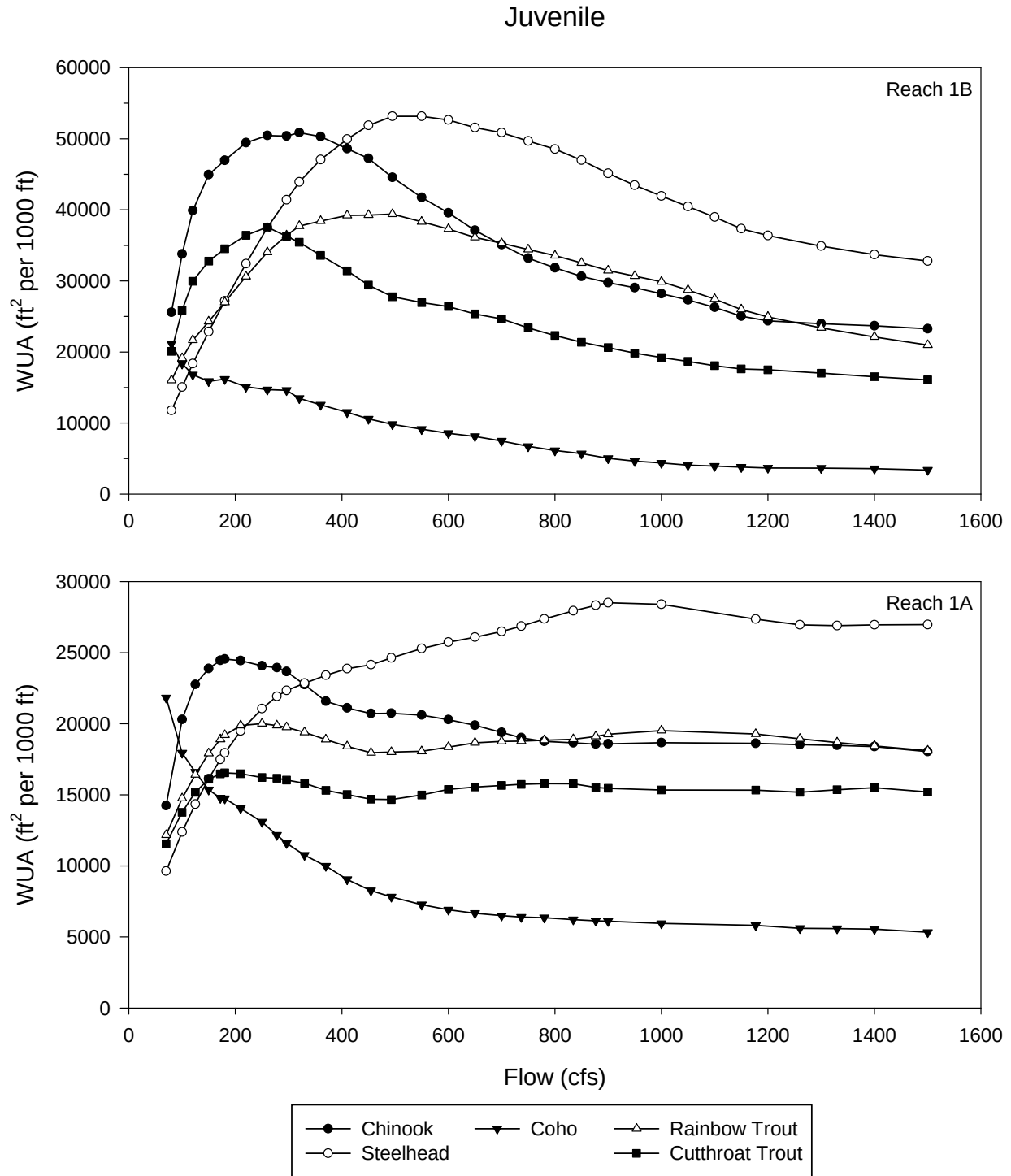


Figure D1-21. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook and coho salmon and steelhead, rainbow and cutthroat trout juvenile habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

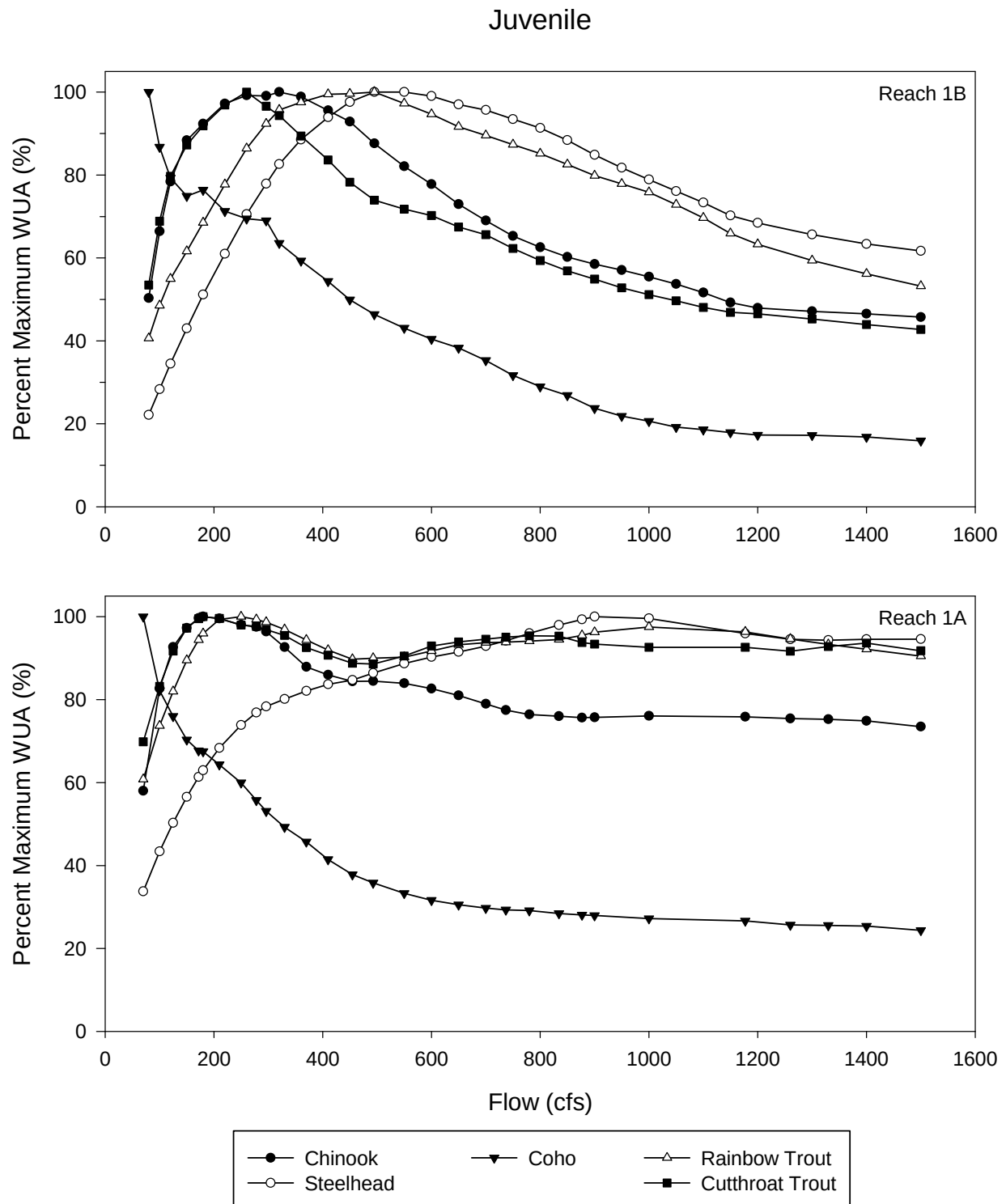


Figure D1-22. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook and coho salmon and steelhead, rainbow and cutthroat trout juvenile habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

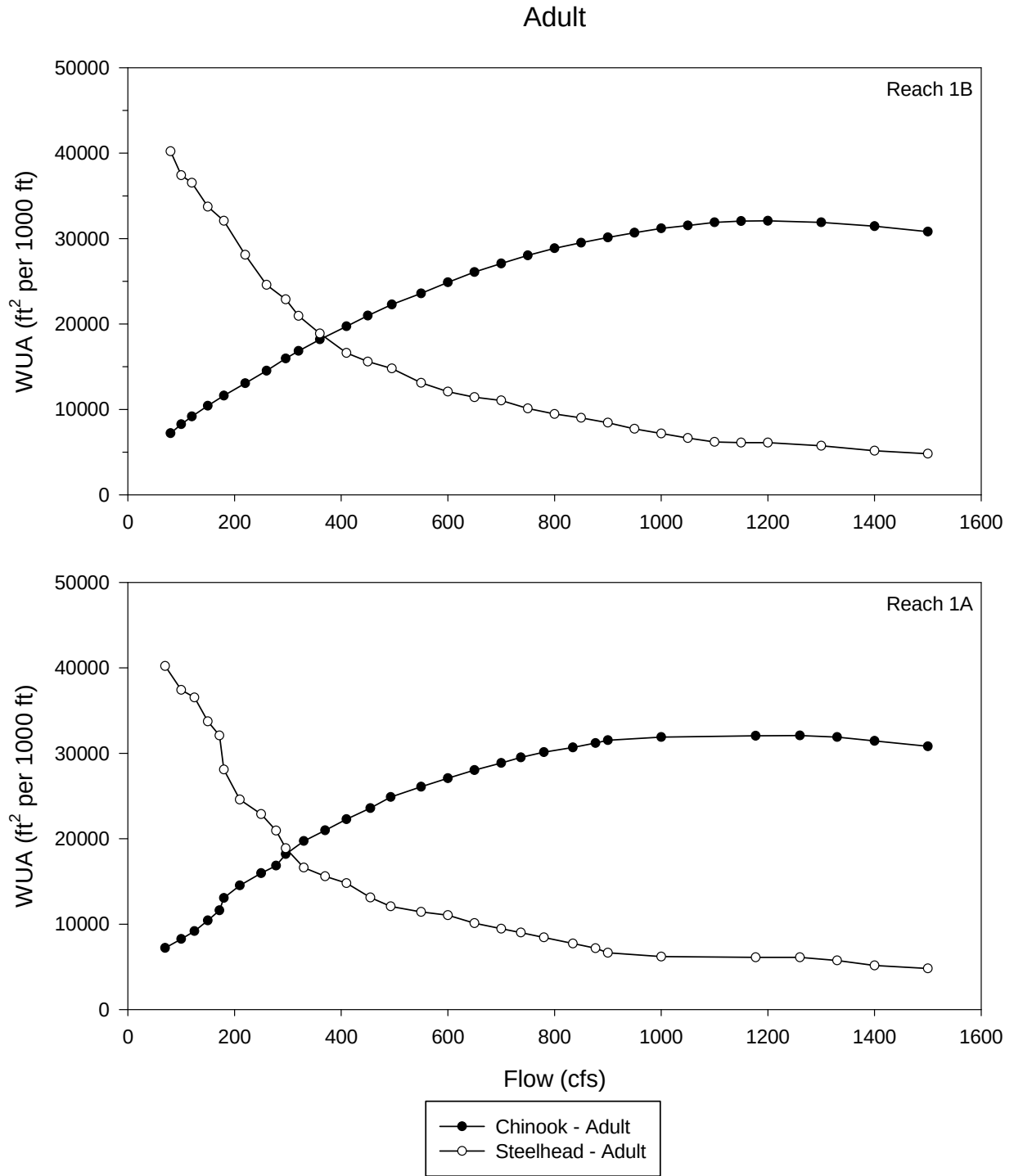


Figure D1-23. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

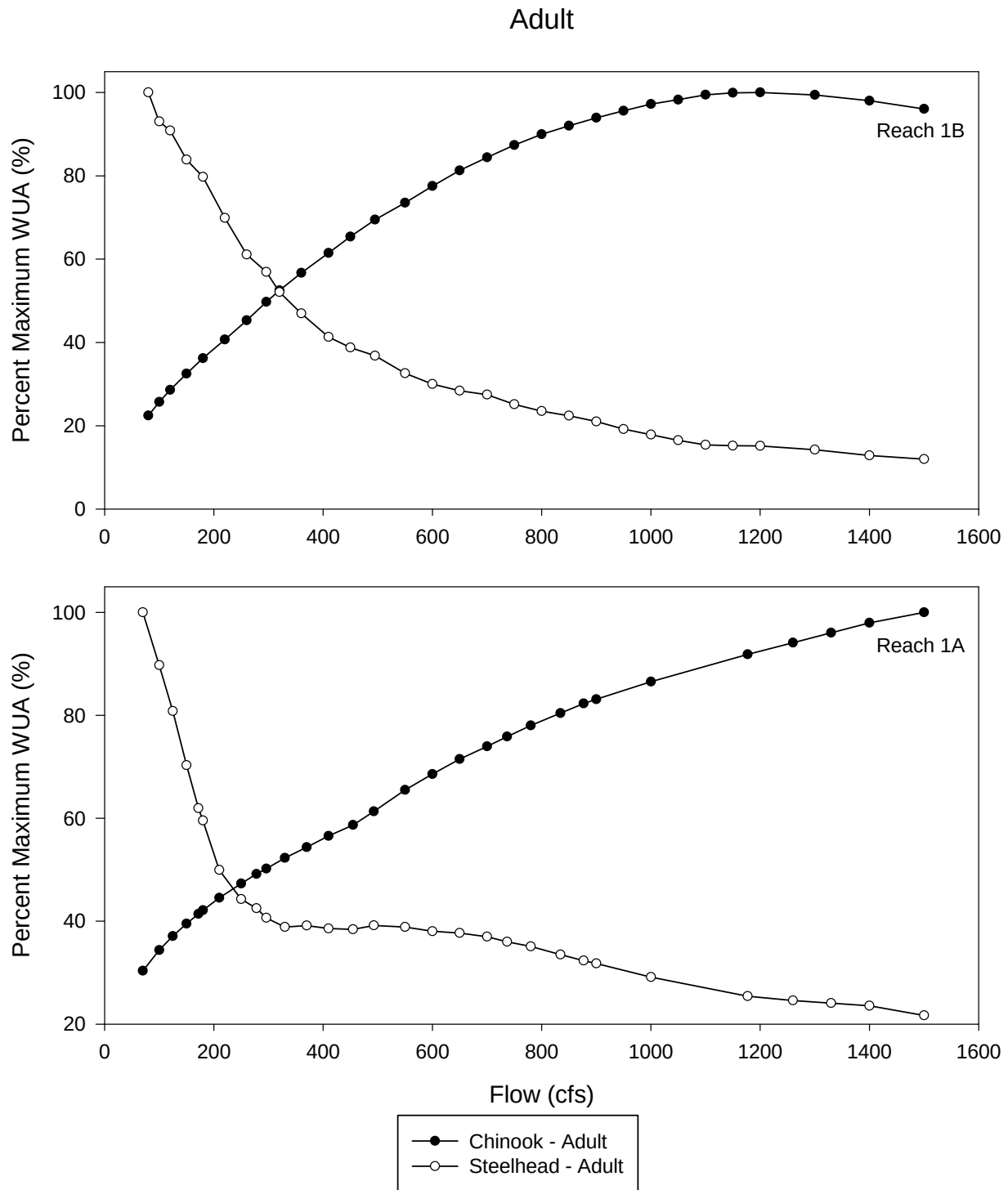


Figure D1-24. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat as defined for Reach 1B and Reach 1A within Reach 1 of the Sultan River, Washington (see Figure 3-1 for reach locations).

APPENDIX D2

Time Series Analysis for Reach 3 – Sultan River

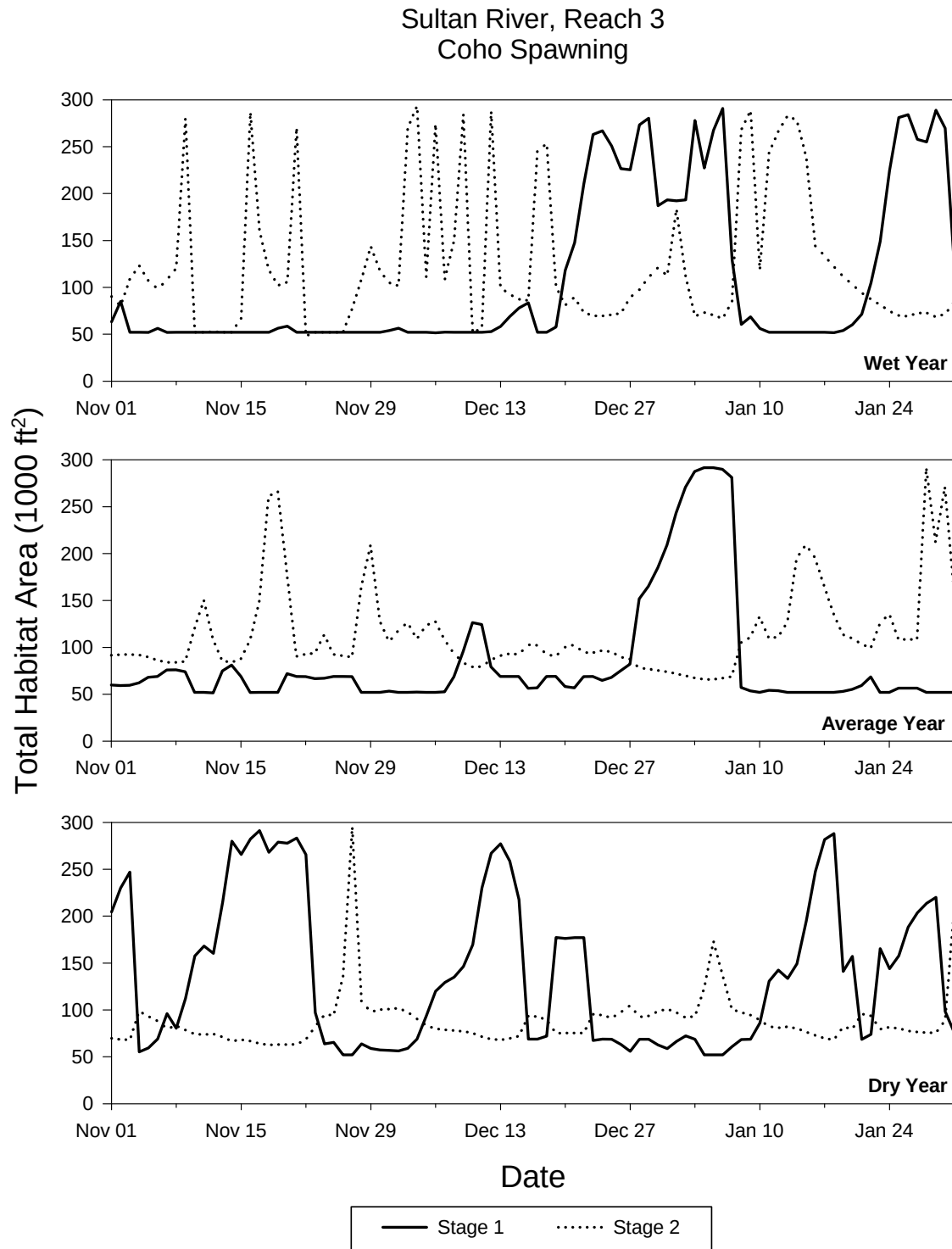


Figure D2-1. Time series analysis depicting total coho salmon spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 3 of the Sultan River, Washington.

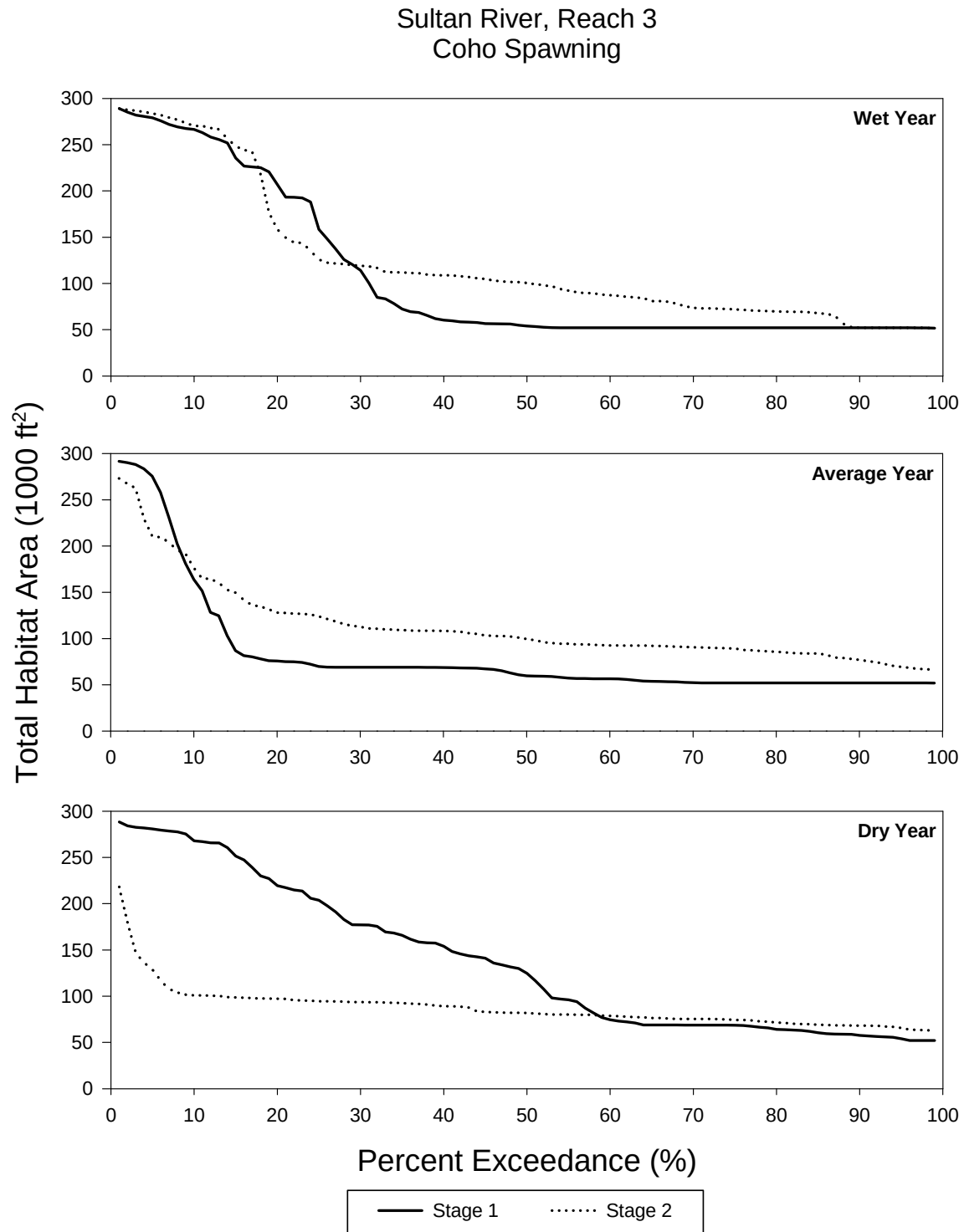


Figure D2-2. Habitat duration curves for coho salmon spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 3 of the Sultan River, Washington.

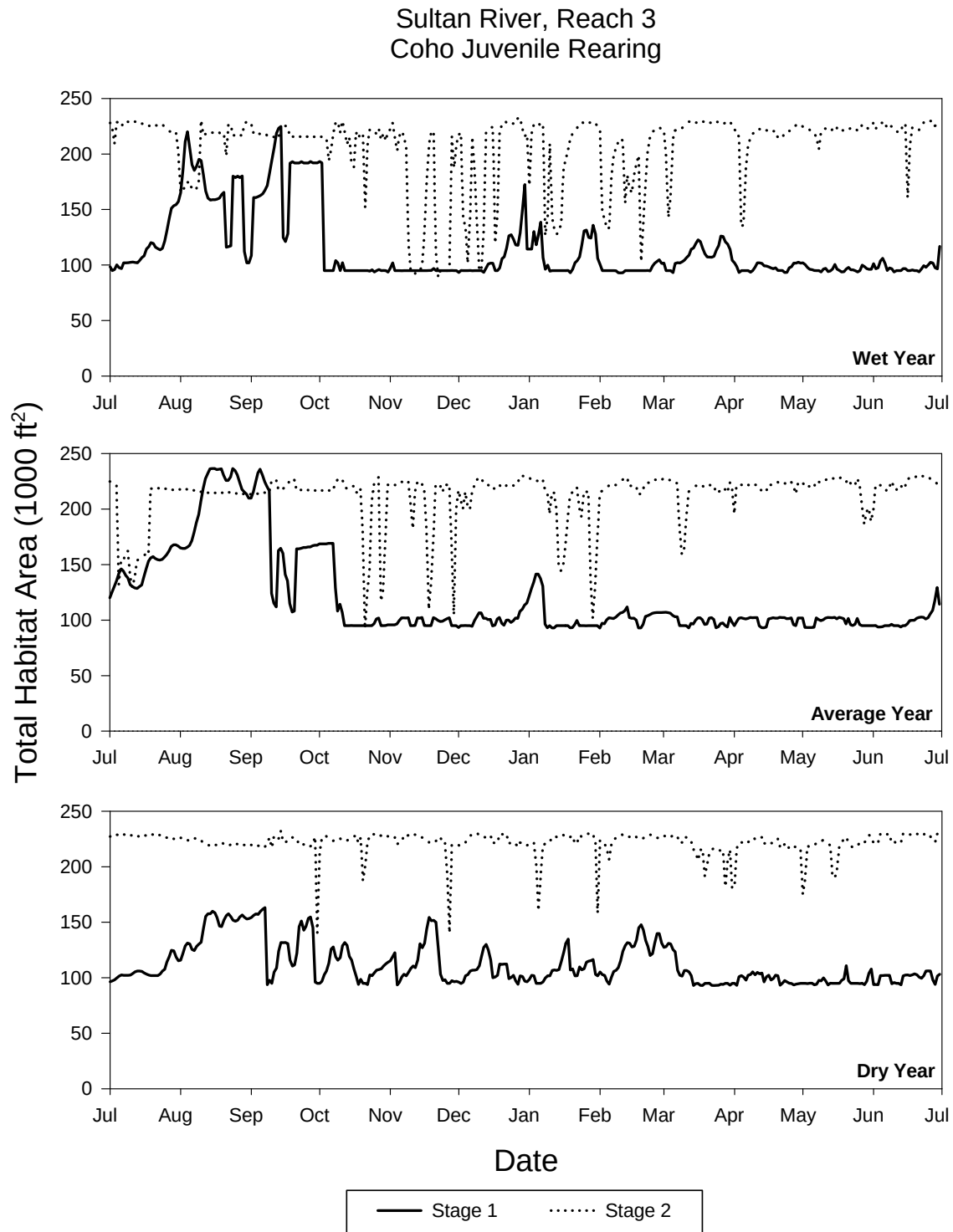


Figure D2-3. Time series analysis depicting total coho salmon juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 3 of the Sultan River, Washington.

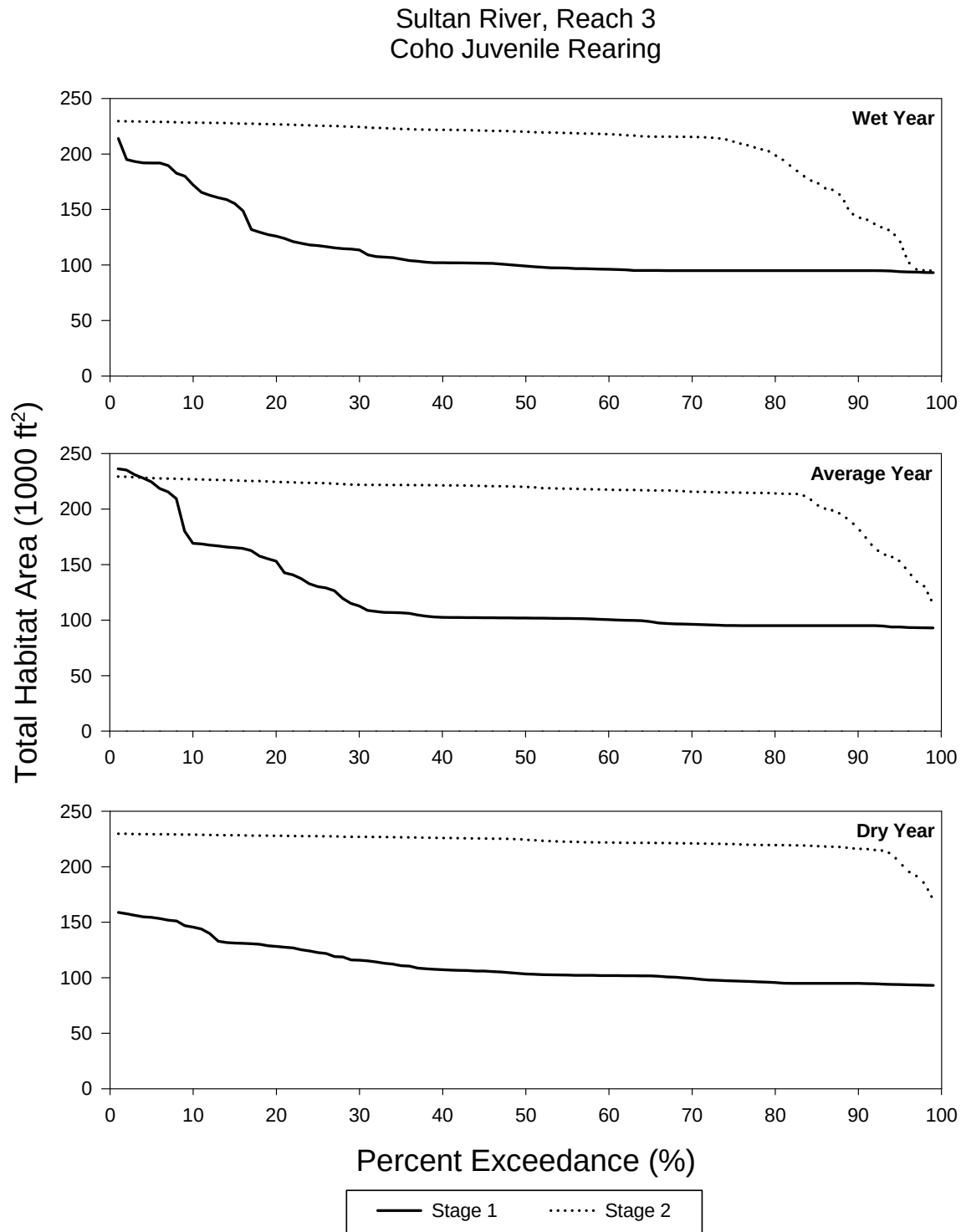


Figure D2-4. Habitat duration curves for coho salmon juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 3 of the Sultan River, Washington.

Sultan River, Reach 3 Rainbow Trout Juvenile Rearing

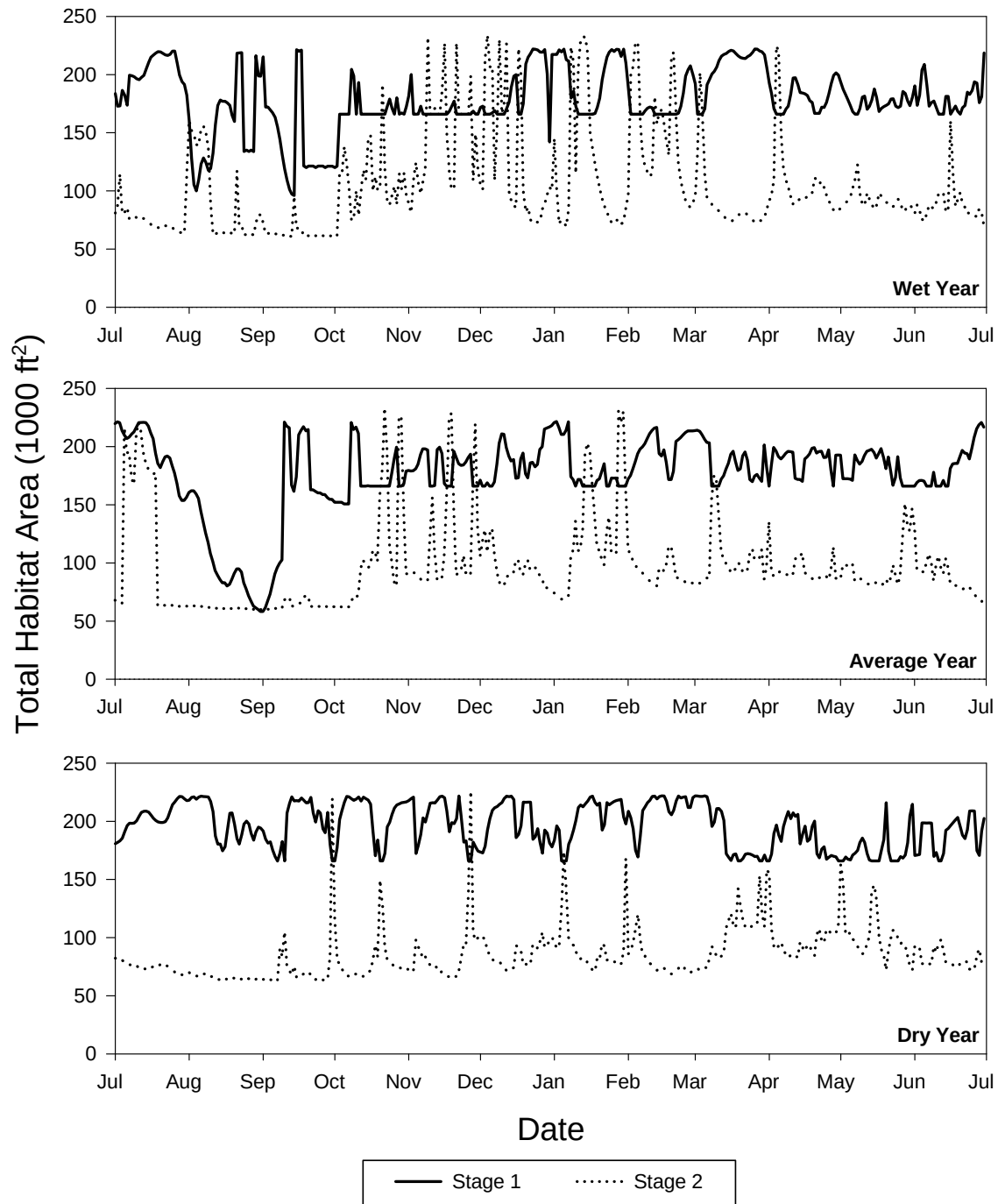


Figure D2-5. Time series analysis depicting total rainbow trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 3 of the Sultan River, Washington.

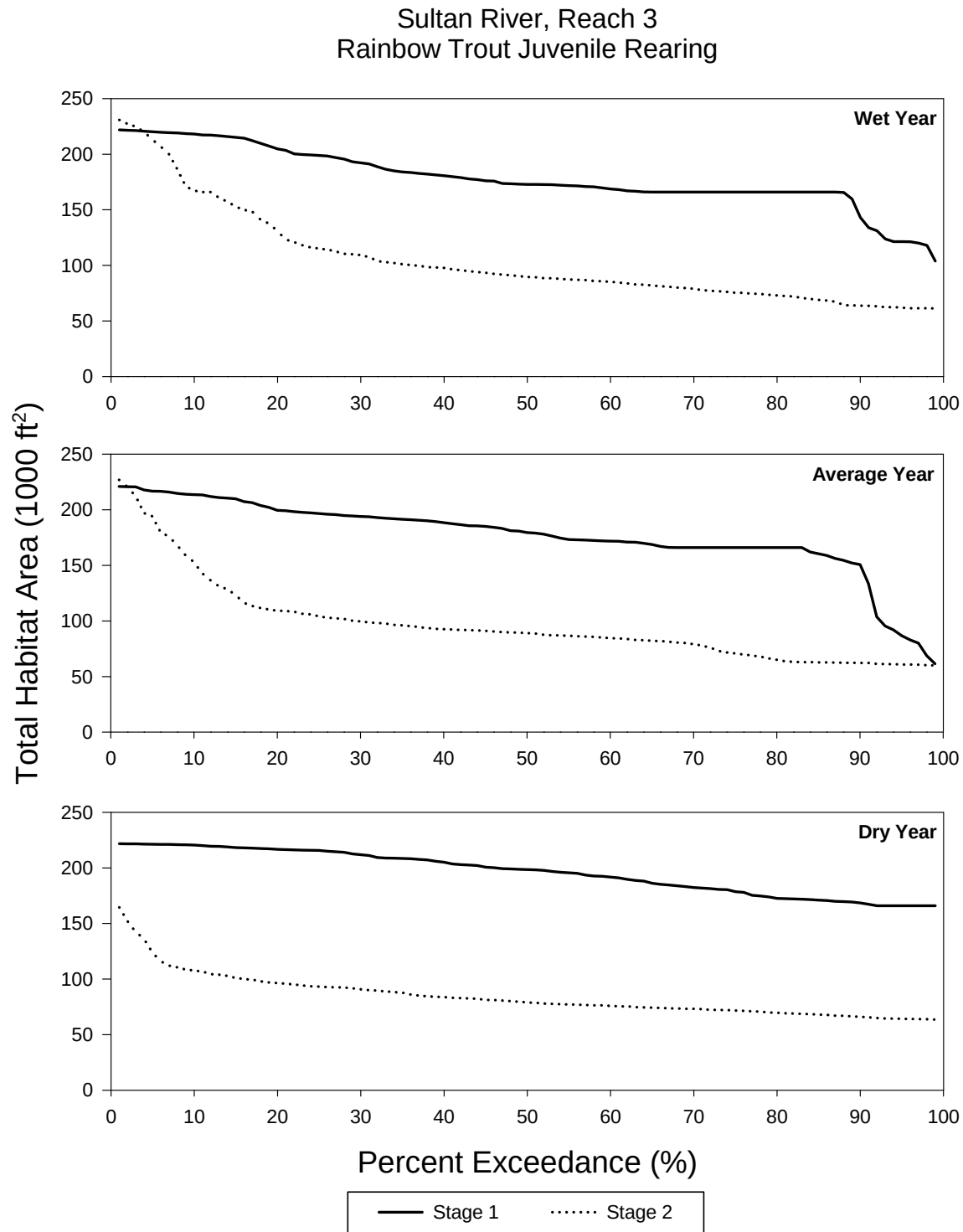


Figure D2-6. Habitat duration curves for rainbow trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 3 of the Sultan River, Washington.

Sultan River, Reach 3 Cutthroat Trout Juvenile Rearing

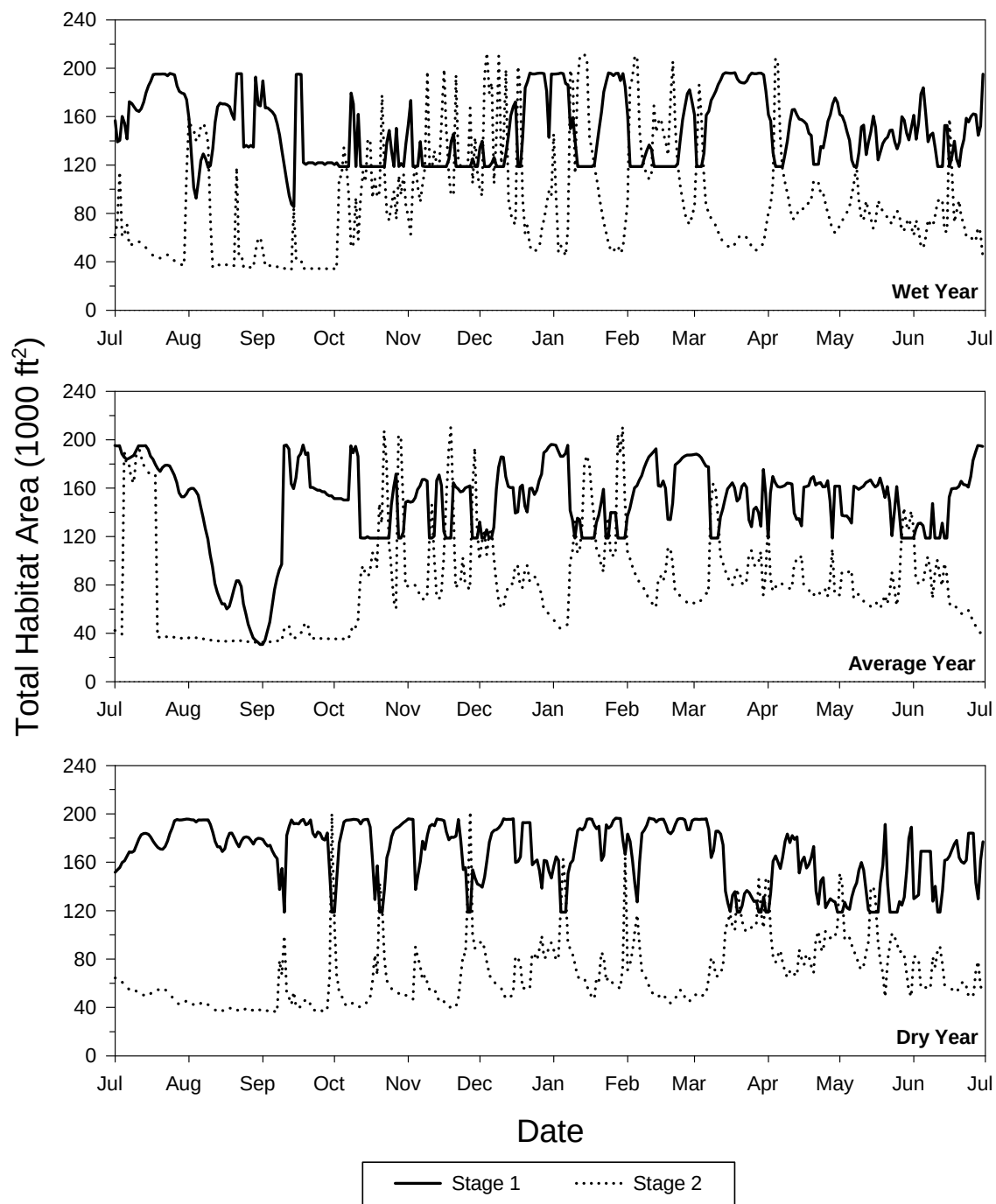


Figure D2-7. Time series analysis depicting total cutthroat trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 3 of the Sultan River, Washington.

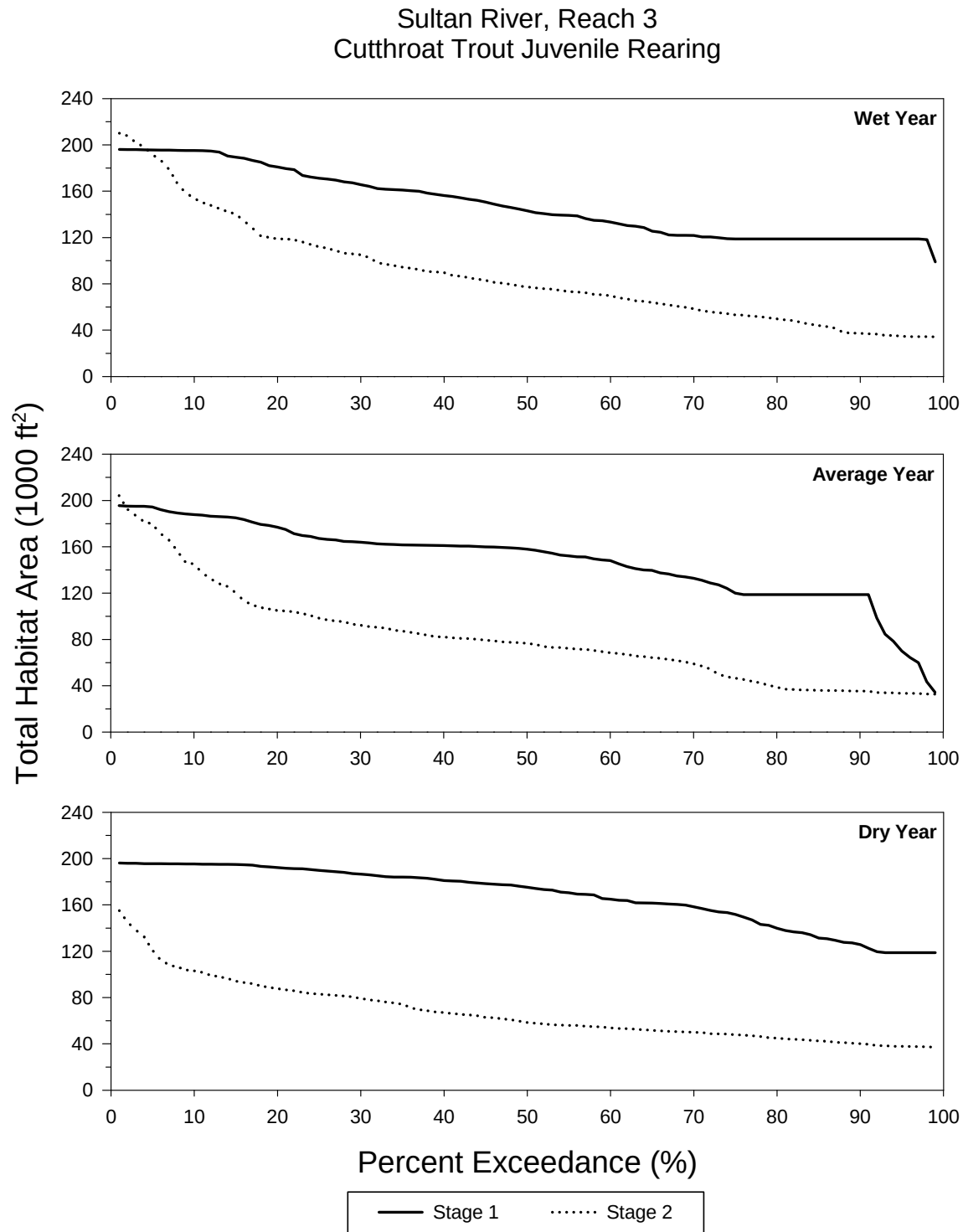


Figure D2-8. Habitat duration curves for cutthroat trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 3 of the Sultan River, Washington.

Sultan River, Reach 3 Chinook Juvenile Rearing

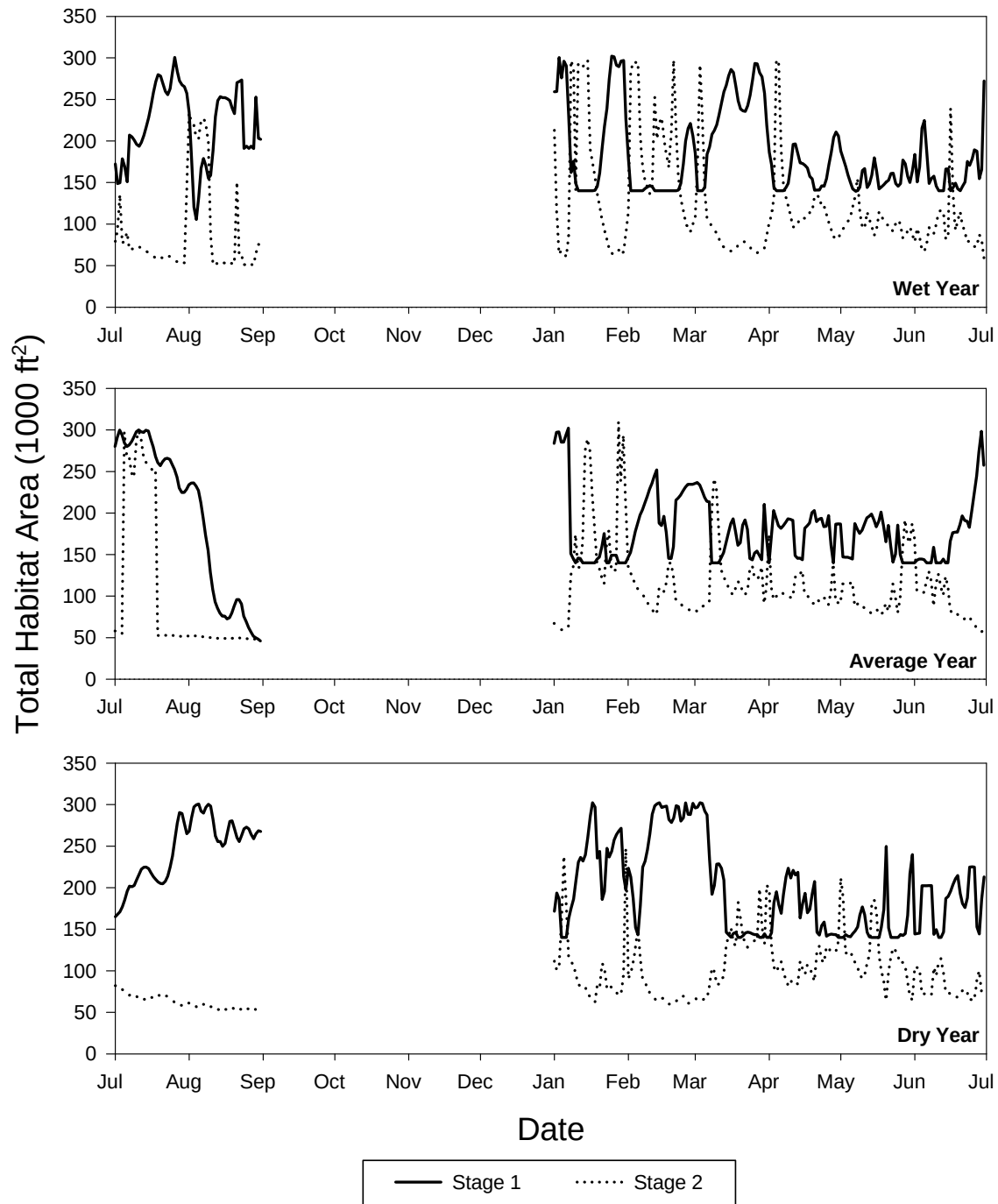


Figure D2-9. Time series analysis depicting total Chinook salmon juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 3 of the Sultan River, Washington.

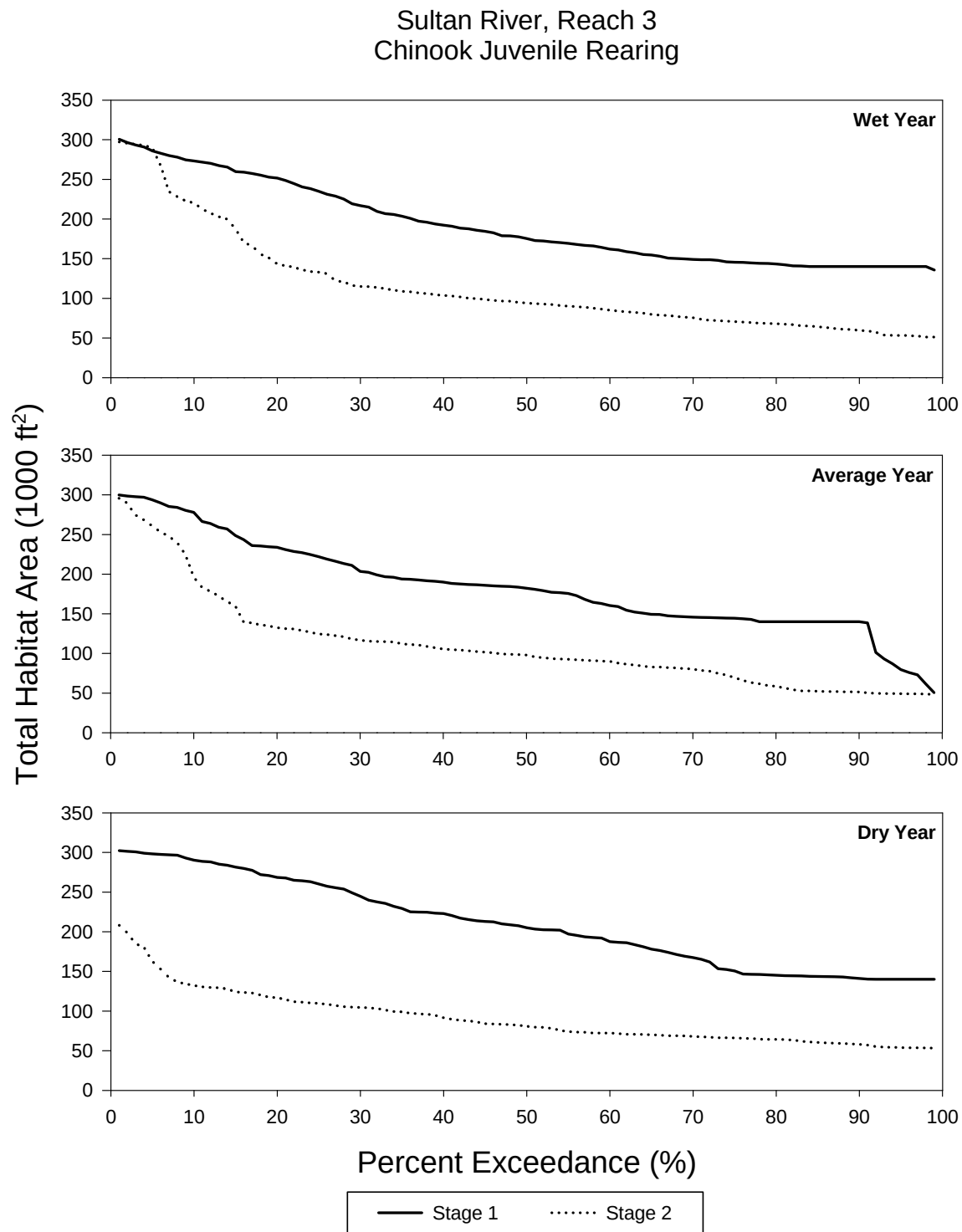


Figure D2-10. Habitat duration curves for Chinook salmon juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 3 of the Sultan River, Washington.

Sultan River, Reach 3 Steelhead Juvenile Rearing

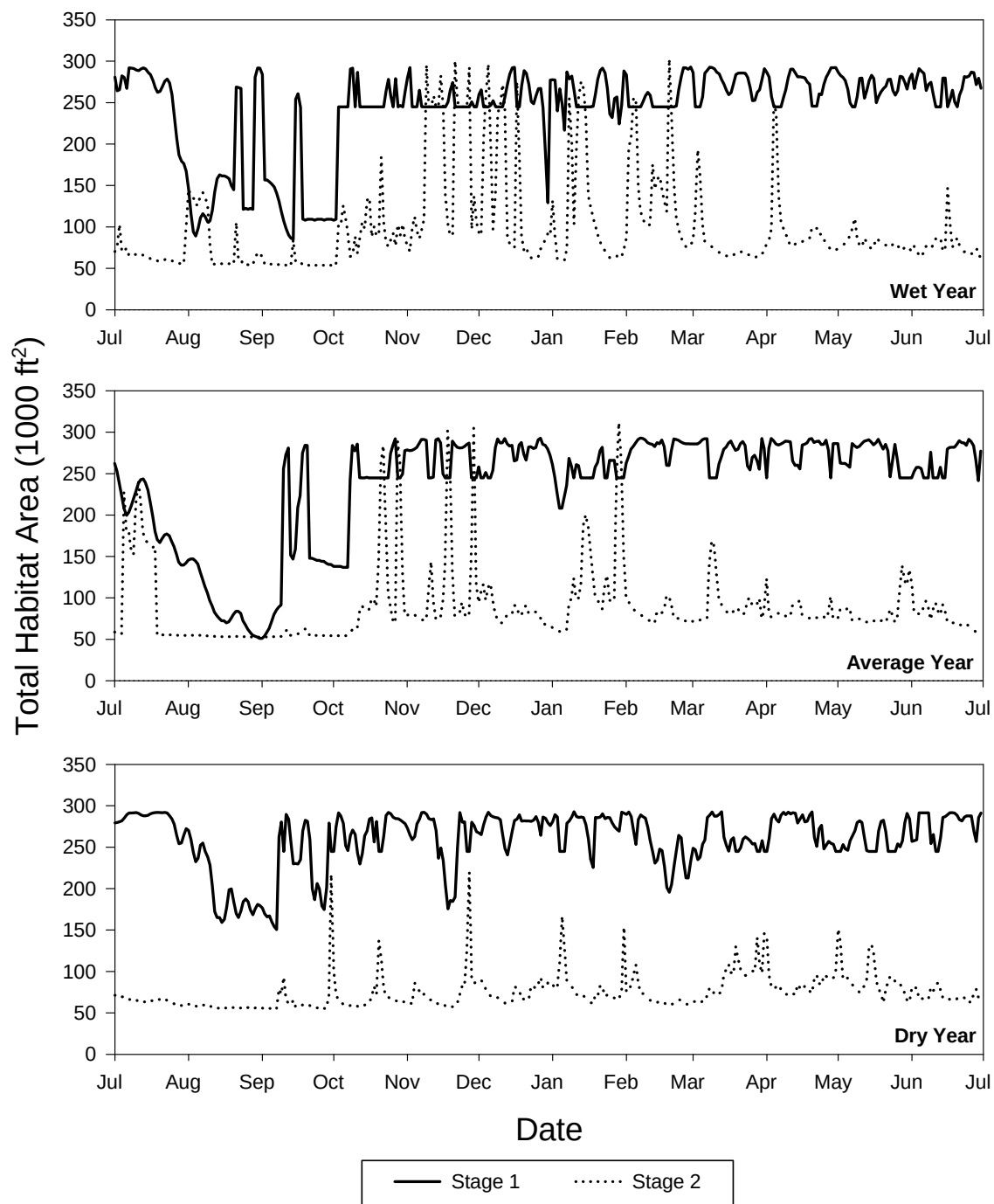


Figure D2-11. Time series analysis depicting total steelhead trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 3 of the Sultan River, Washington.

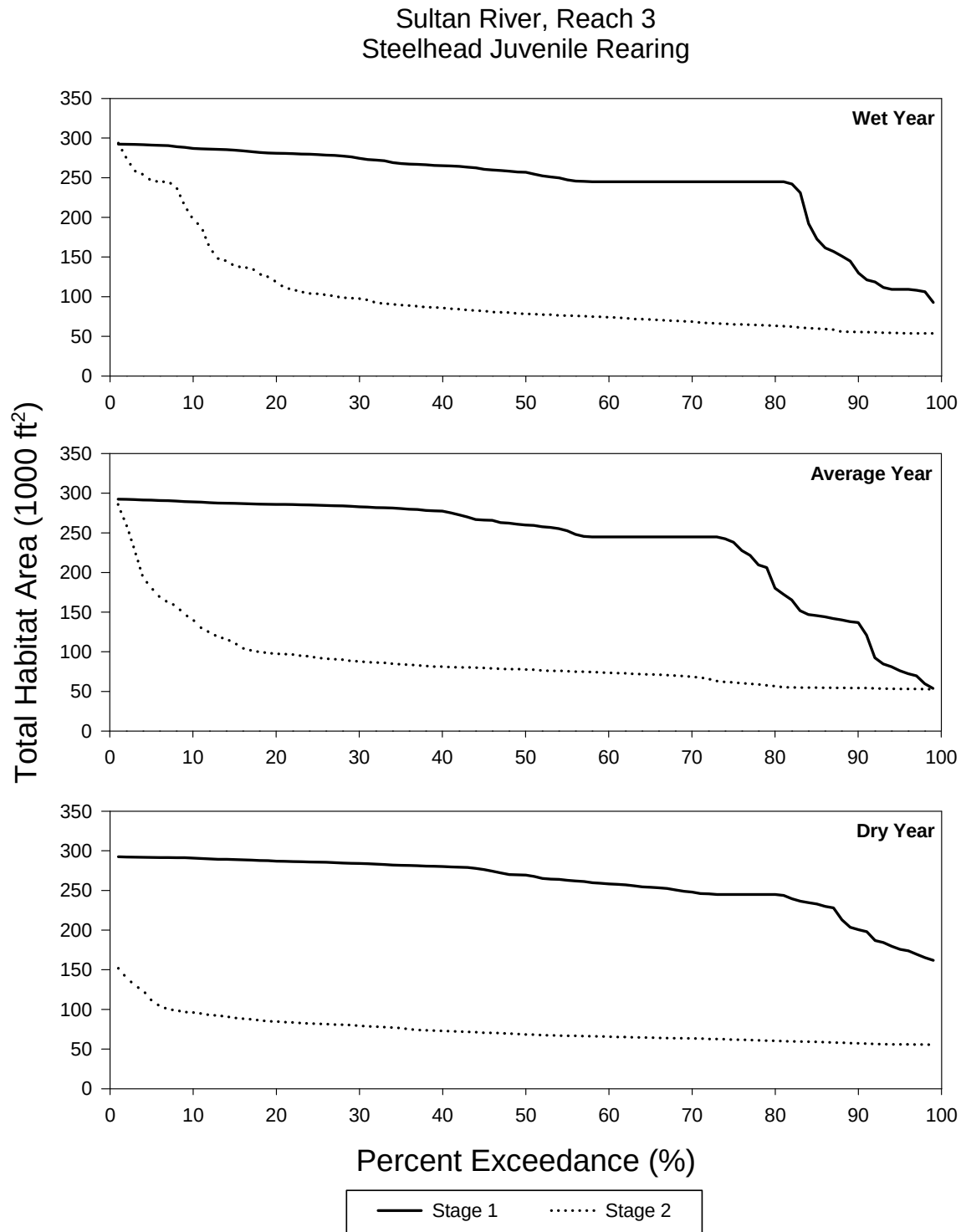


Figure D2-12. Habitat duration curves for steelhead trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 3 of the Sultan River, Washington.

APPENDIX D3

Time Series Analysis for Reach 2 – Sultan River

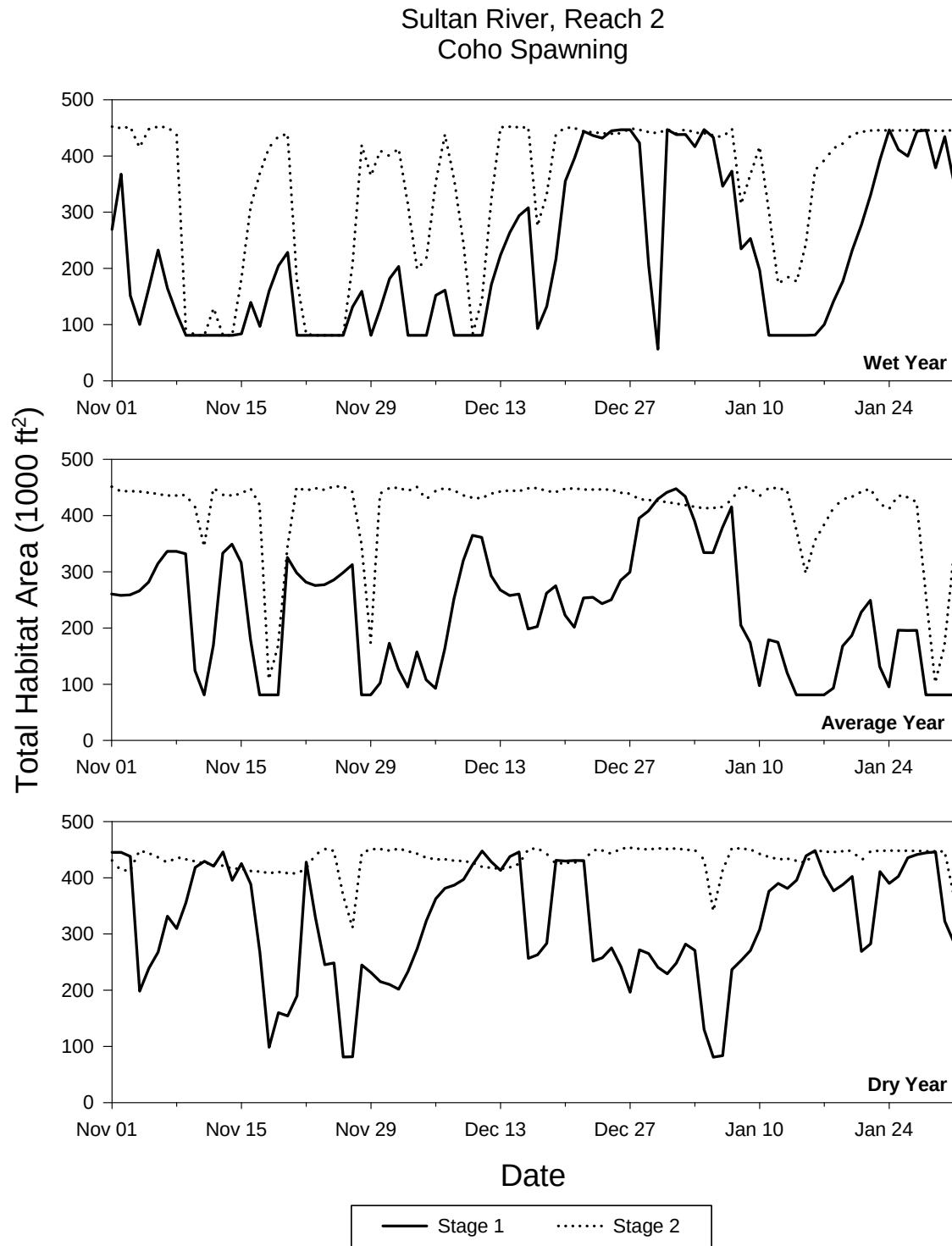


Figure D3-1. Time series analysis depicting total coho salmon spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

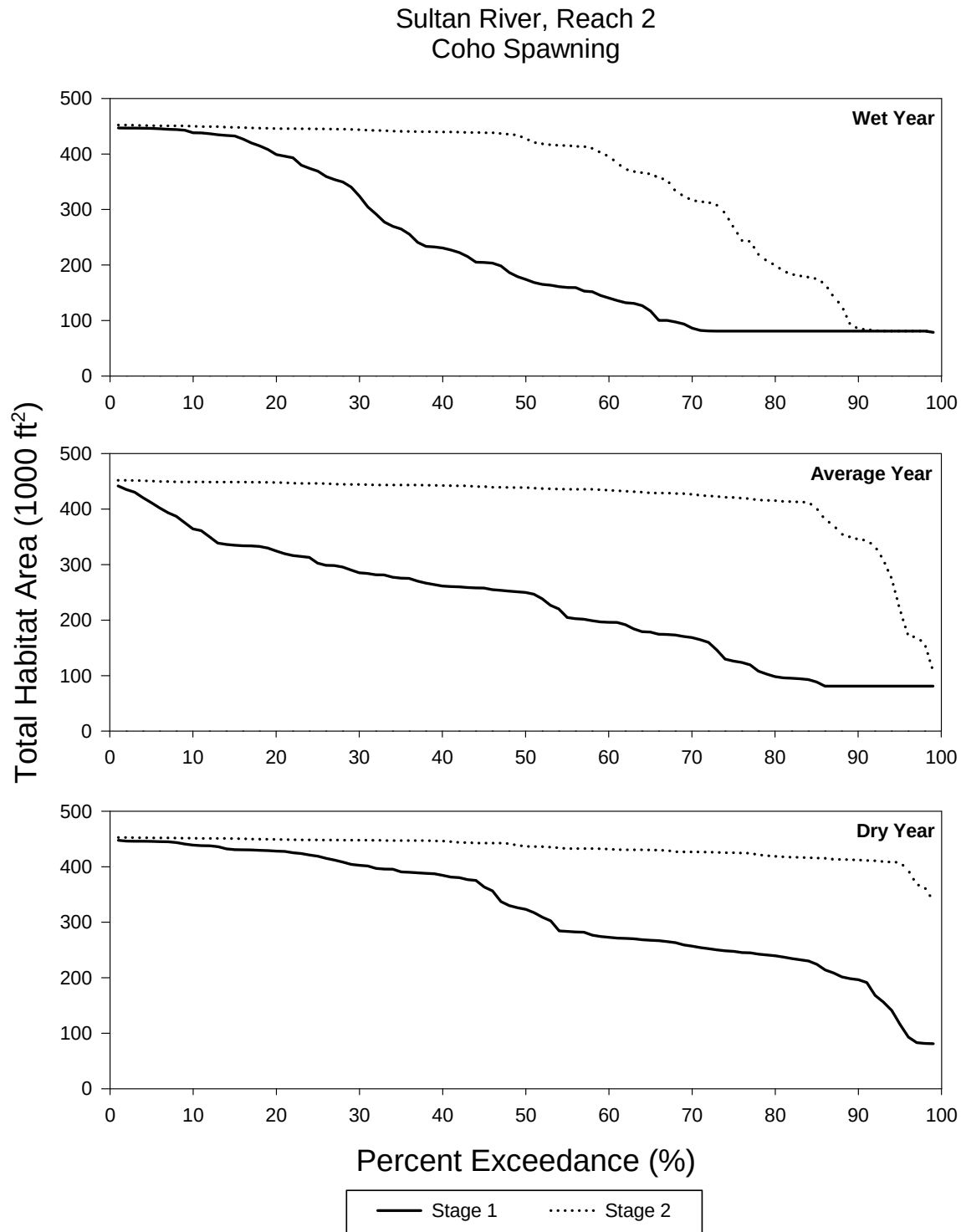


Figure D3-2. Habitat duration curves for coho salmon spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

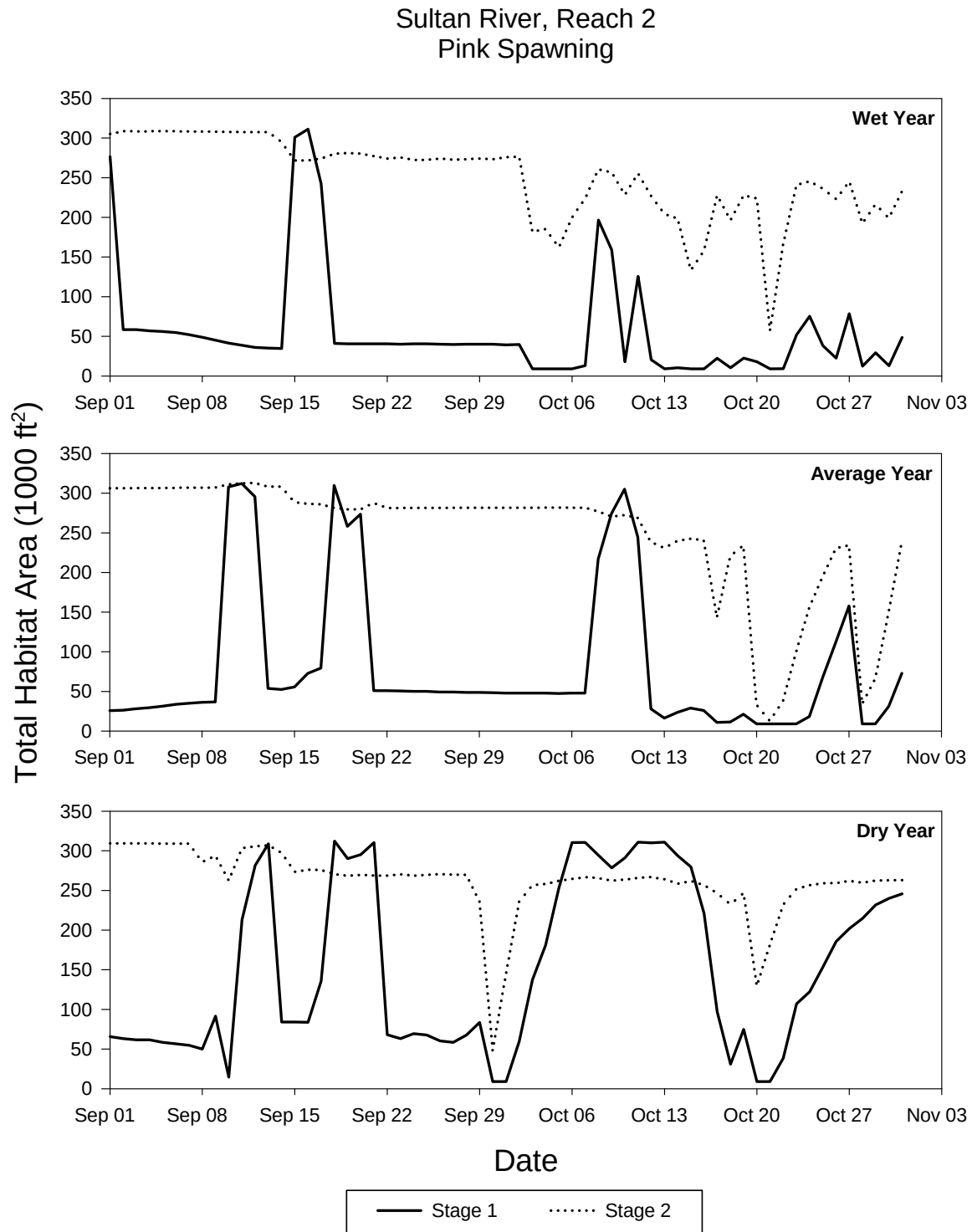


Figure D3-3. Time series analysis depicting total pink salmon spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

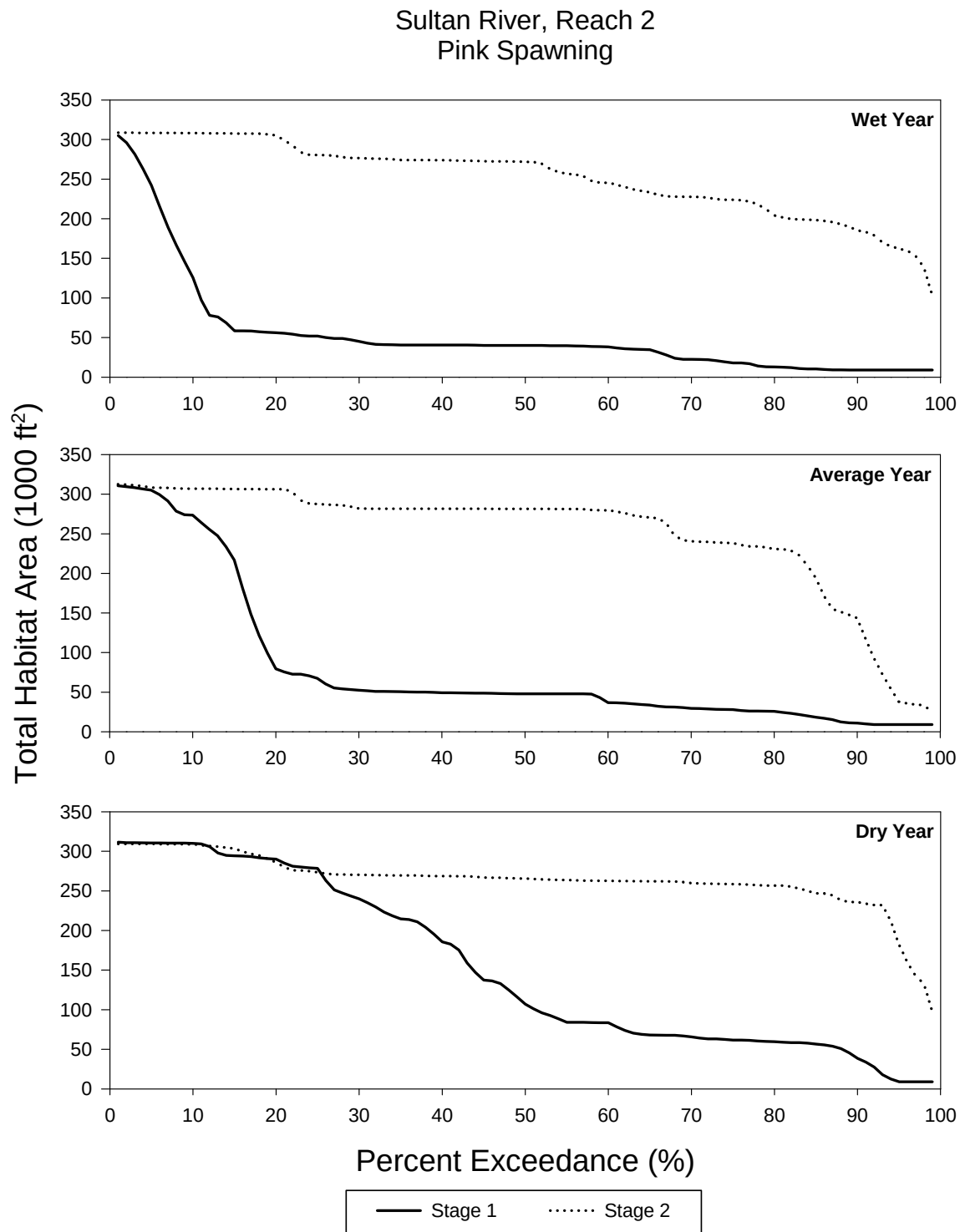


Figure D3-4. Habitat duration curves for pink salmon spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

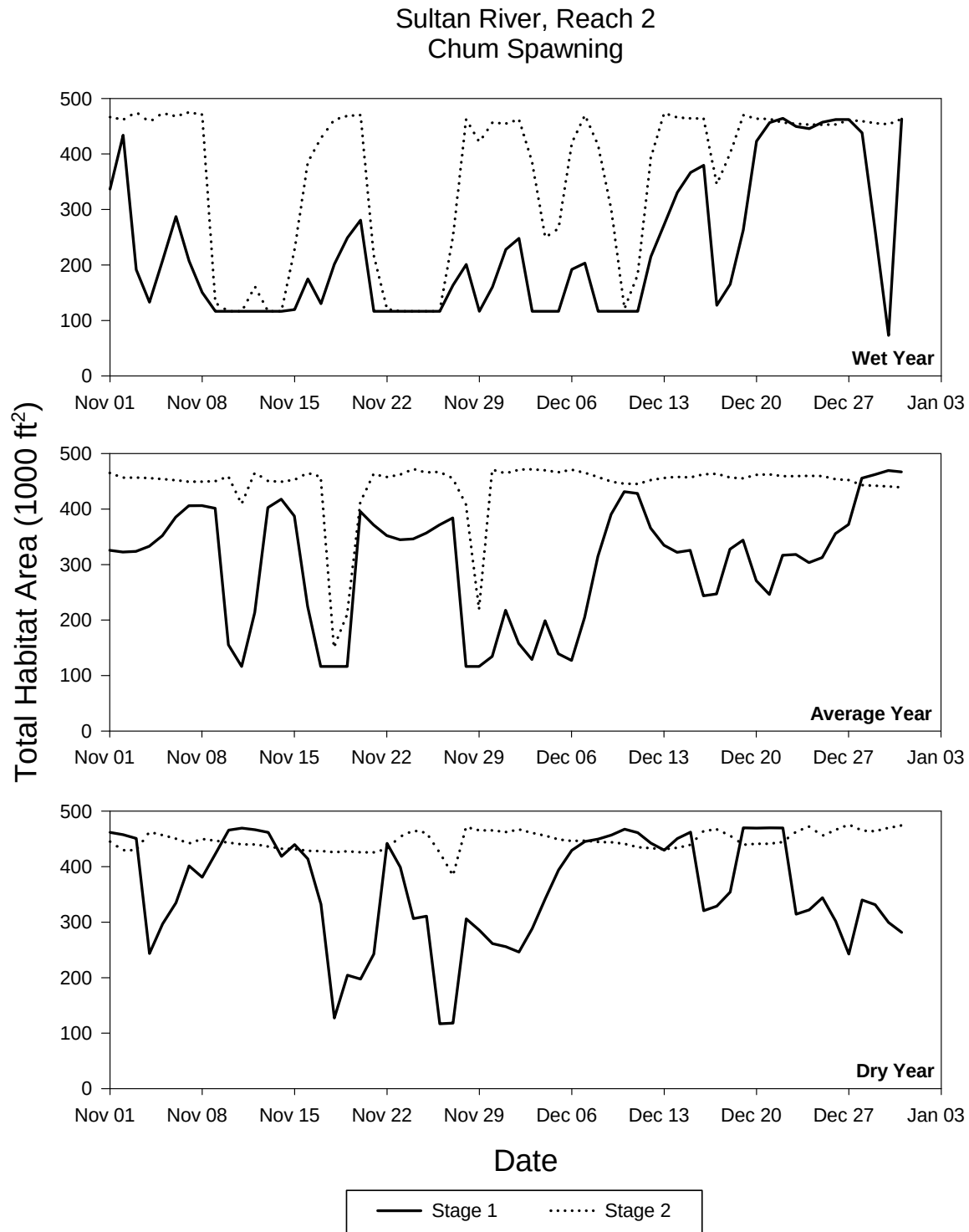


Figure D3-5. Time series analysis depicting total chum salmon spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

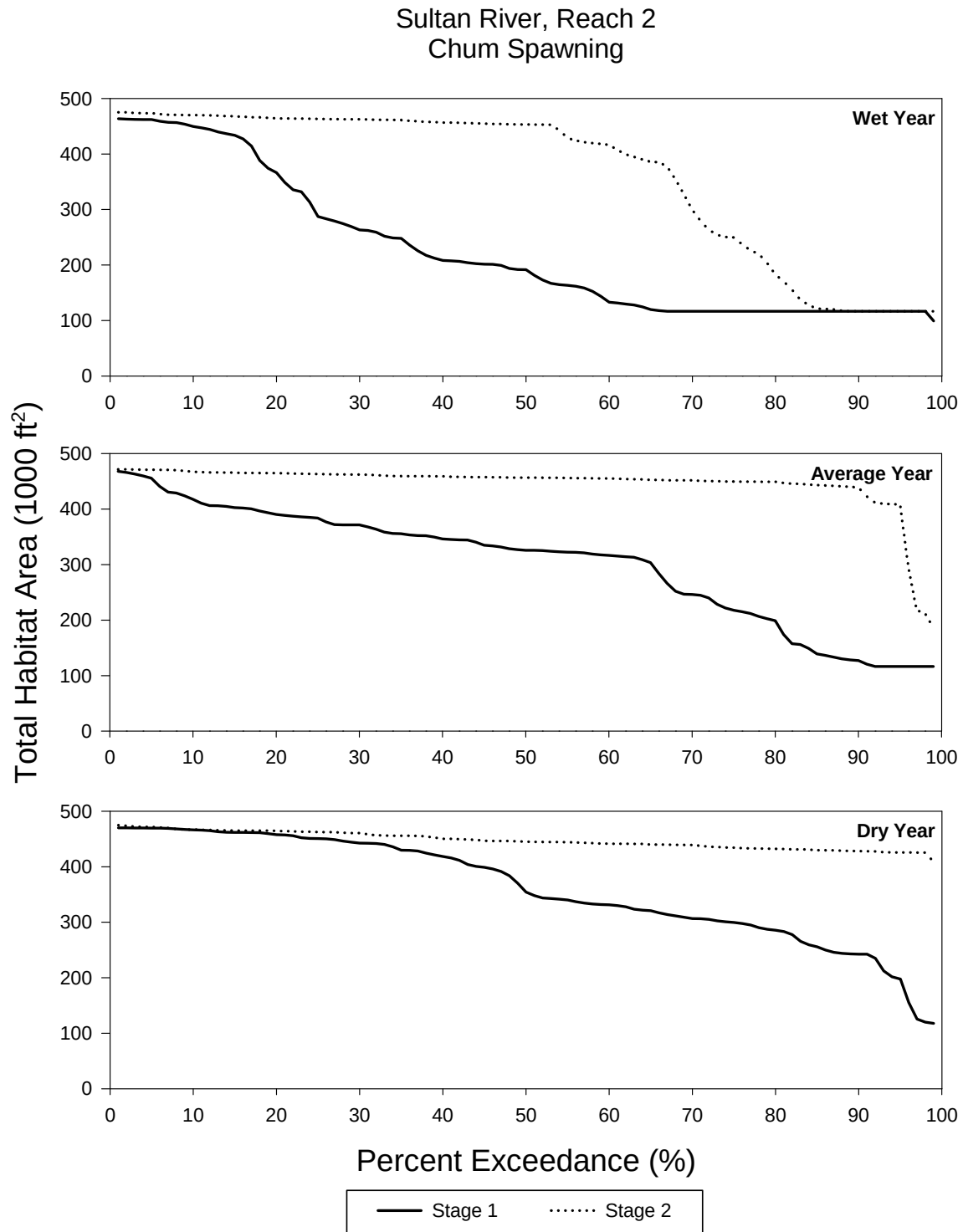


Figure D3-6. Habitat duration curves for chum salmon spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

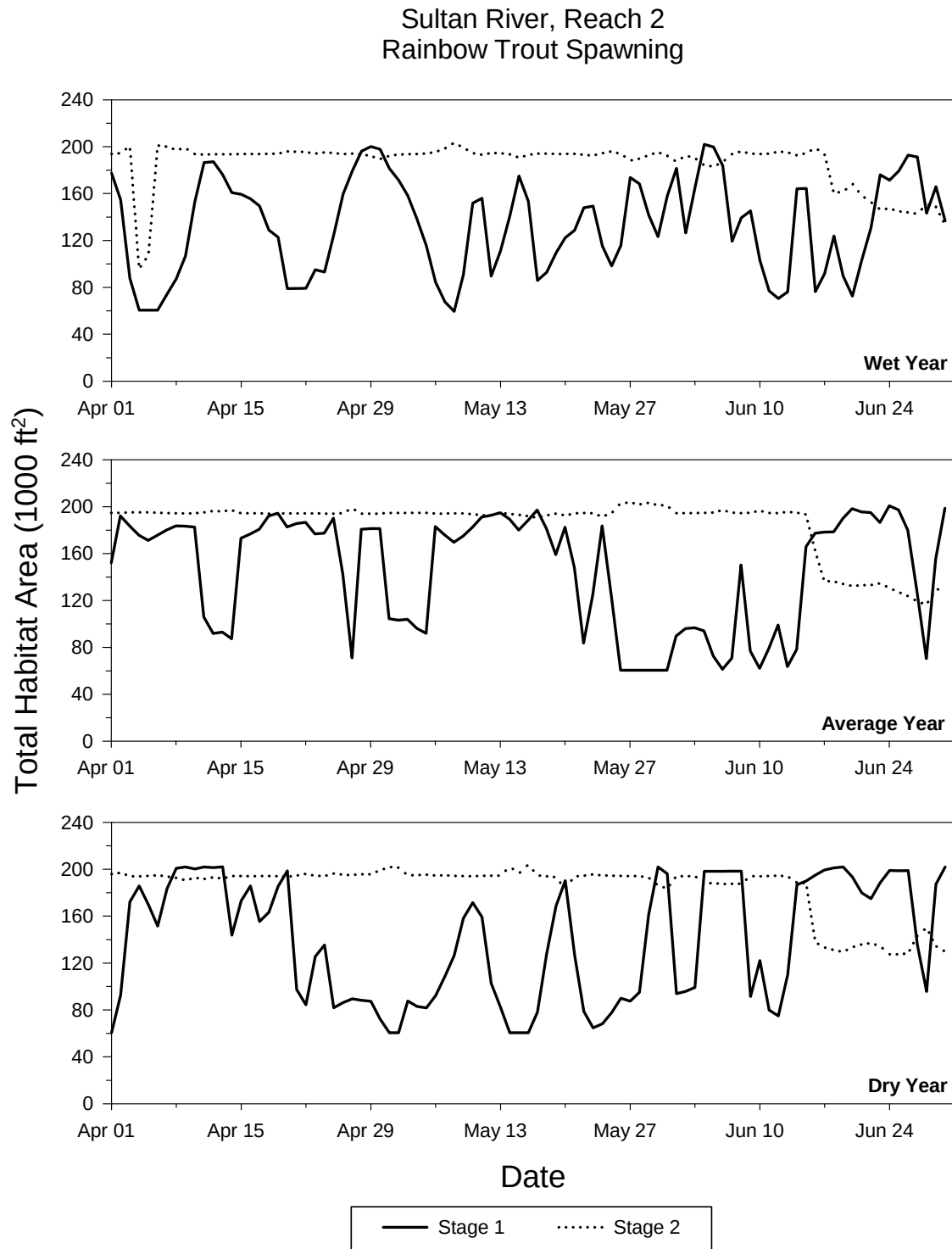


Figure D3-7. Time series analysis depicting total rainbow trout spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

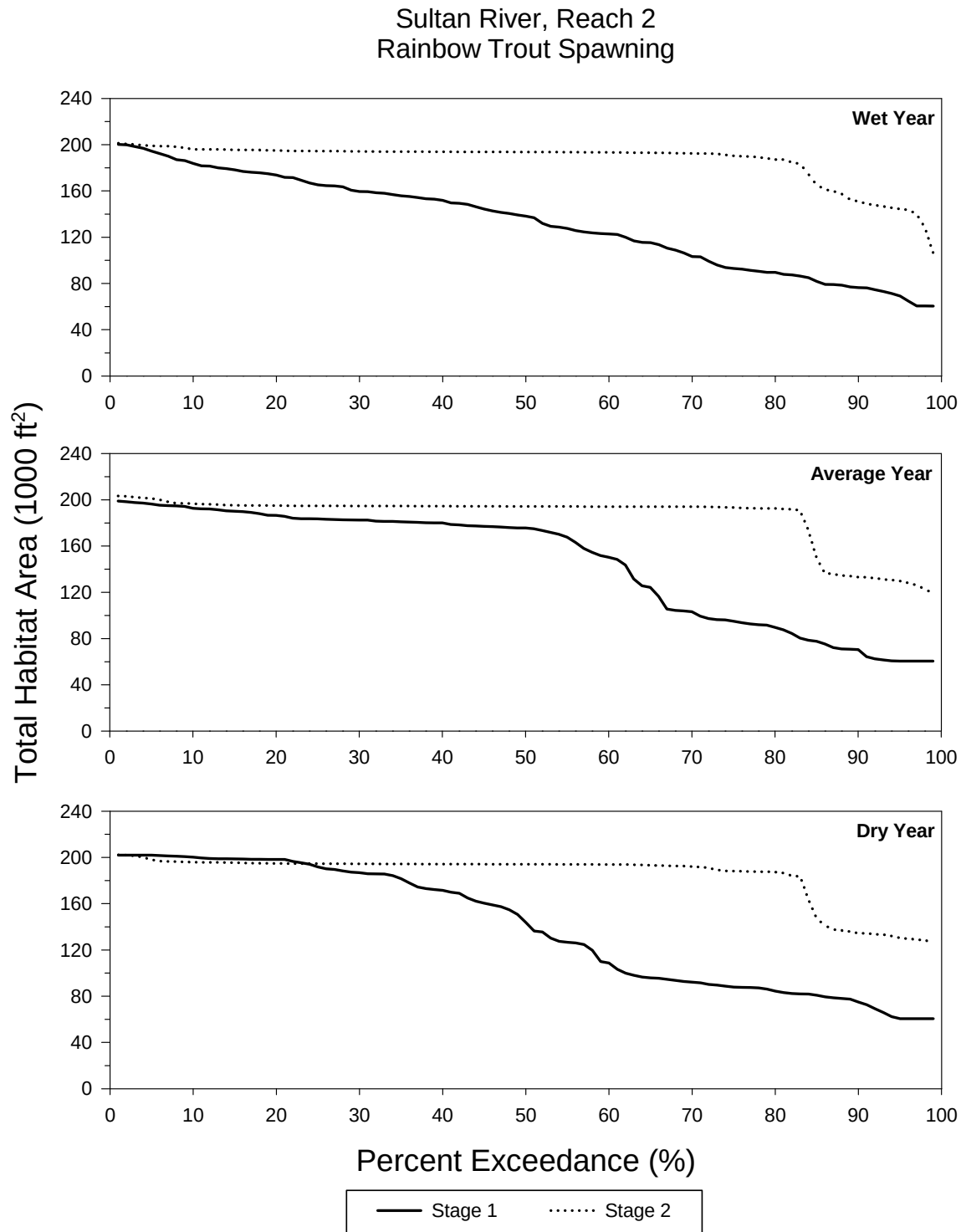


Figure D3-8. Habitat duration curves for rainbow trout spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

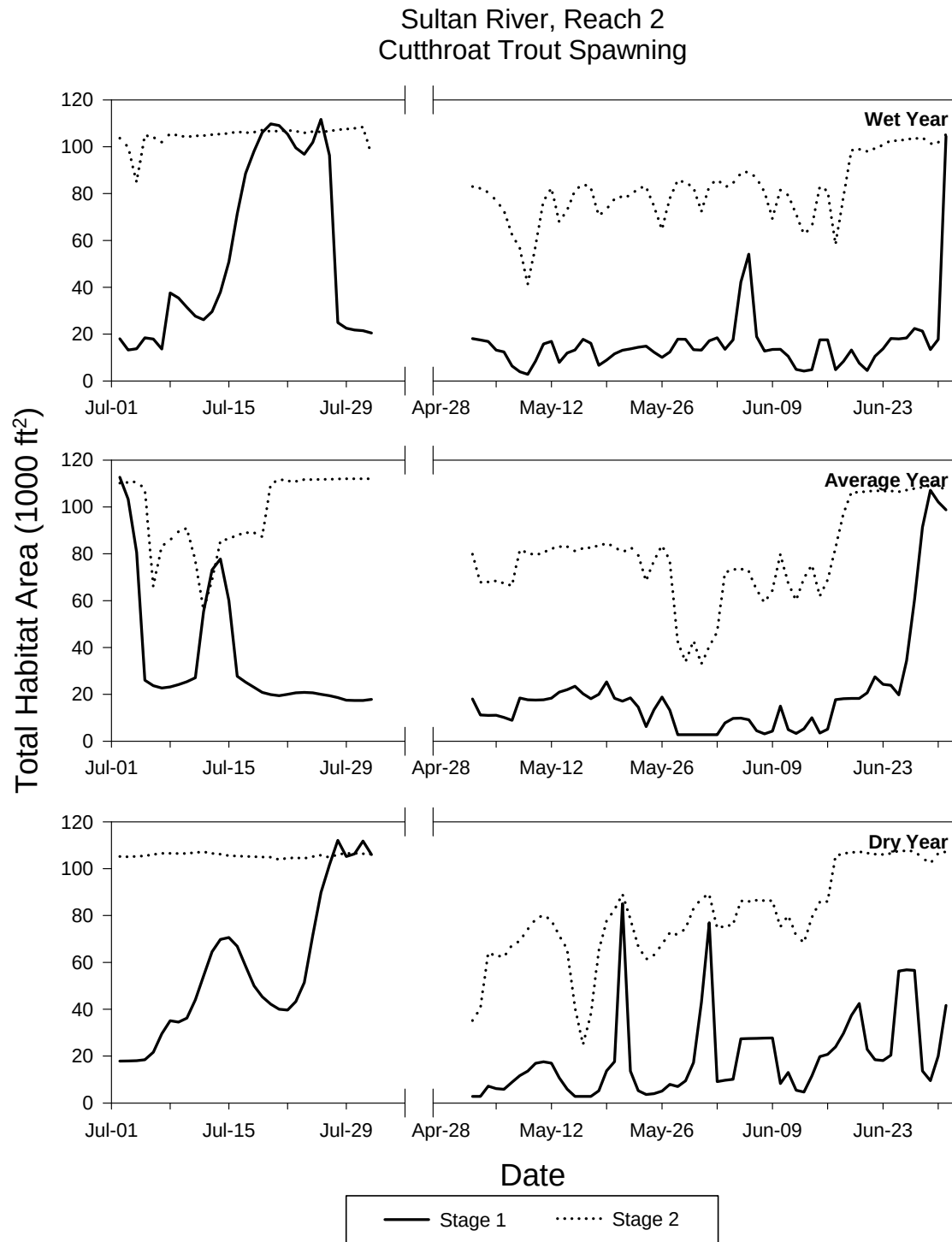


Figure D3-9. Time series analysis depicting total cutthroat trout spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

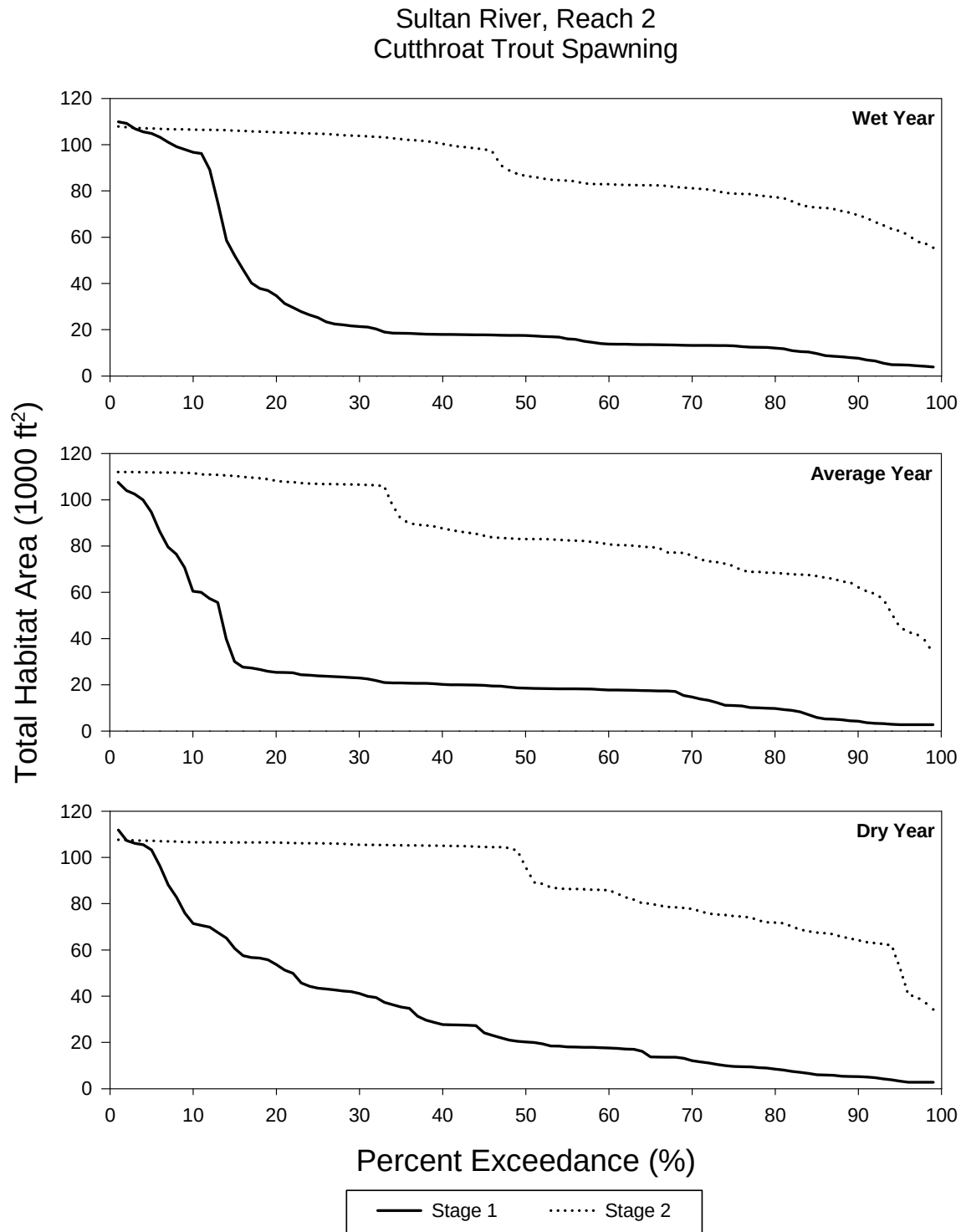


Figure D3-10. Habitat duration curves for cutthroat trout spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

Sultan River, Reach 2 Chinook Juvenile Rearing

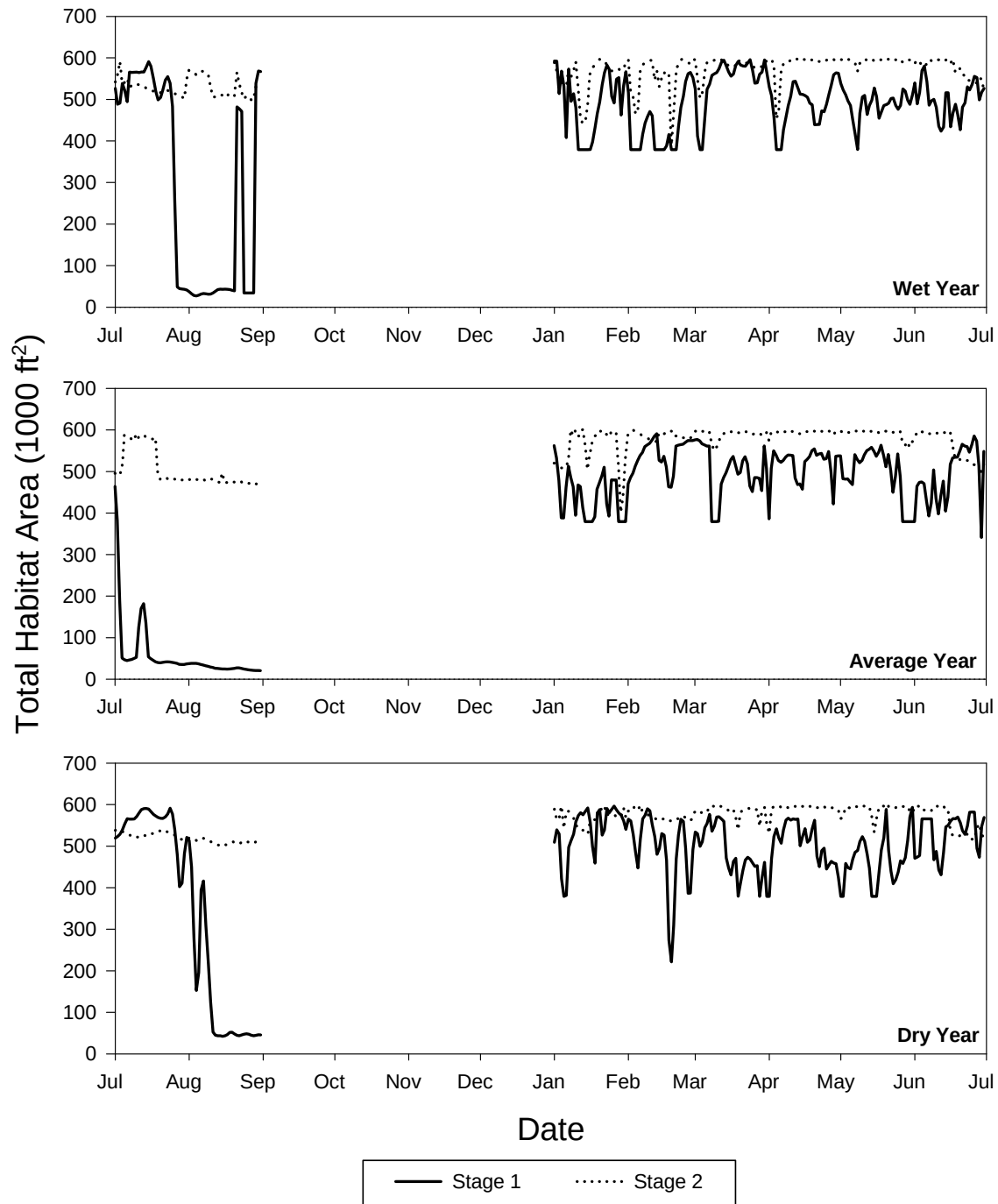


Figure D3-11. Time series analysis depicting total Chinook salmon juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

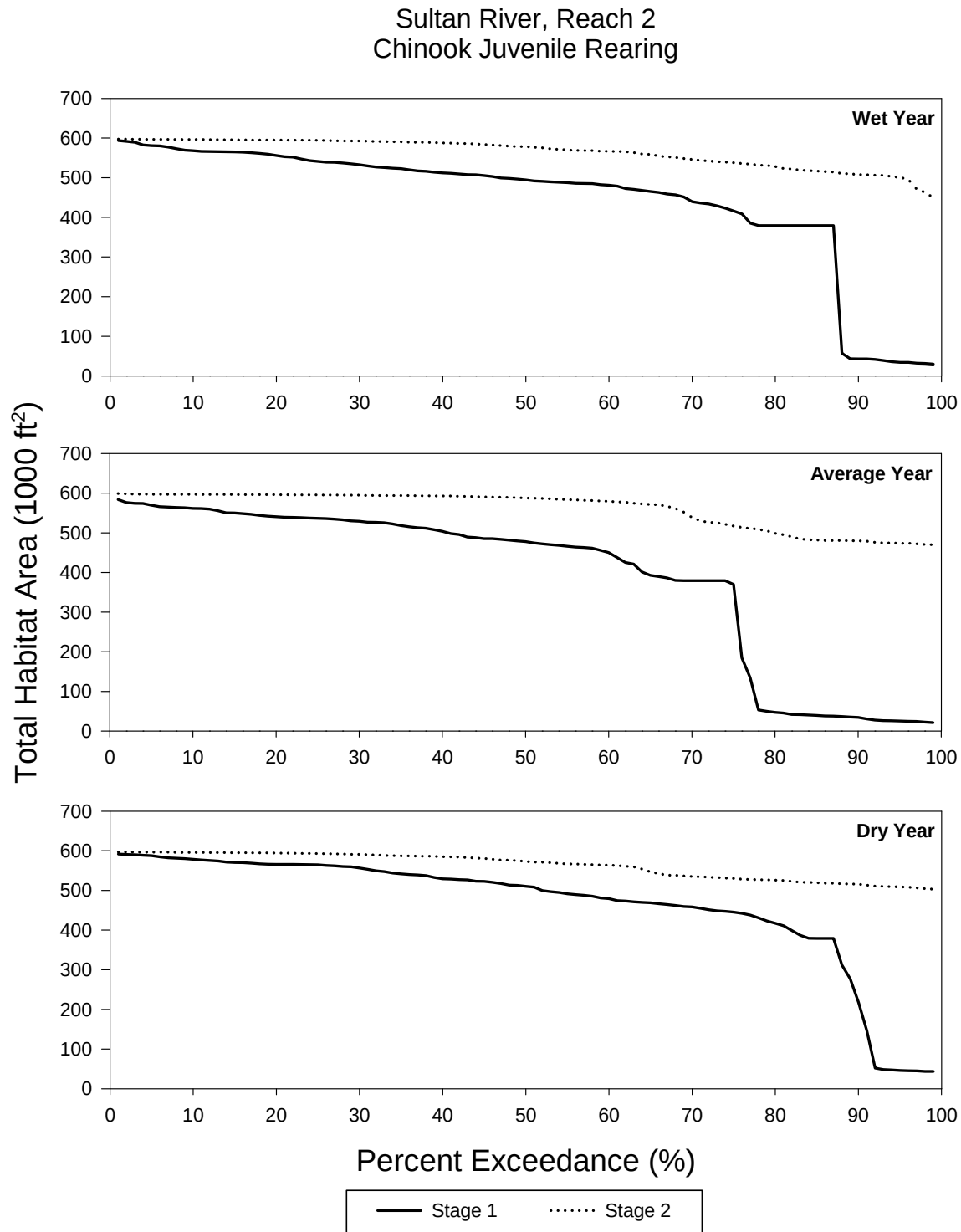


Figure D3-12. Habitat duration curves for Chinook salmon juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

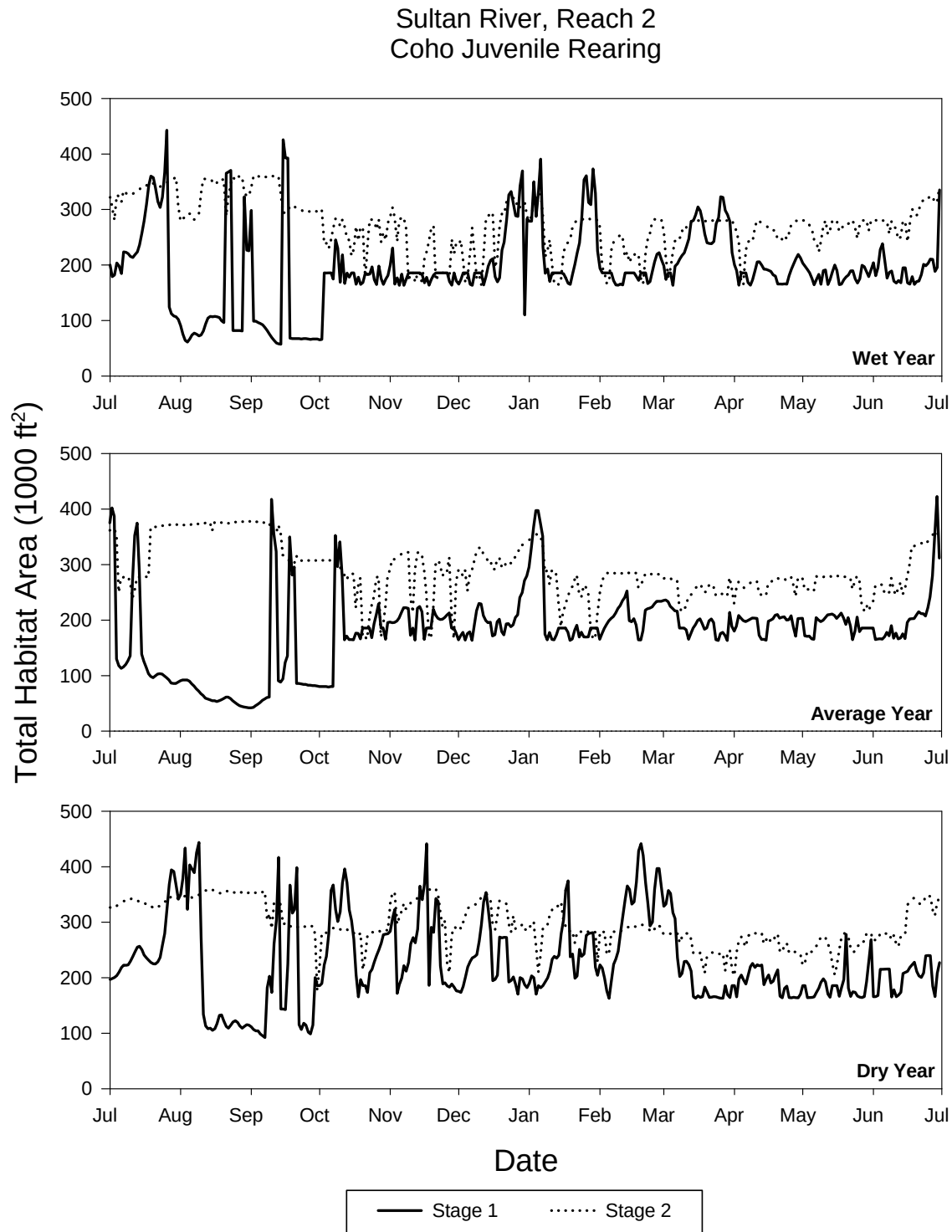


Figure D3-13. Time series analysis depicting total coho salmon juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

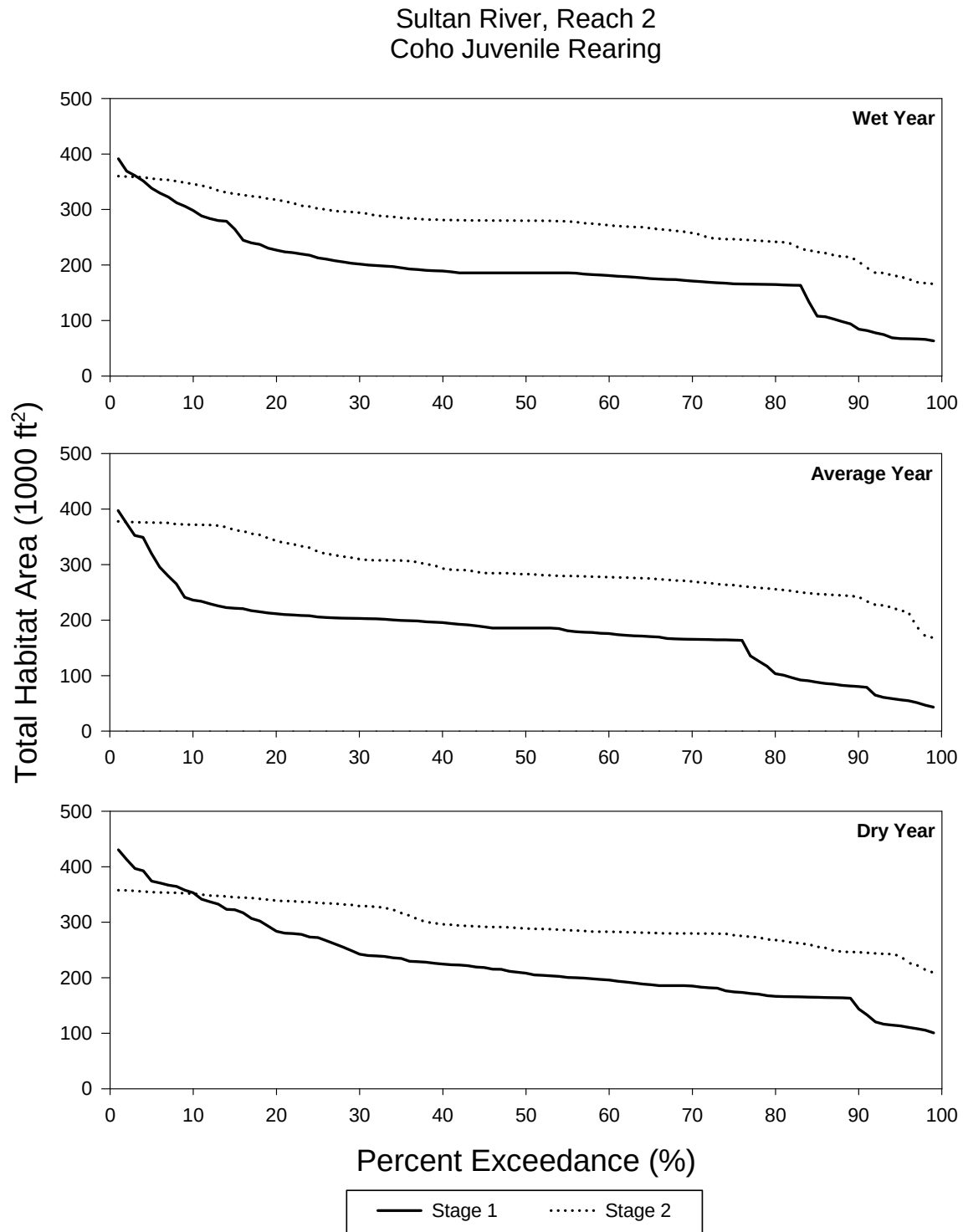


Figure D3-14. Habitat duration curves for coho salmon juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

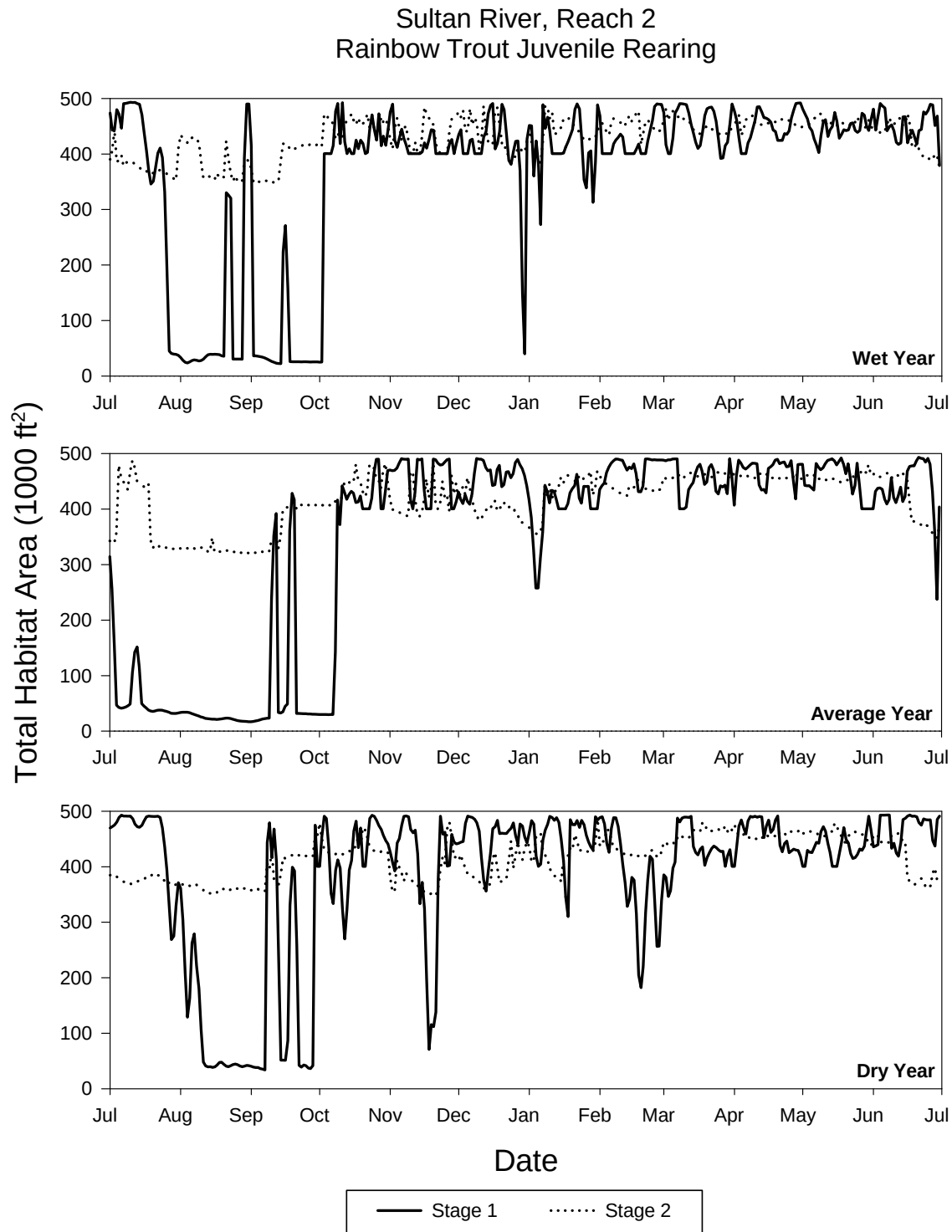


Figure D3-15. Time series analysis depicting total rainbow trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

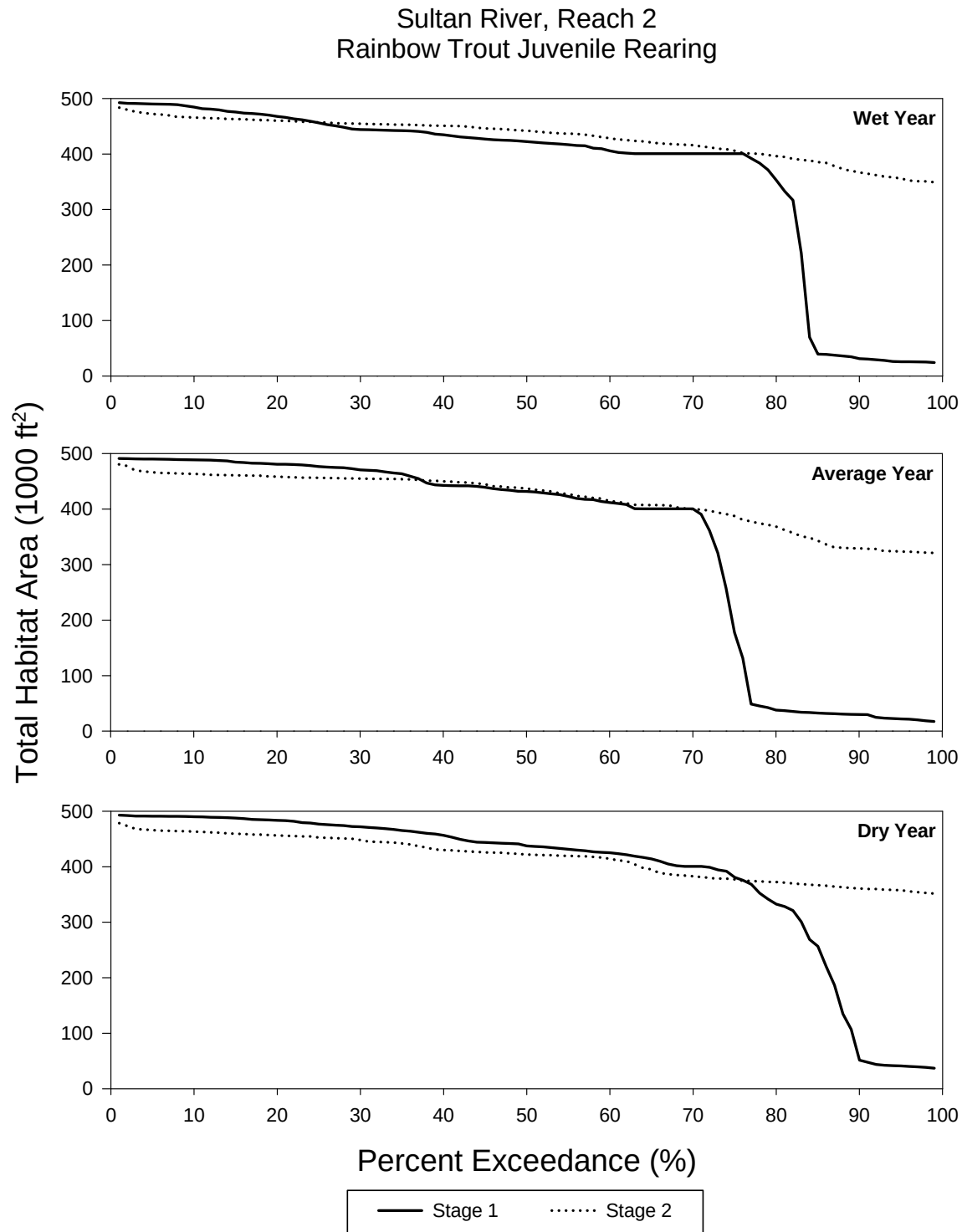


Figure D3-16. Habitat duration curves for rainbow trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

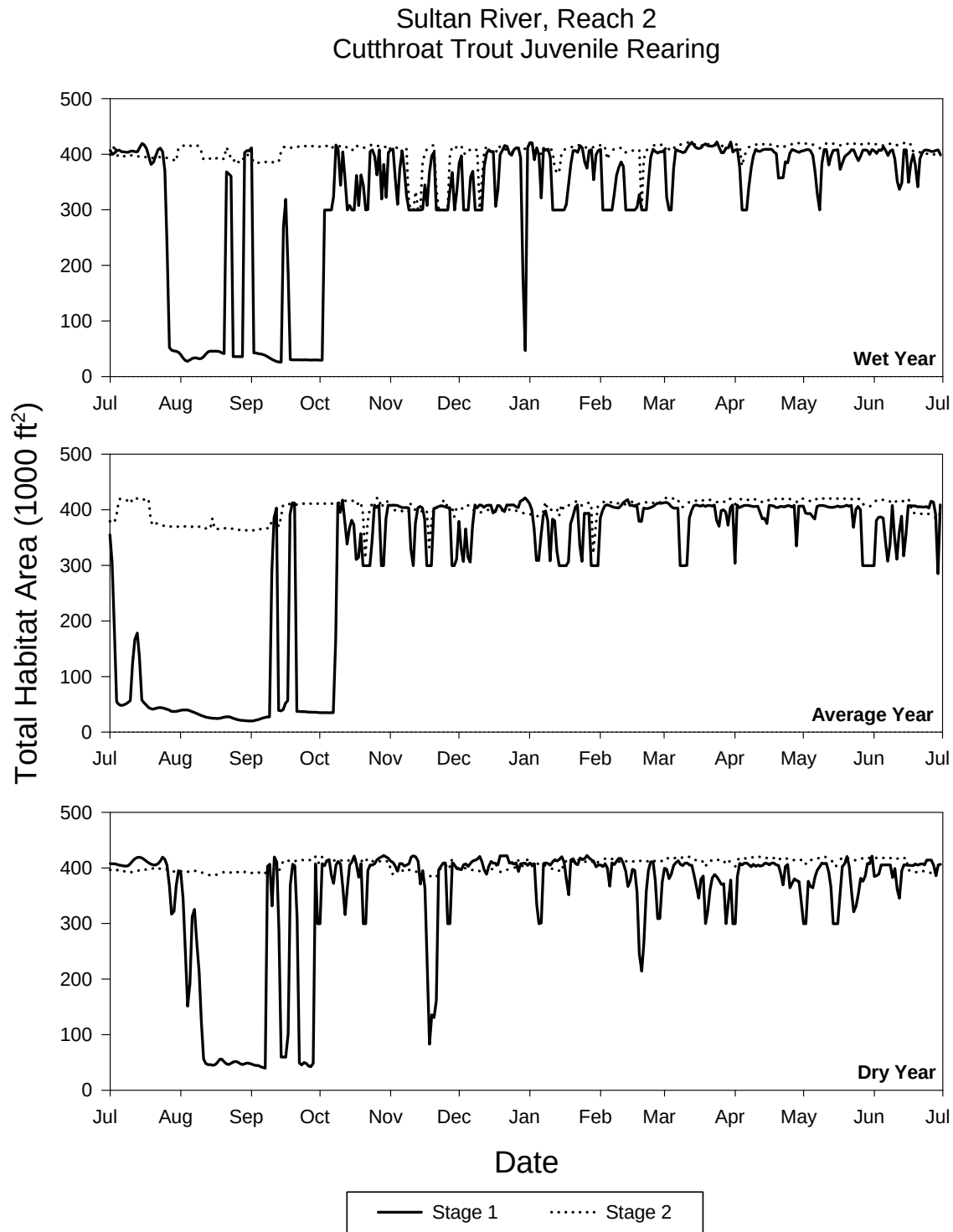


Figure D3-17. Time series analysis depicting total cutthroat trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

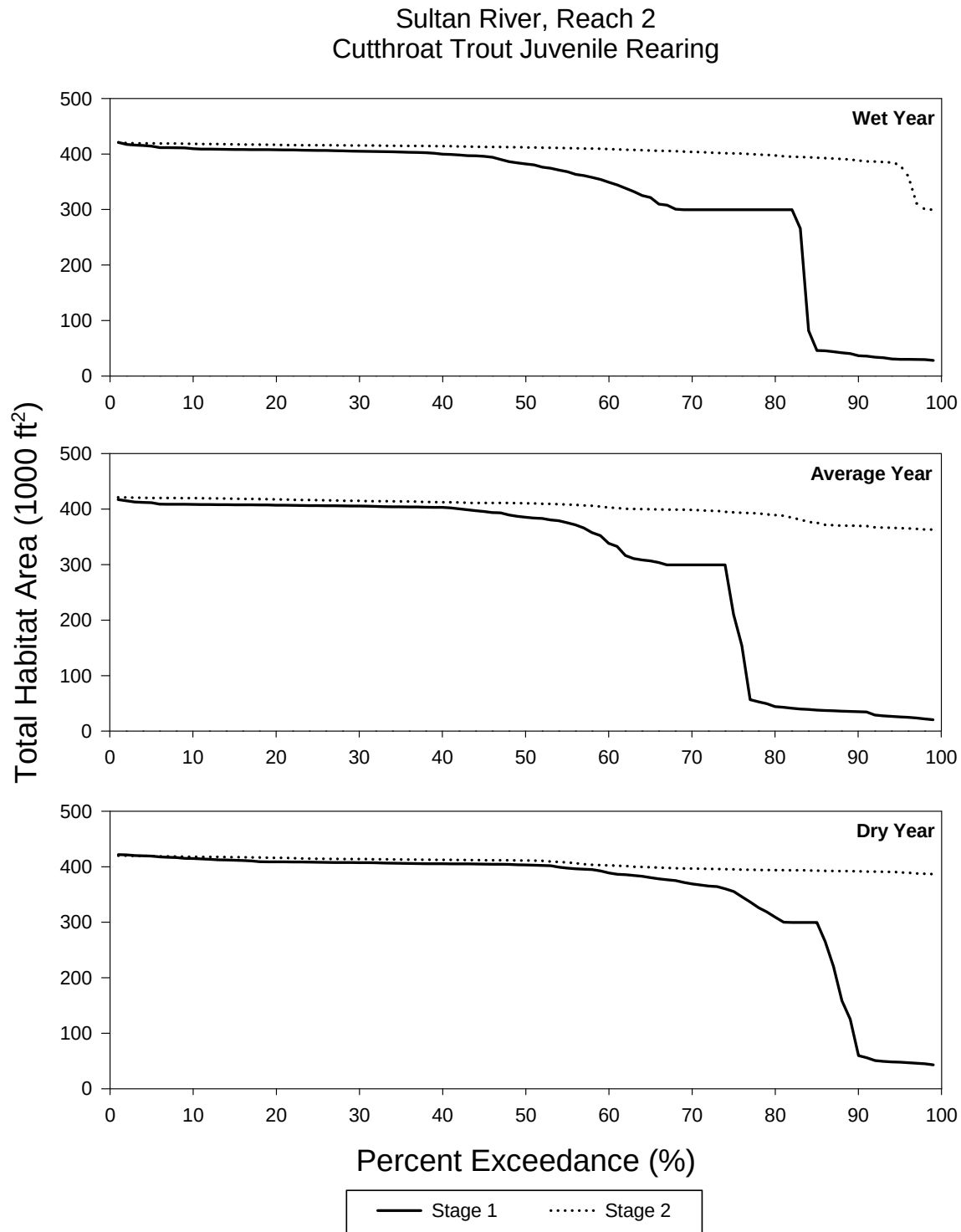


Figure D3-18. Habitat duration curves for cutthroat trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

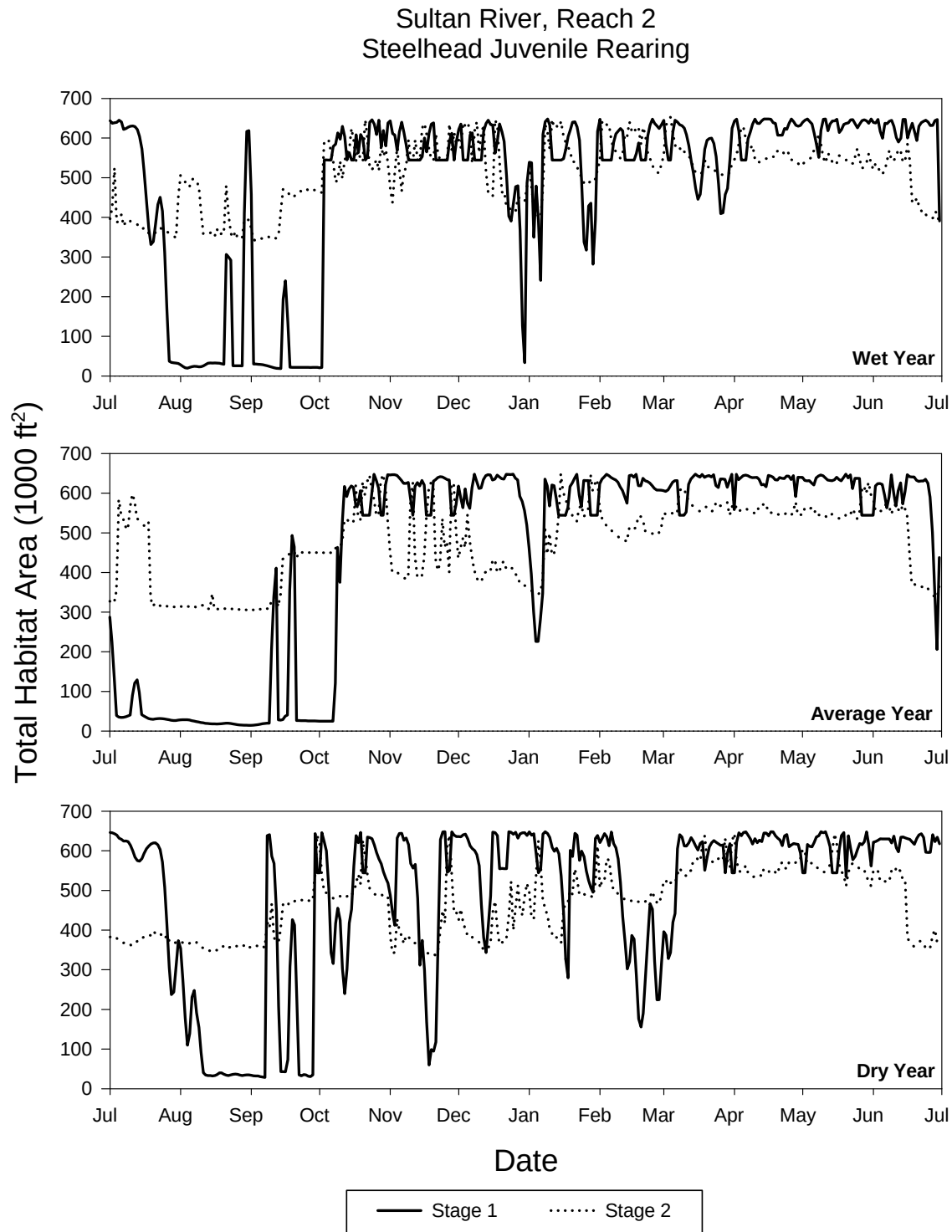


Figure D3-19. Time series analysis depicting total steelhead trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 2 of the Sultan River, Washington.

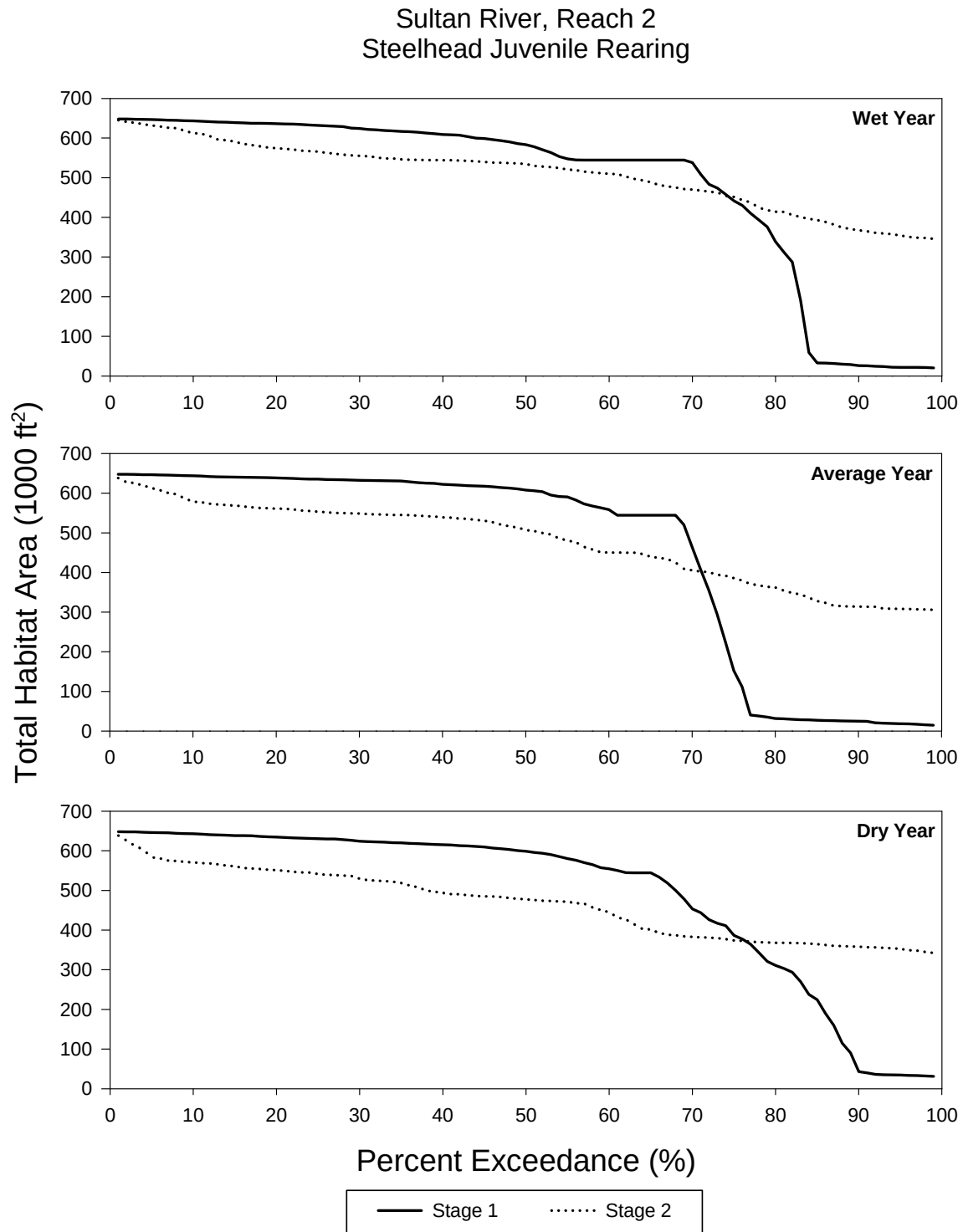


Figure D3-20. Habitat duration curves for steelhead trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 2 of the Sultan River, Washington.

APPENDIX D4

Time Series Analysis for Reach 1 – Sultan River

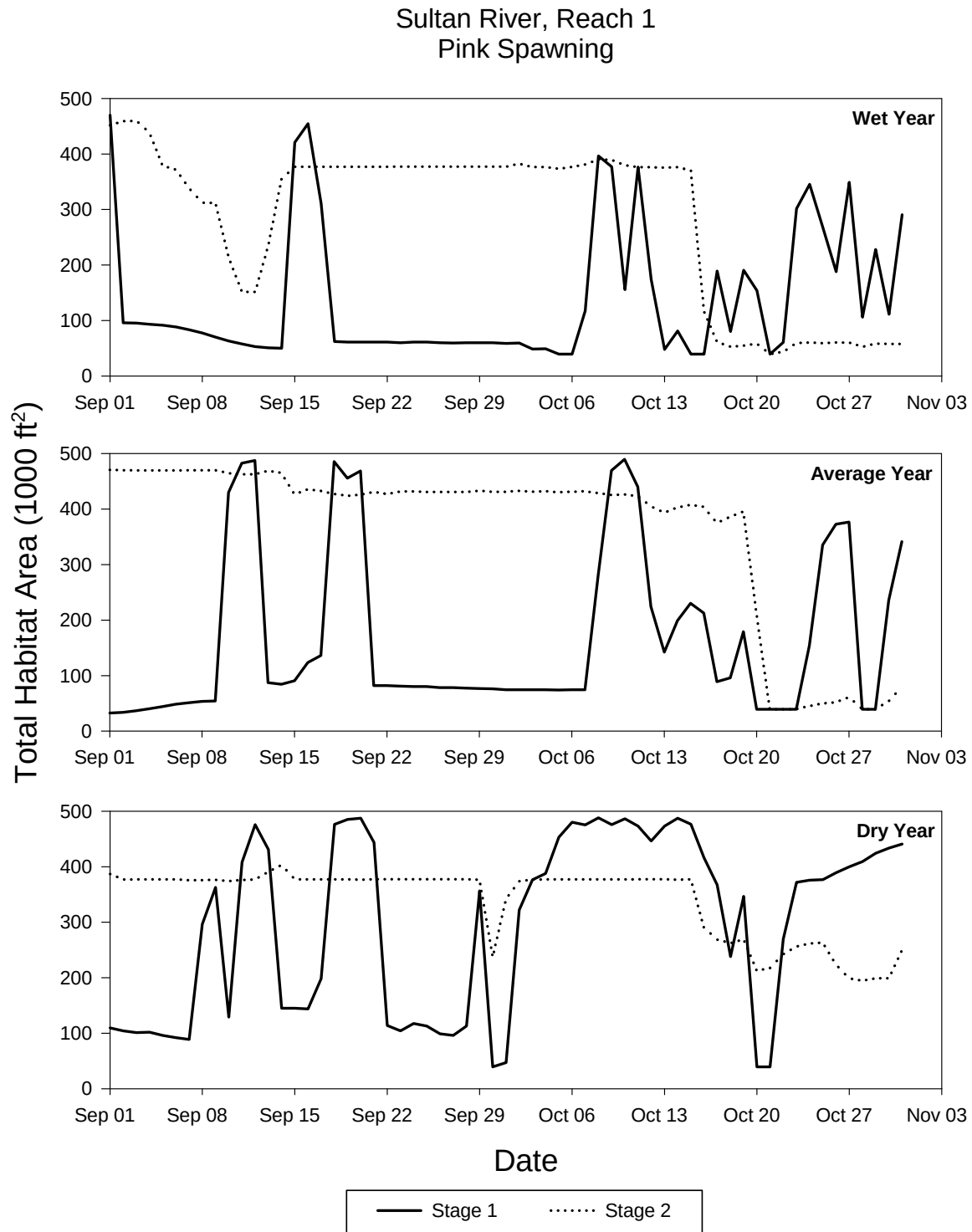


Figure D4-1. Time series analysis depicting total pink salmon spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

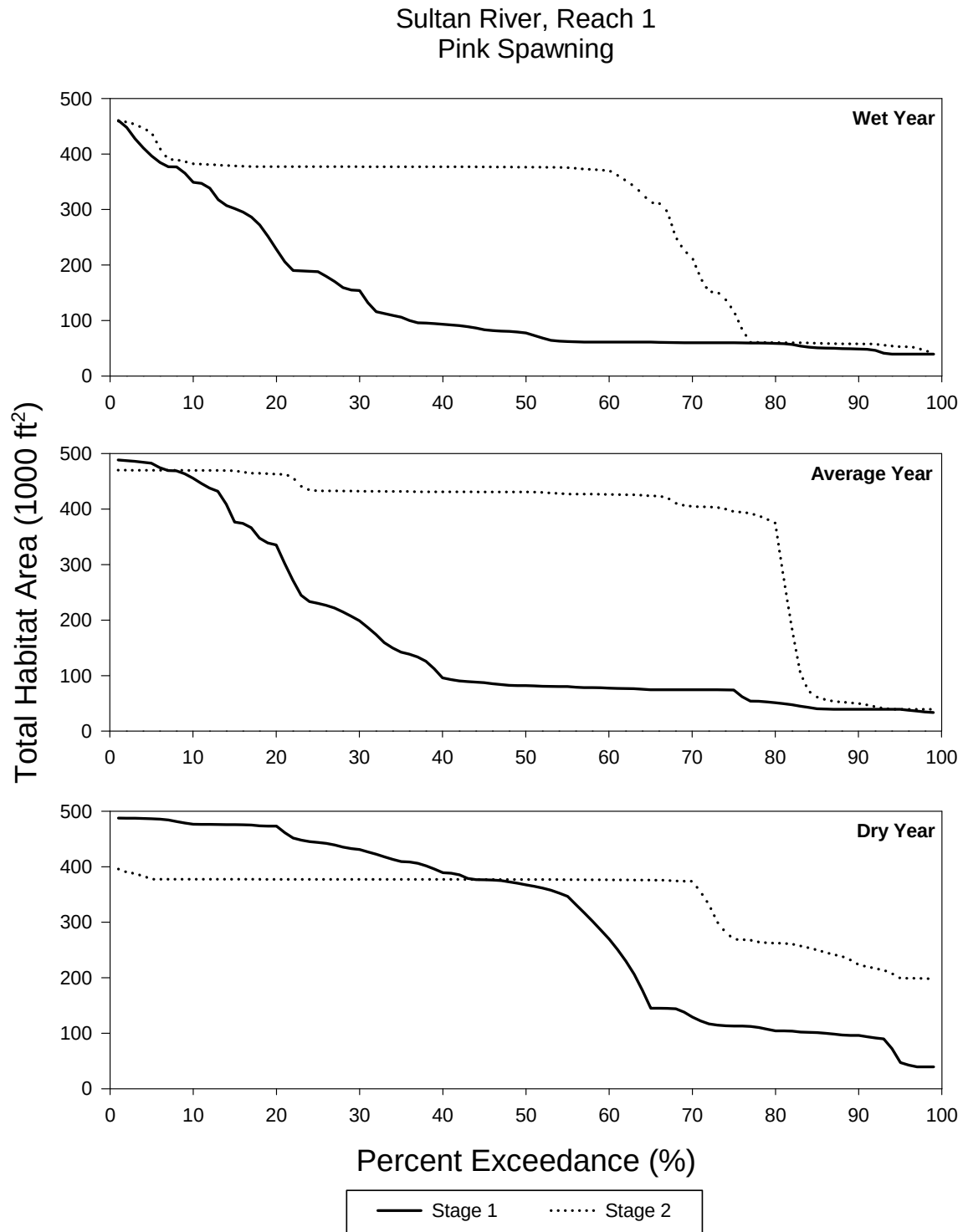


Figure D4-2. Habitat duration curves for pink salmon spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

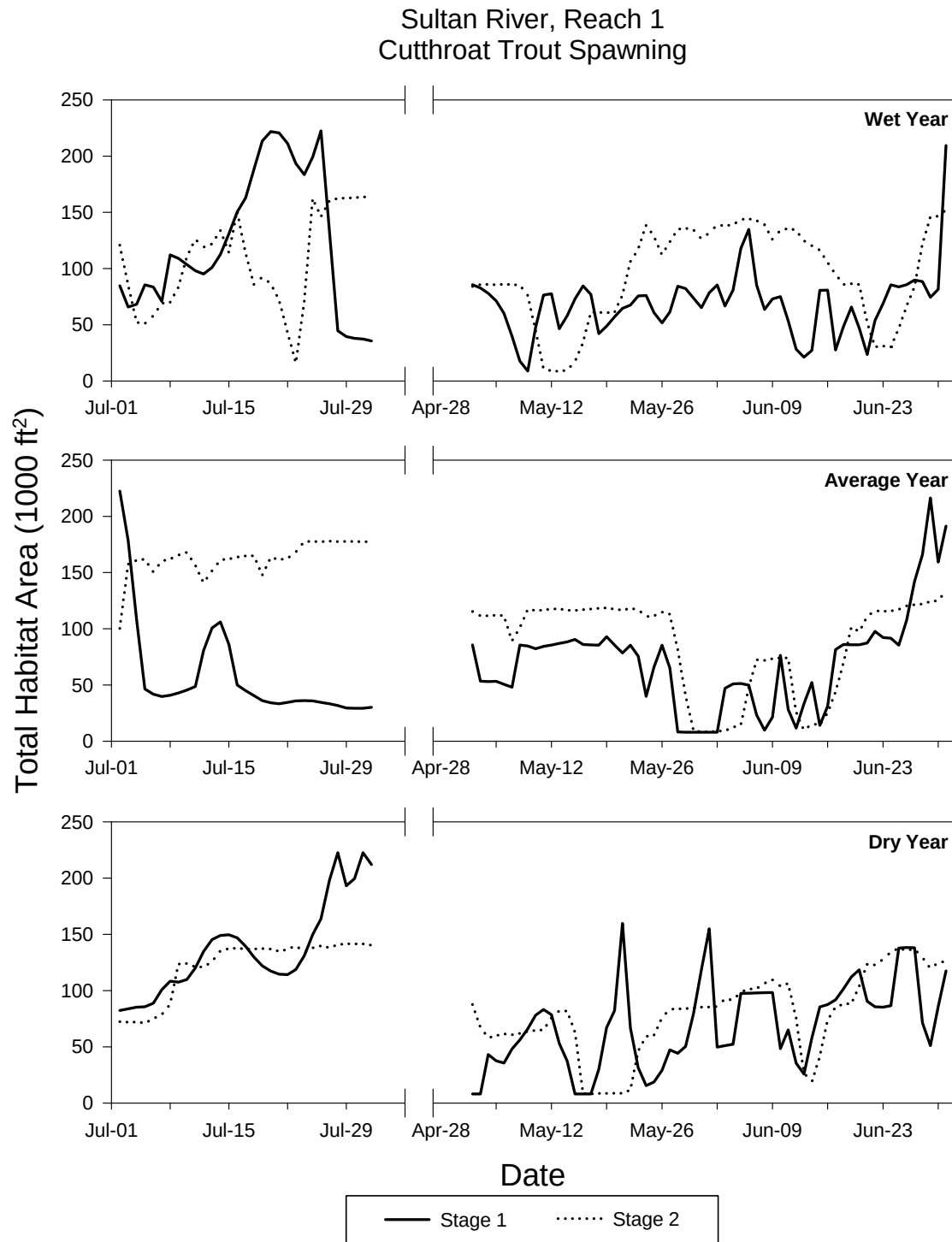


Figure D4-3. Time series analysis depicting total cutthroat trout spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

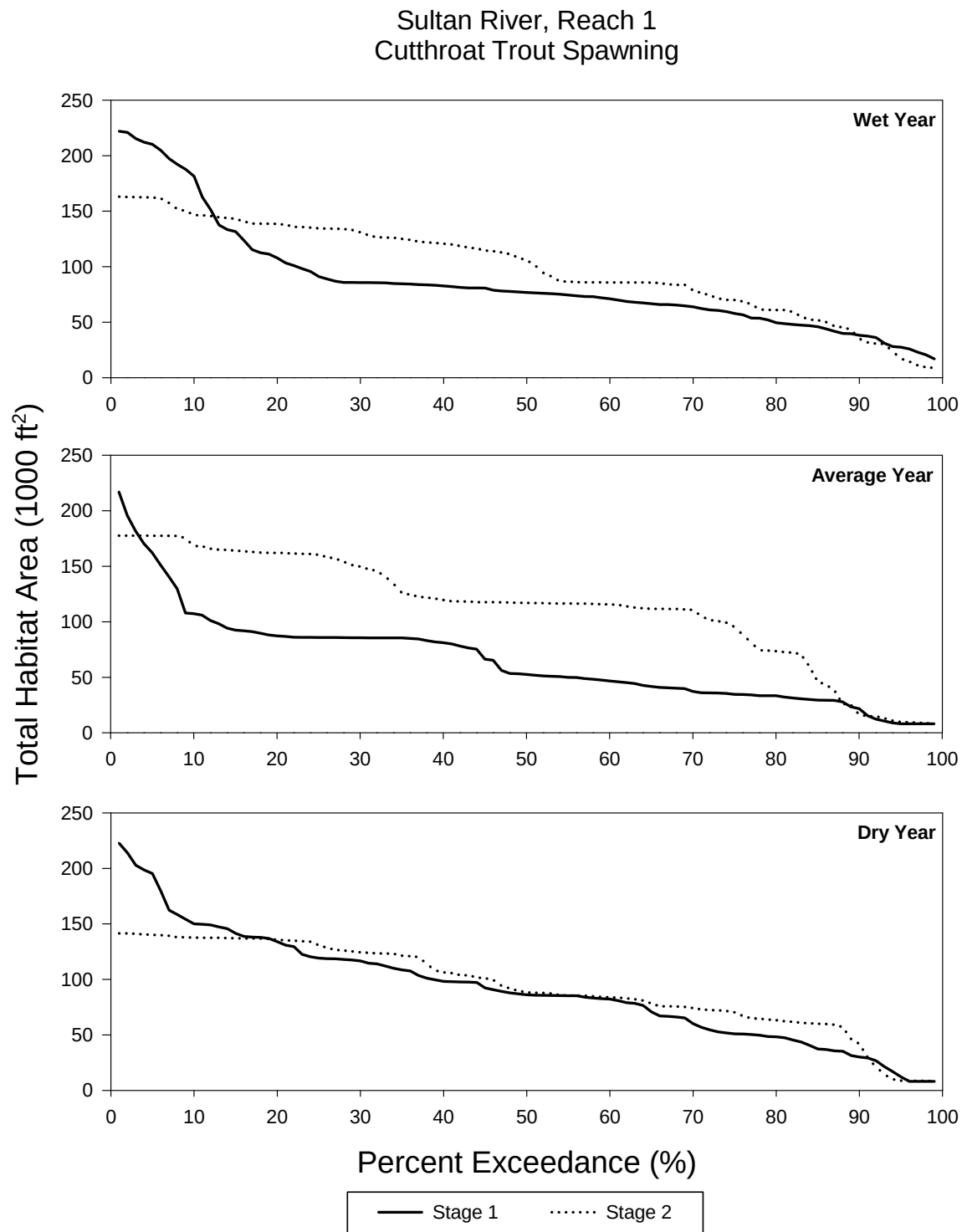


Figure D4-4. Habitat duration curves for cutthroat trout spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

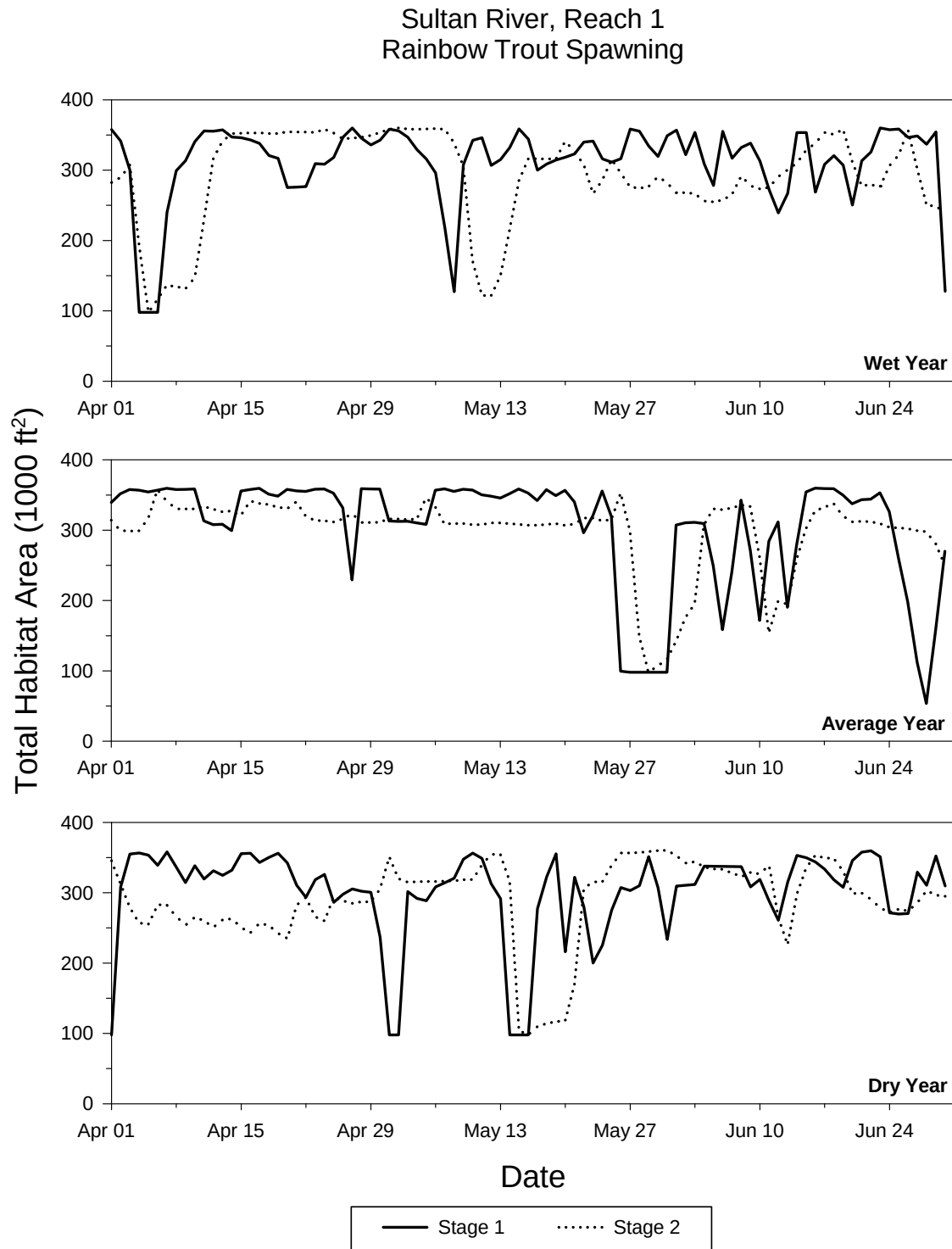


Figure D4-5. Time series analysis depicting total rainbow trout spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

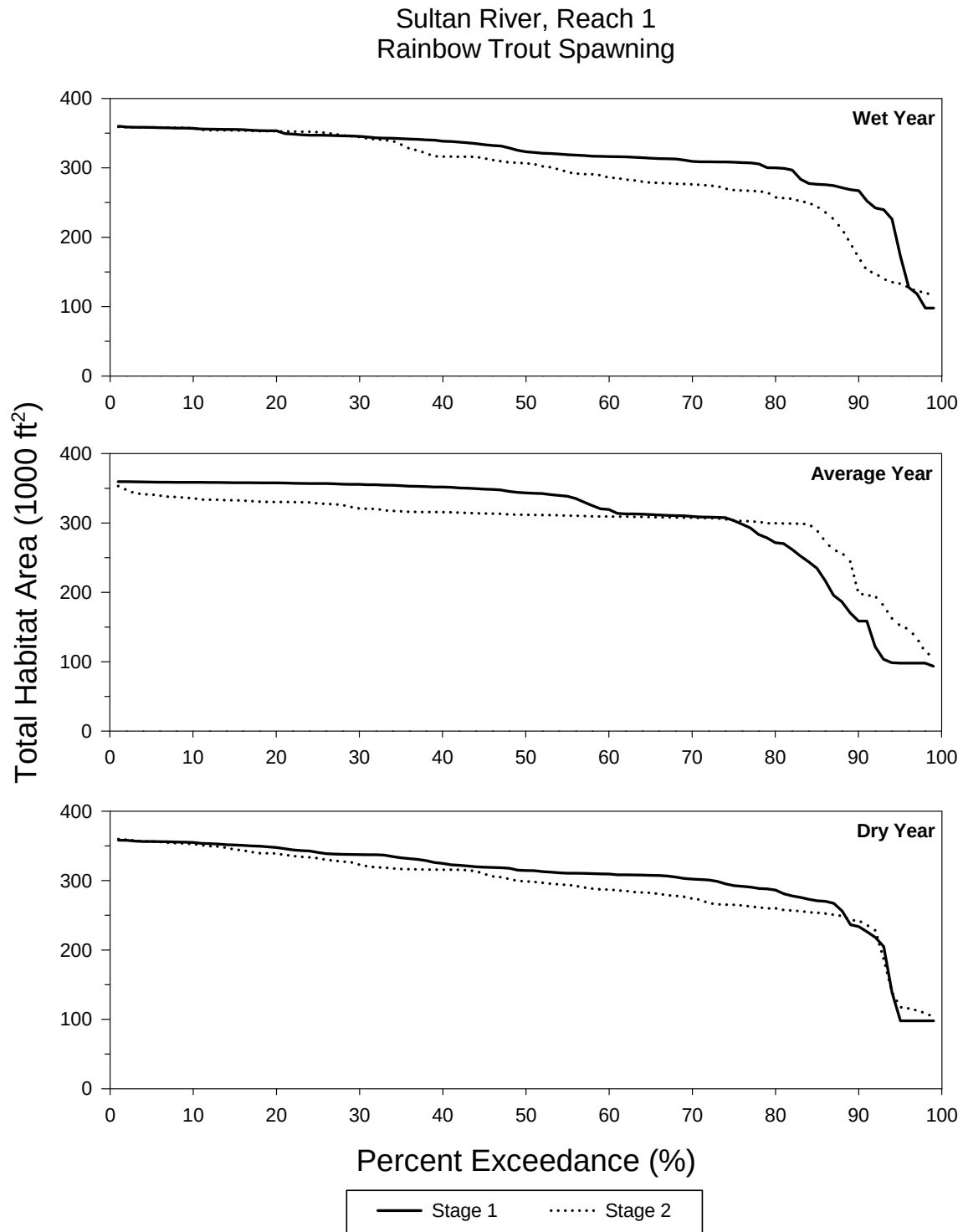


Figure D4-6. Habitat duration curves for rainbow trout spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

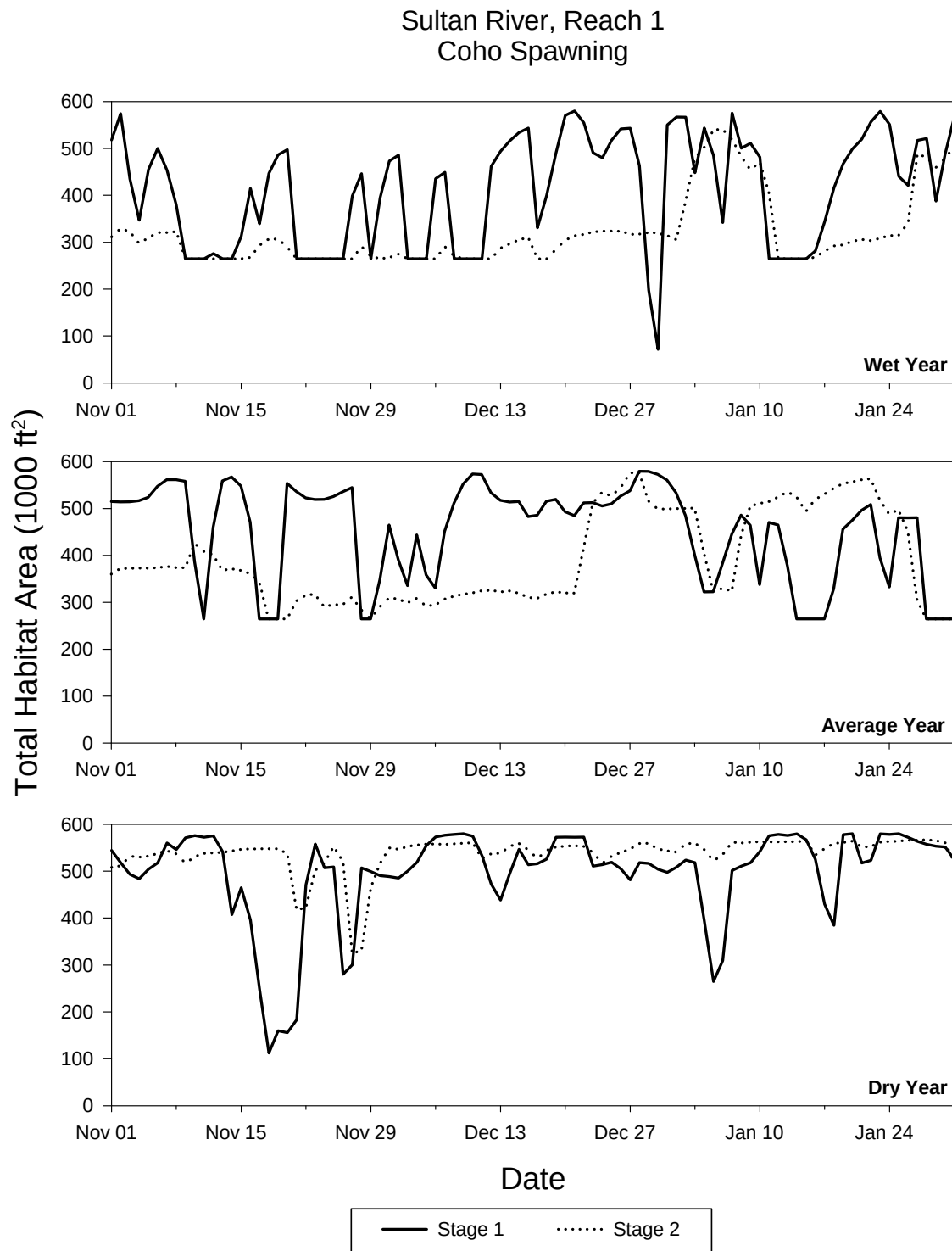


Figure D4-7. Time series analysis depicting total coho salmon spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

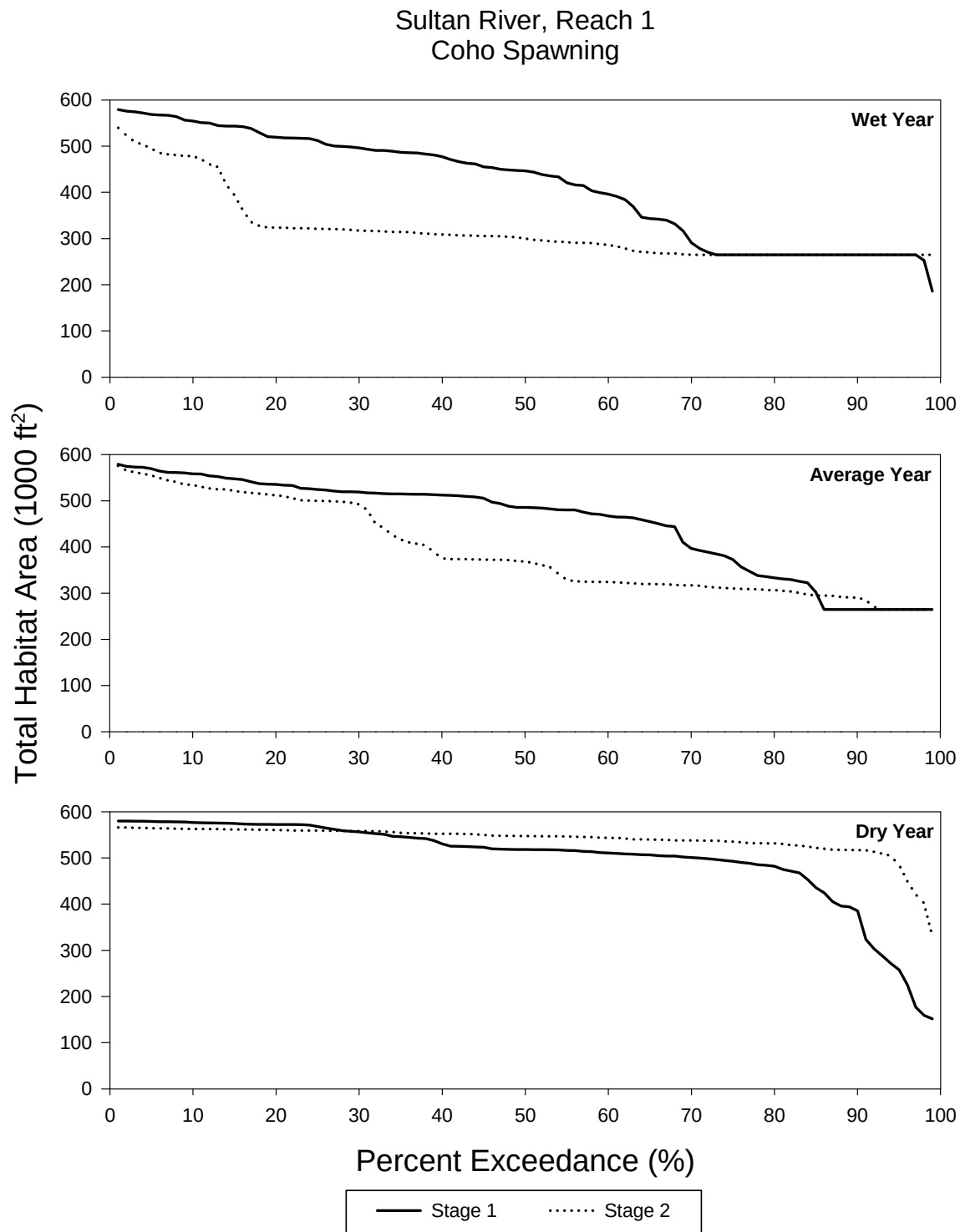


Figure D4-8. Habitat duration curves for coho salmon spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

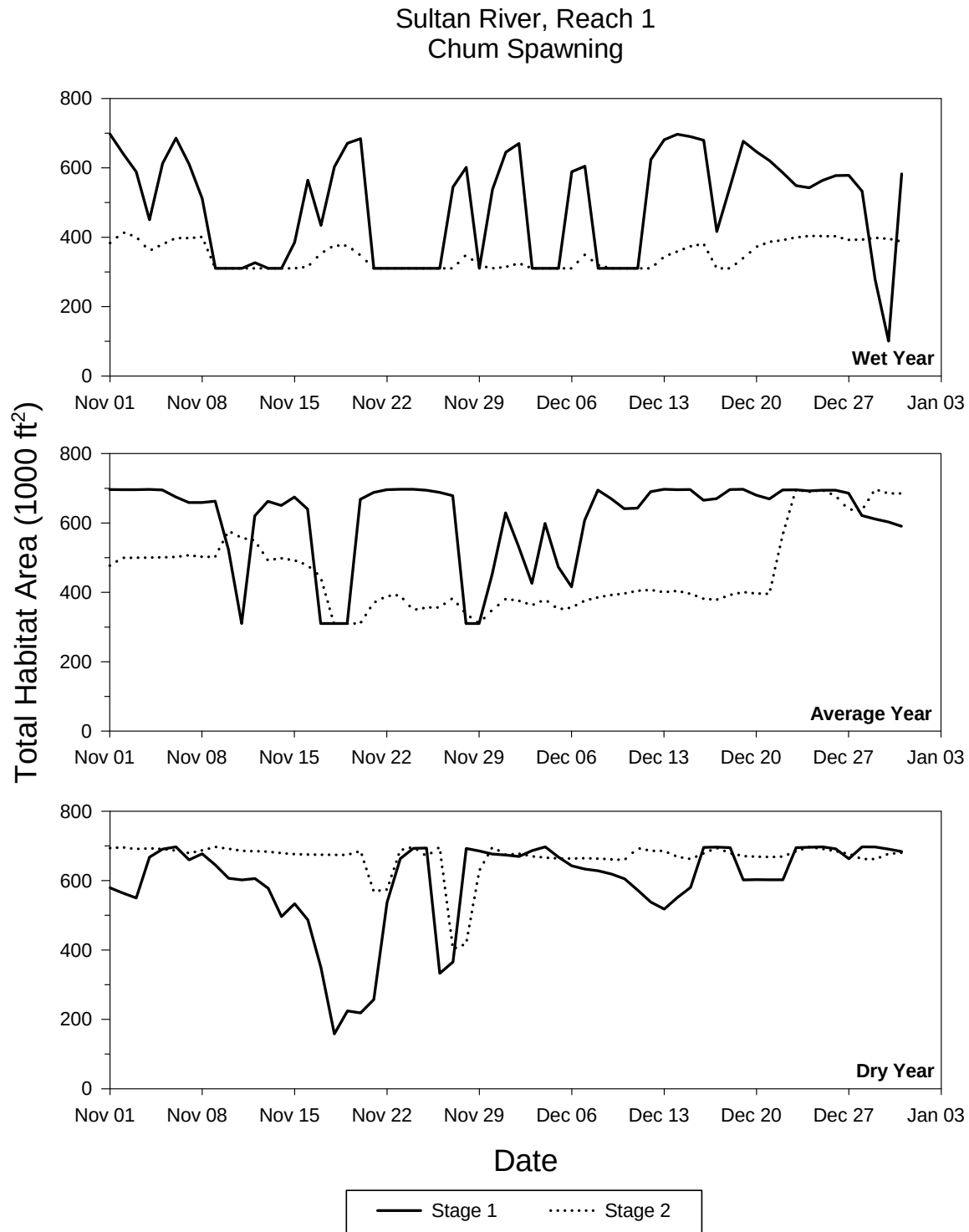


Figure D4-9. Time series analysis depicting total chum salmon spawning habitat (1000 ft²) available over the period of spawning under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

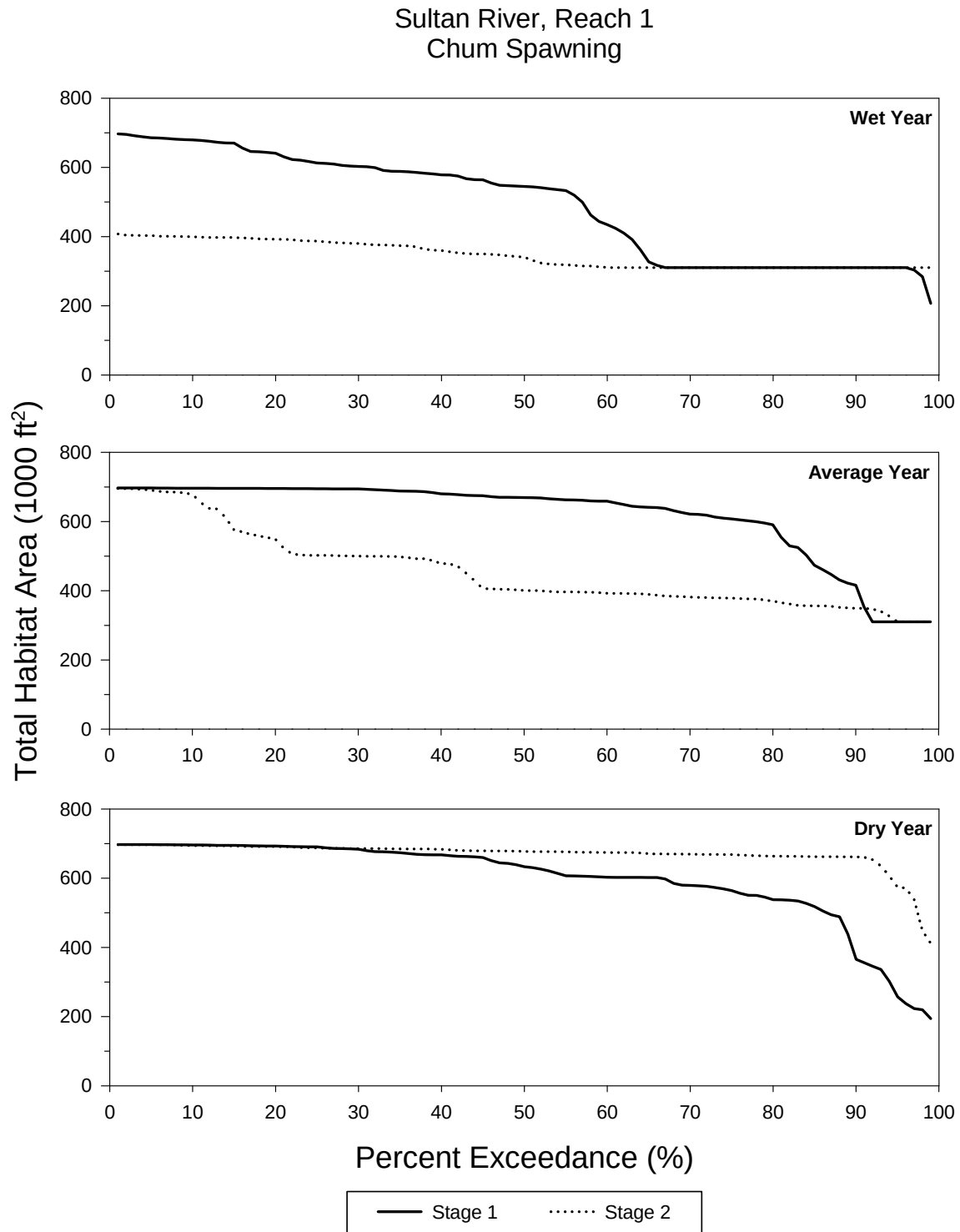


Figure D4-10. Habitat duration curves for chum salmon spawning habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

Sultan River, Reach 1 Chinook Juvenile Rearing

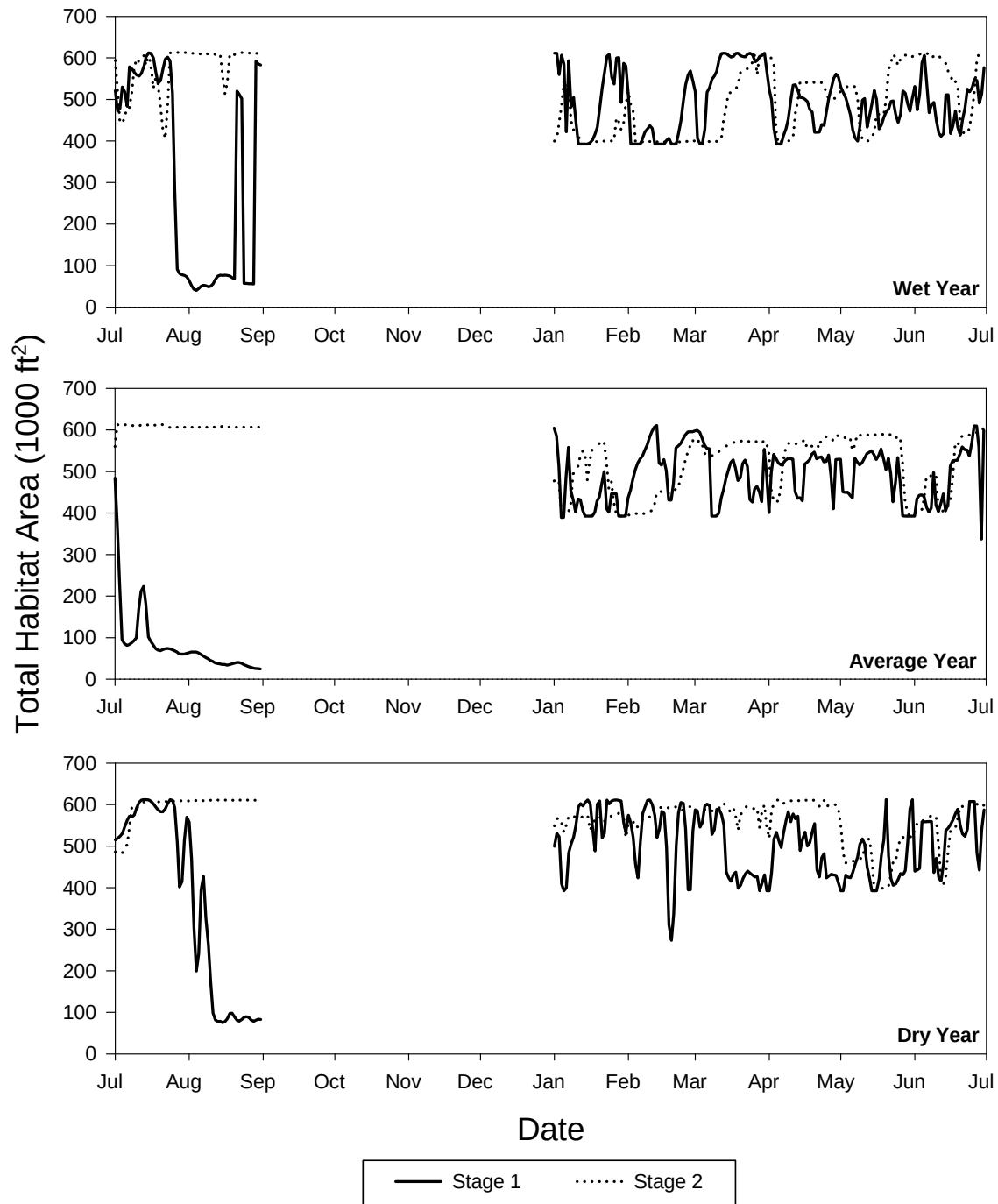


Figure D4-11. Time series analysis depicting total Chinook salmon juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

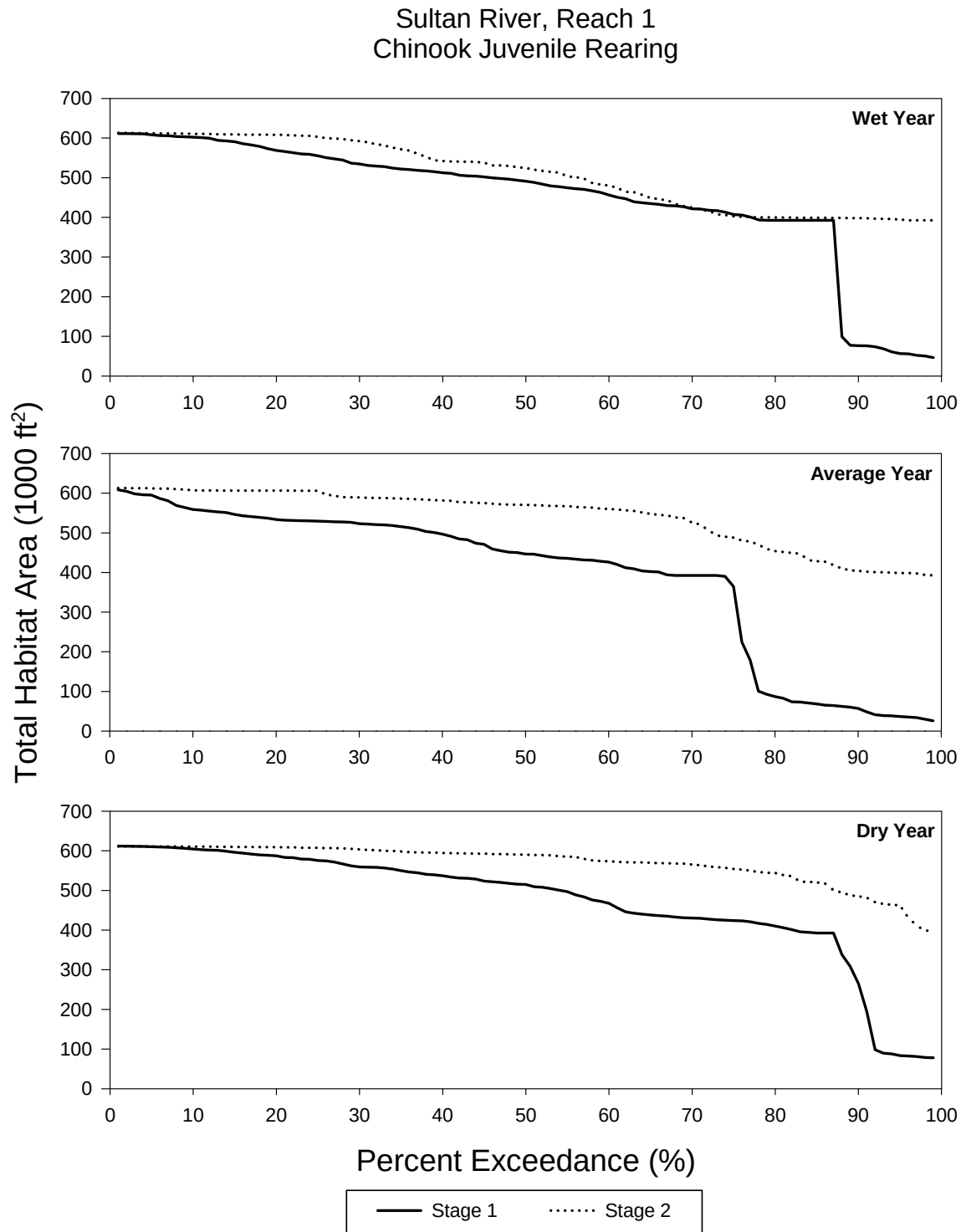


Figure D4-12. Habitat duration curves for Chinook salmon juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

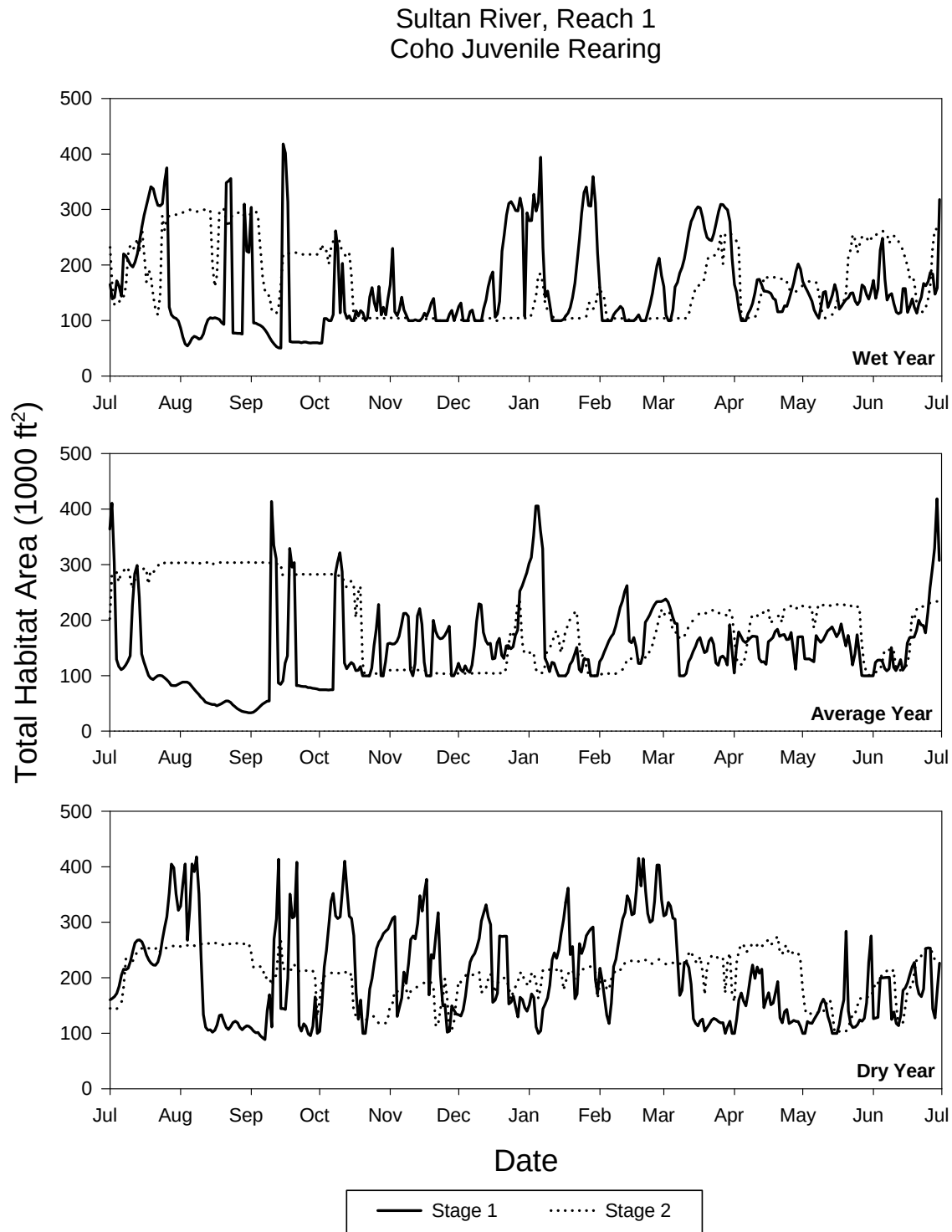


Figure D4-13. Time series analysis depicting total coho salmon juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

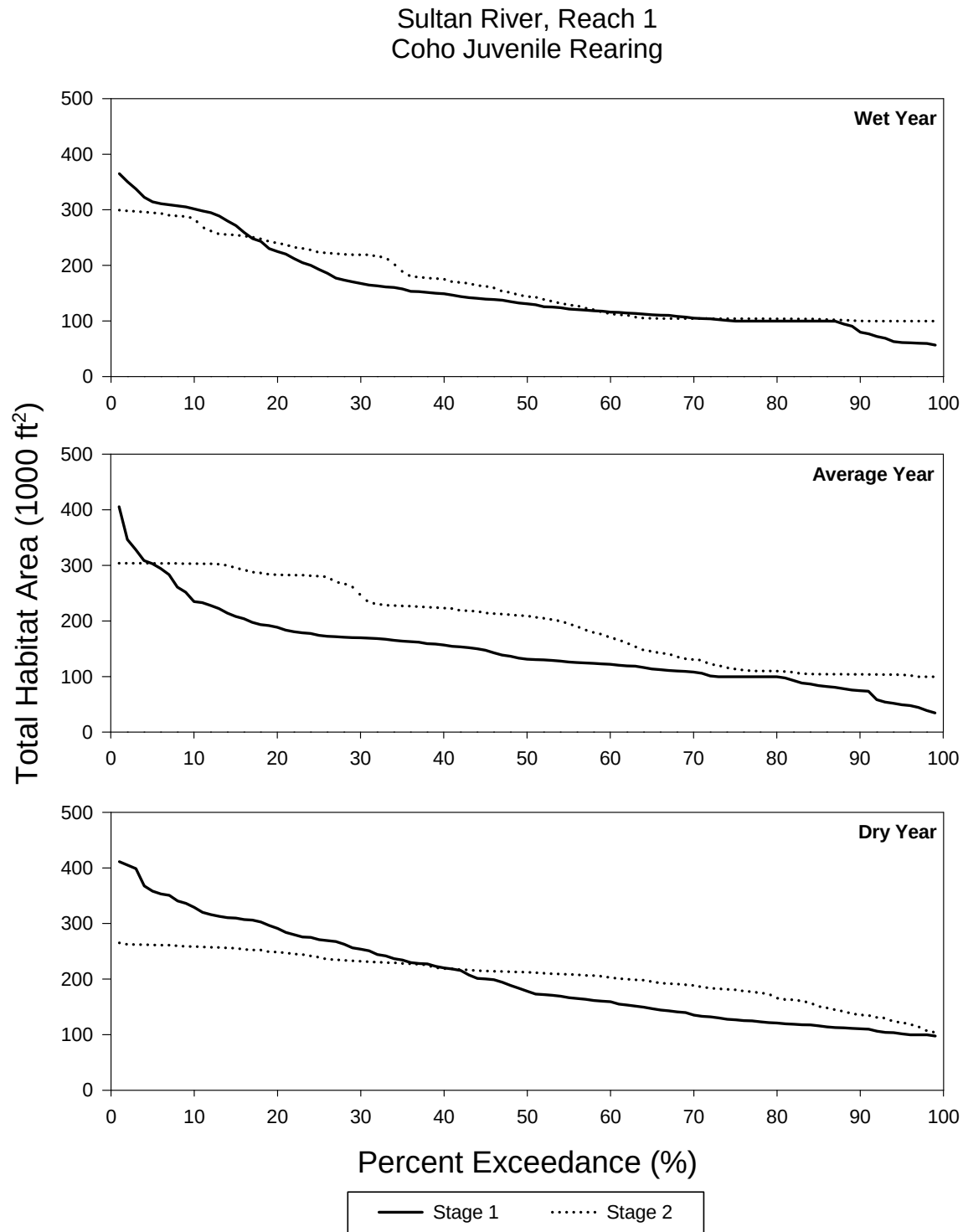


Figure D4-14. Habitat duration curves for coho salmon juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

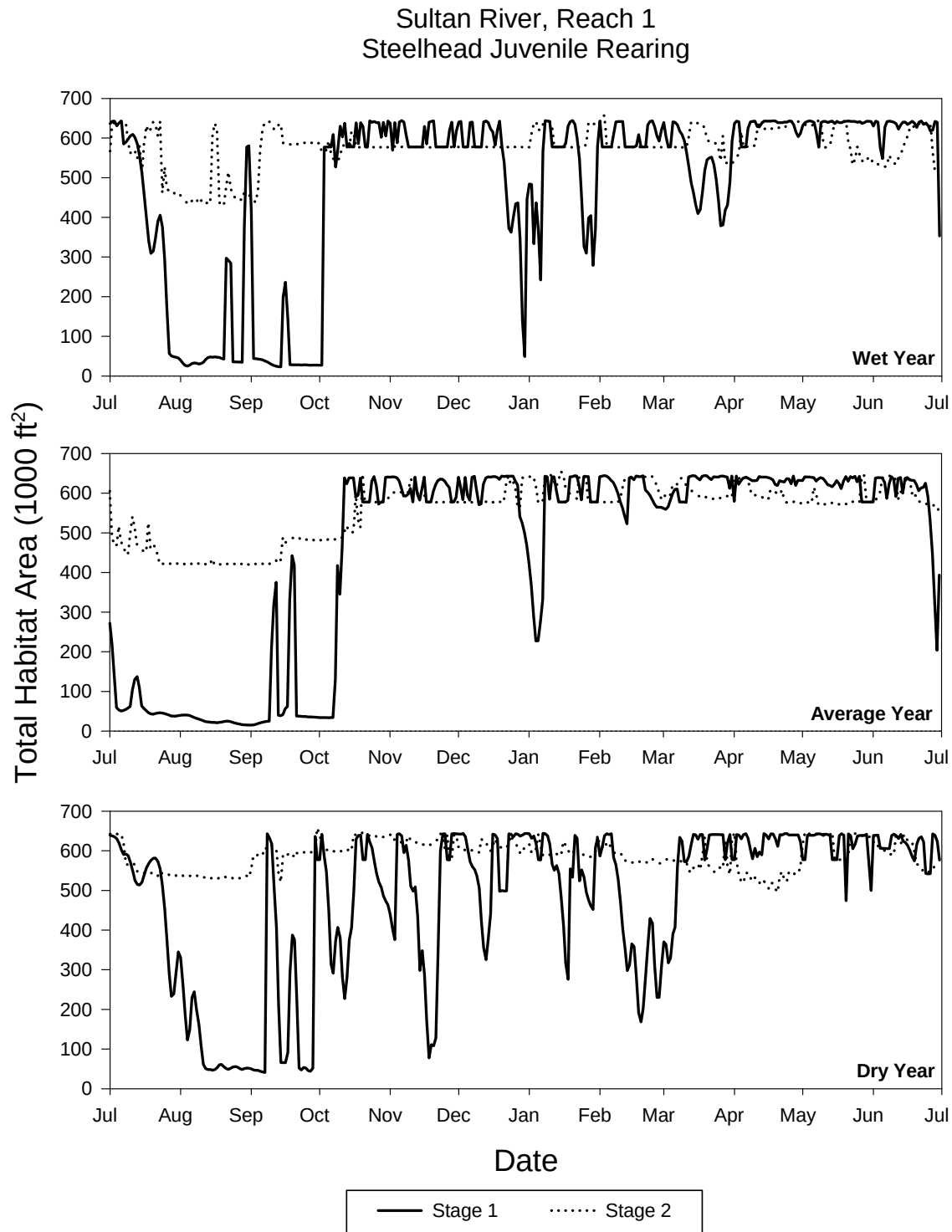


Figure D4-15. Time series analysis depicting total steelhead trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

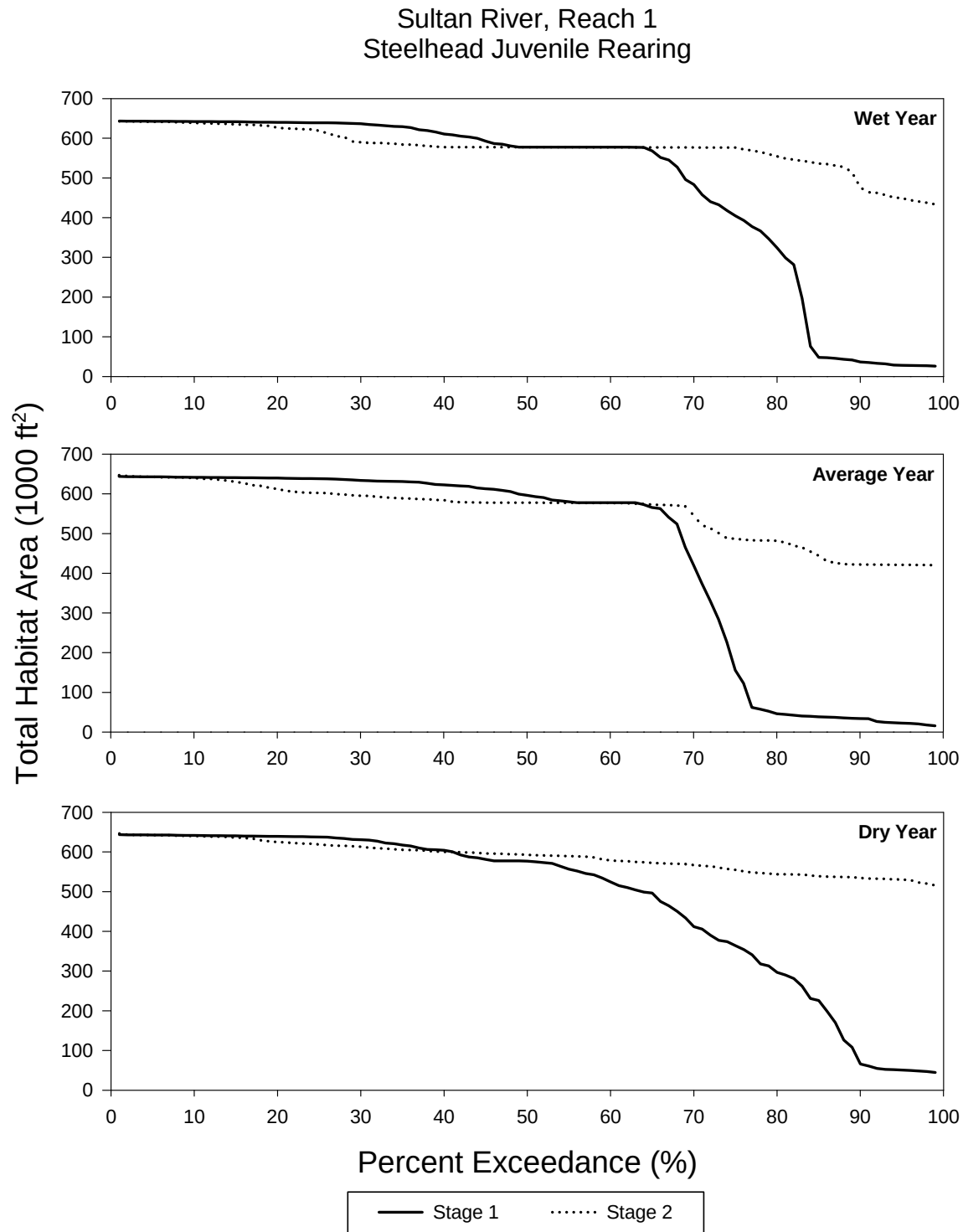


Figure D4-16. Habitat duration curves for steelhead trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

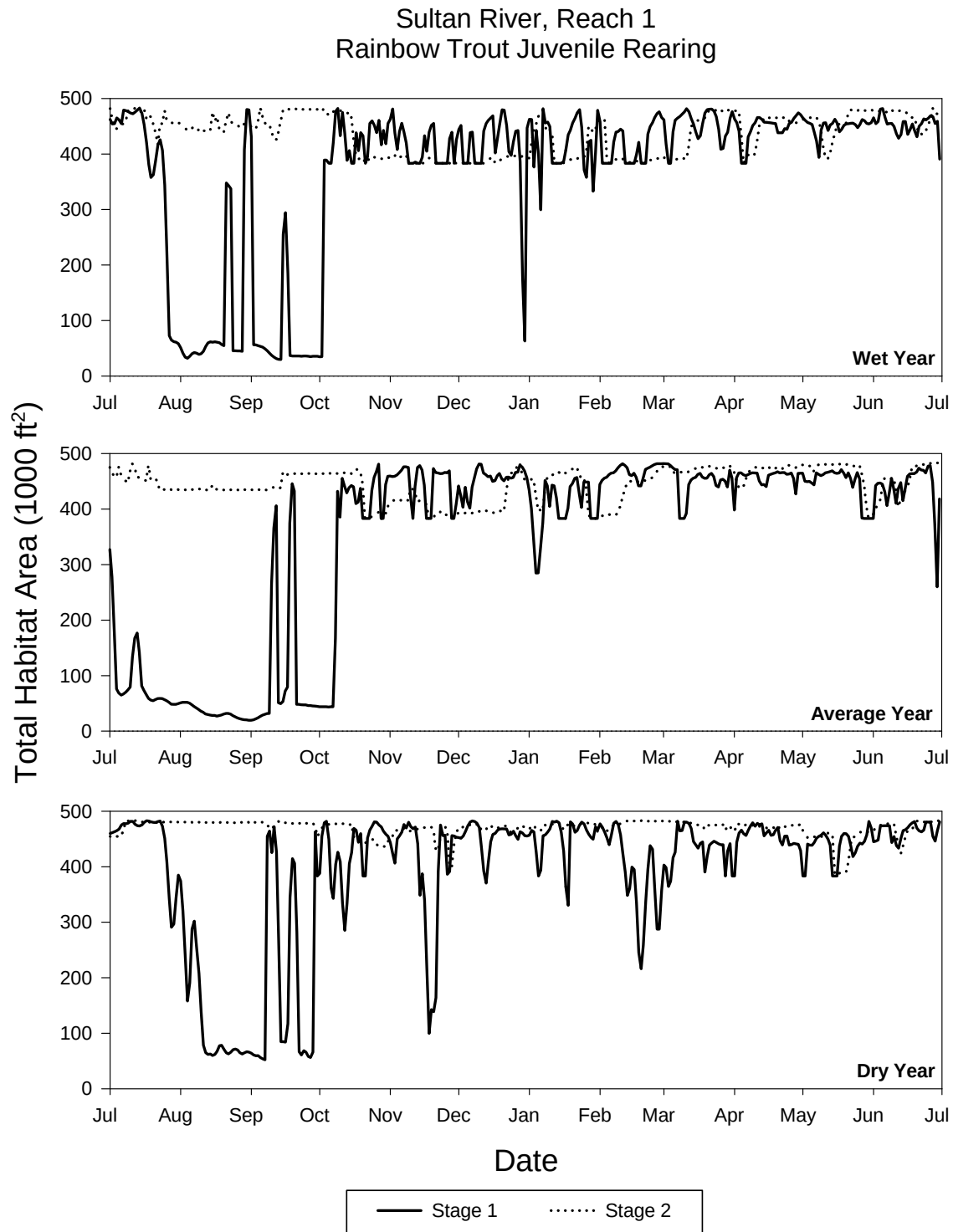


Figure D4-17. Time series analysis depicting total rainbow trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

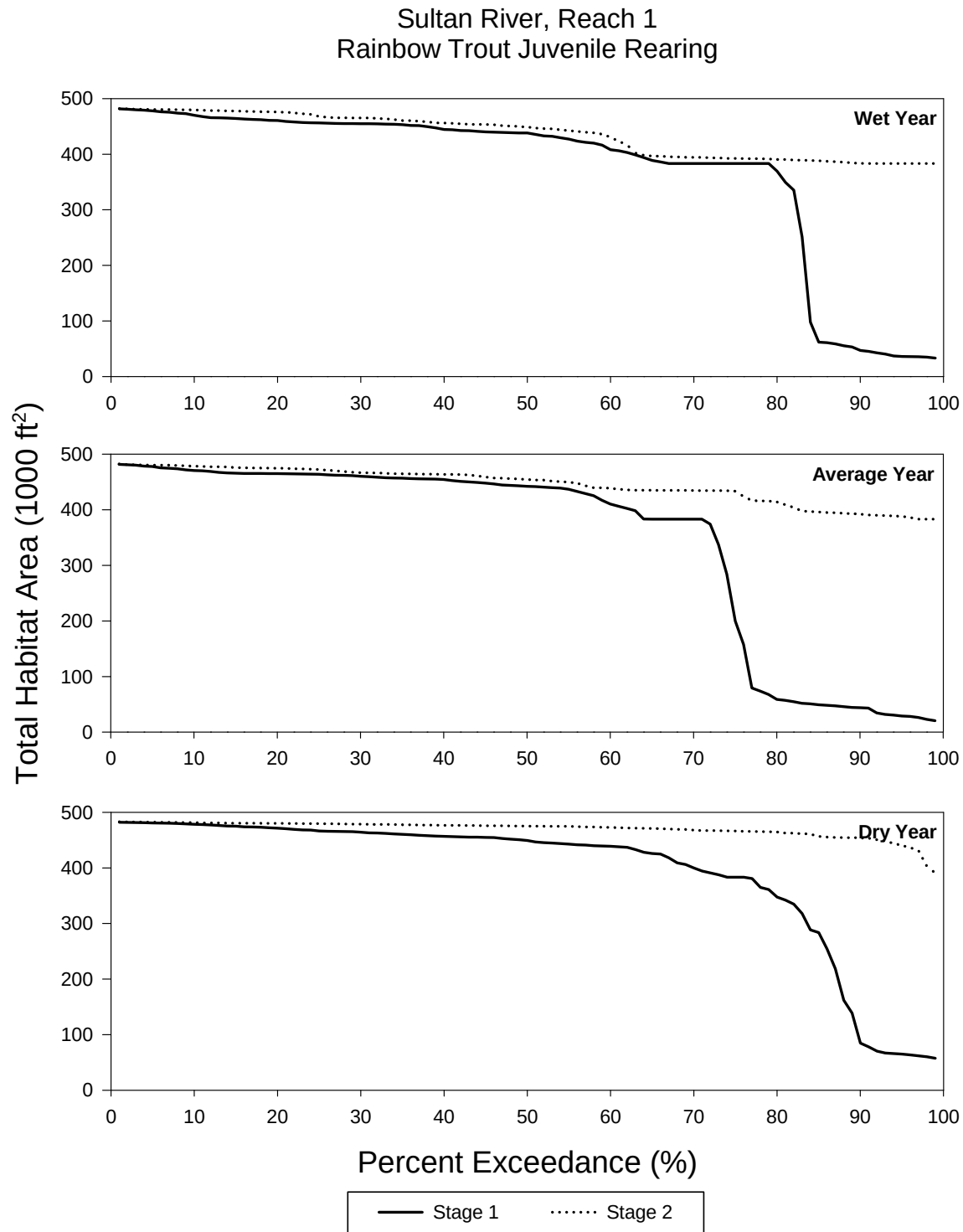


Figure D4-18. Habitat duration curves for rainbow trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

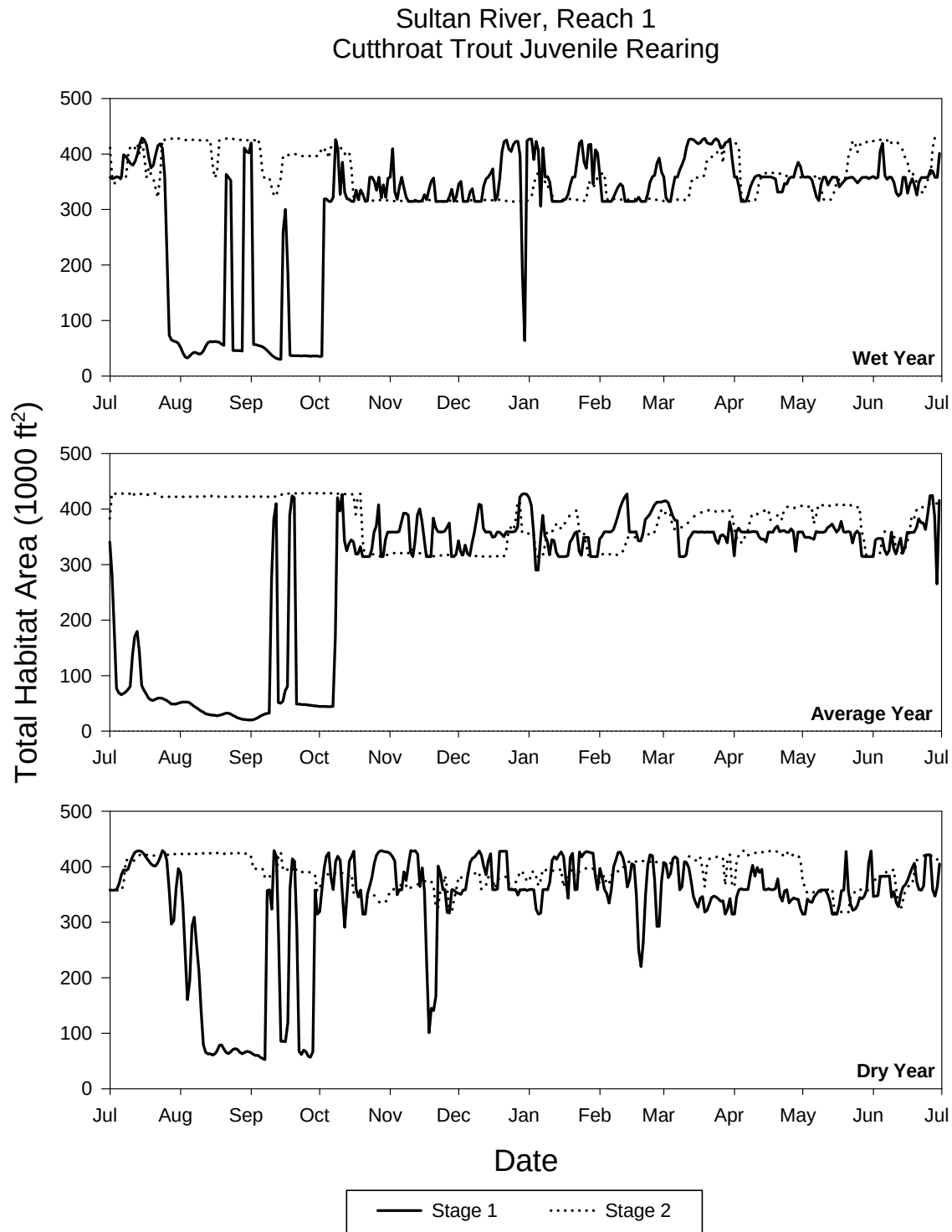


Figure D4-19. Time series analysis depicting total cutthroat trout juvenile rearing habitat (1000 ft²) available during the year under wet, average and dry year scenarios for Reach 1 of the Sultan River, Washington.

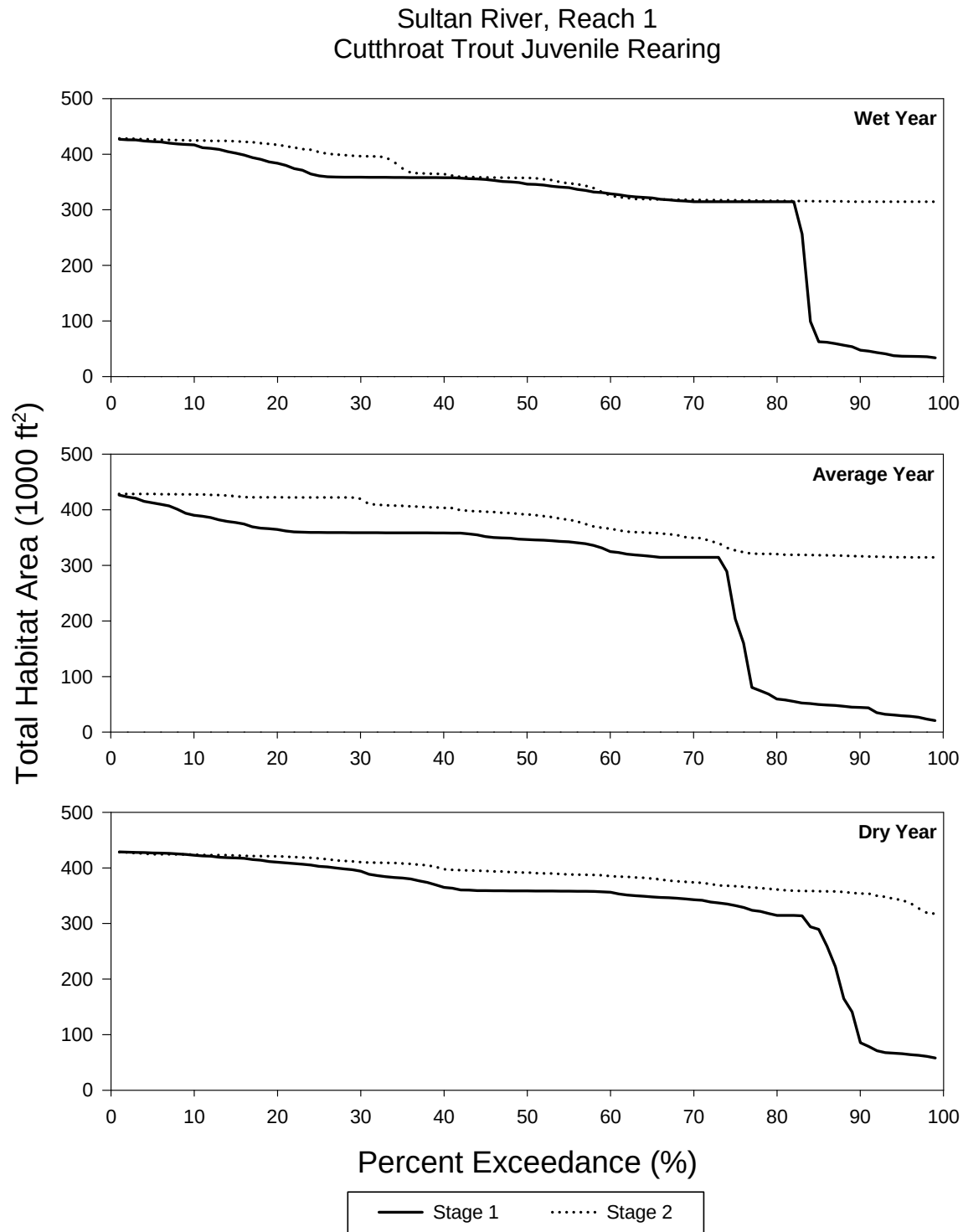


Figure D4-20. Habitat duration curves for cutthroat trout juvenile rearing habitat (1000 ft²) under wet, average, dry year scenarios for Reach 1 of the Sultan River, Washington.

APPENDIX D5

**Weighted Usable Area (ft²/1000 ft) Versus Flow (cfs) Relationships for the
Three Side Channels within Reach 1 of the Sultan River, Washington**

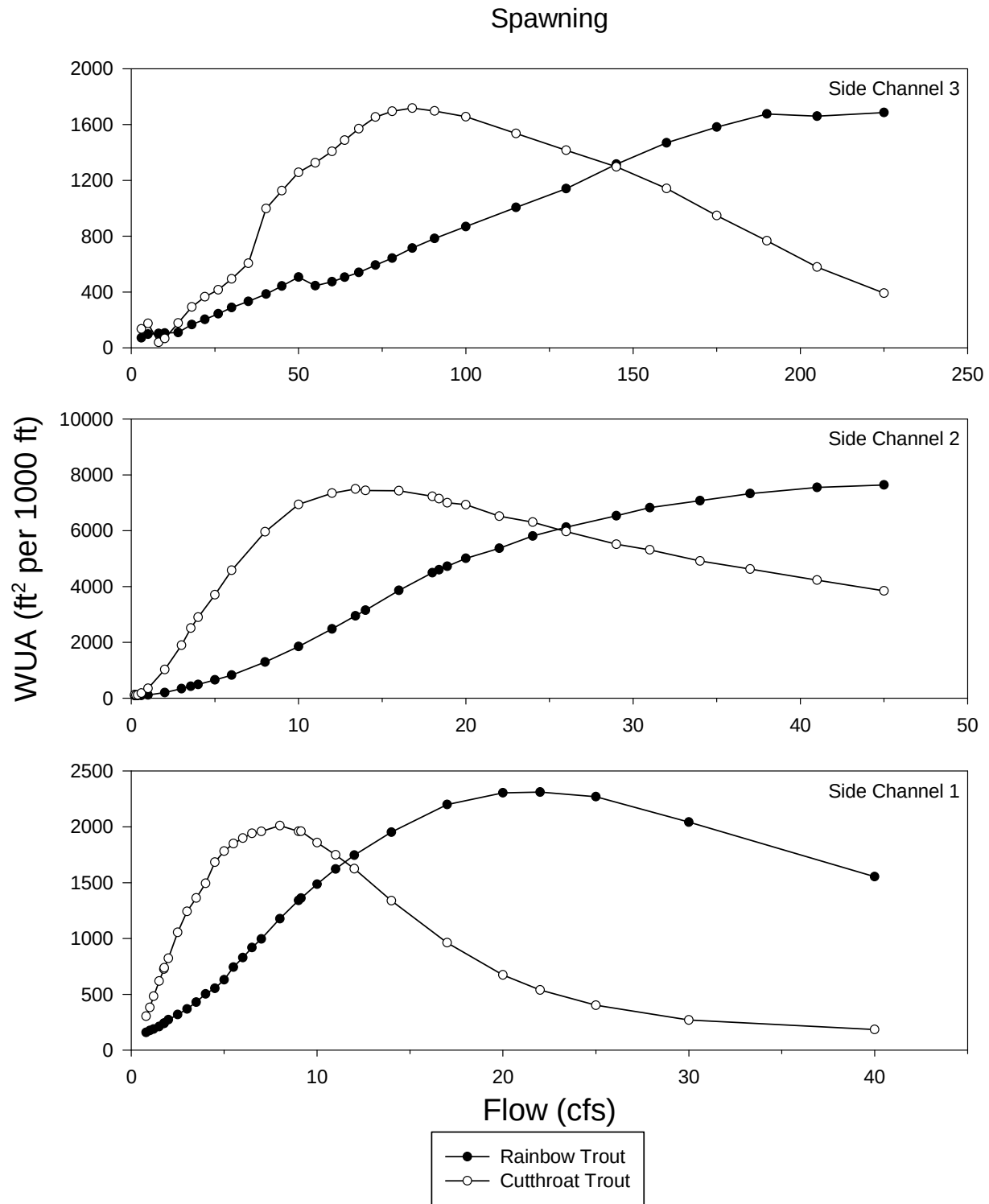


Figure D5-1. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat within the three side channels of Reach 1 of the Sultan River, Washington.

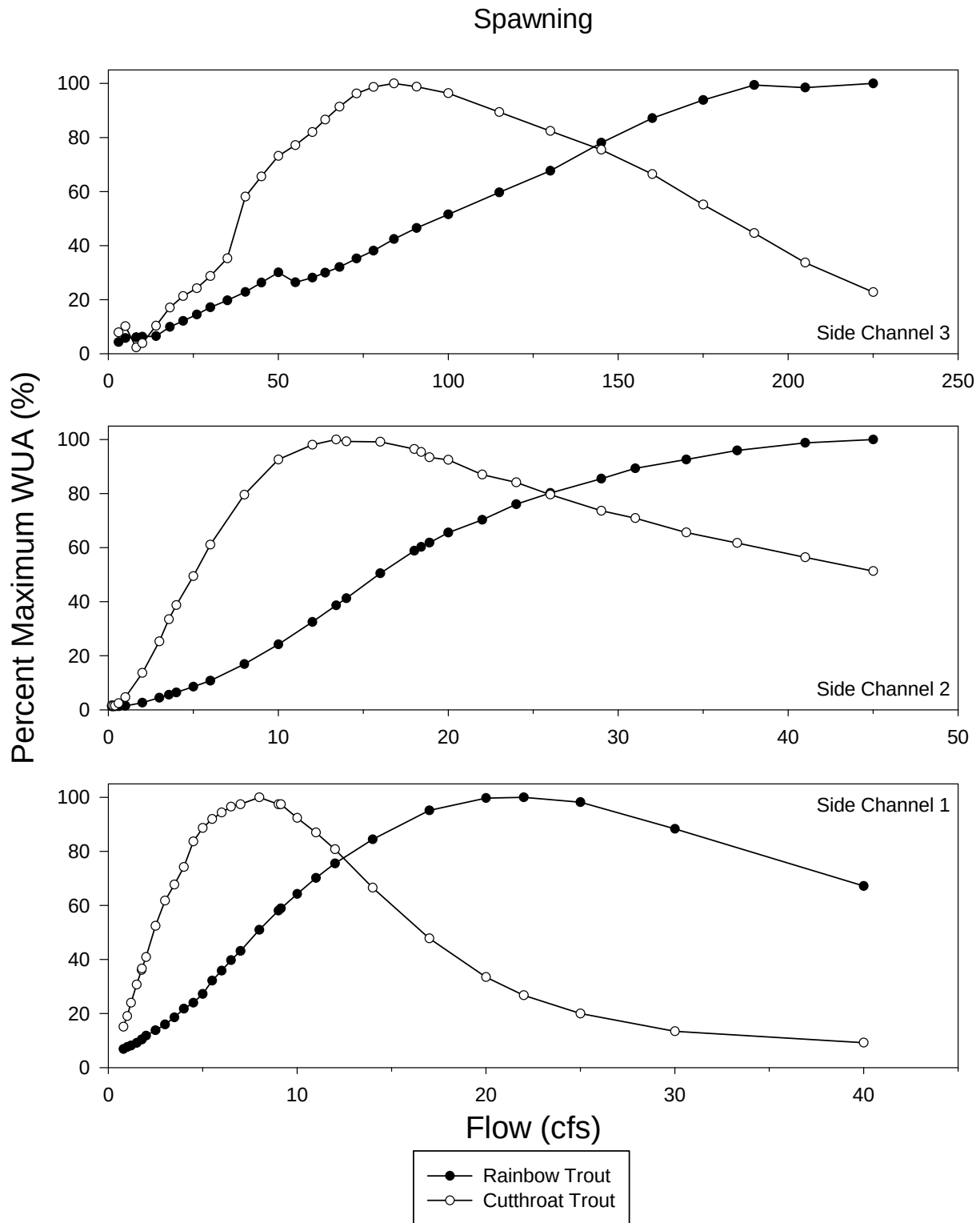


Figure D5-2. Percentage of maximum Weighted Useable Area (WUA) versus flow (cfs) relationships for rainbow and cutthroat trout spawning habitat within the three side channels of Reach 1 of the Sultan River, Washington.

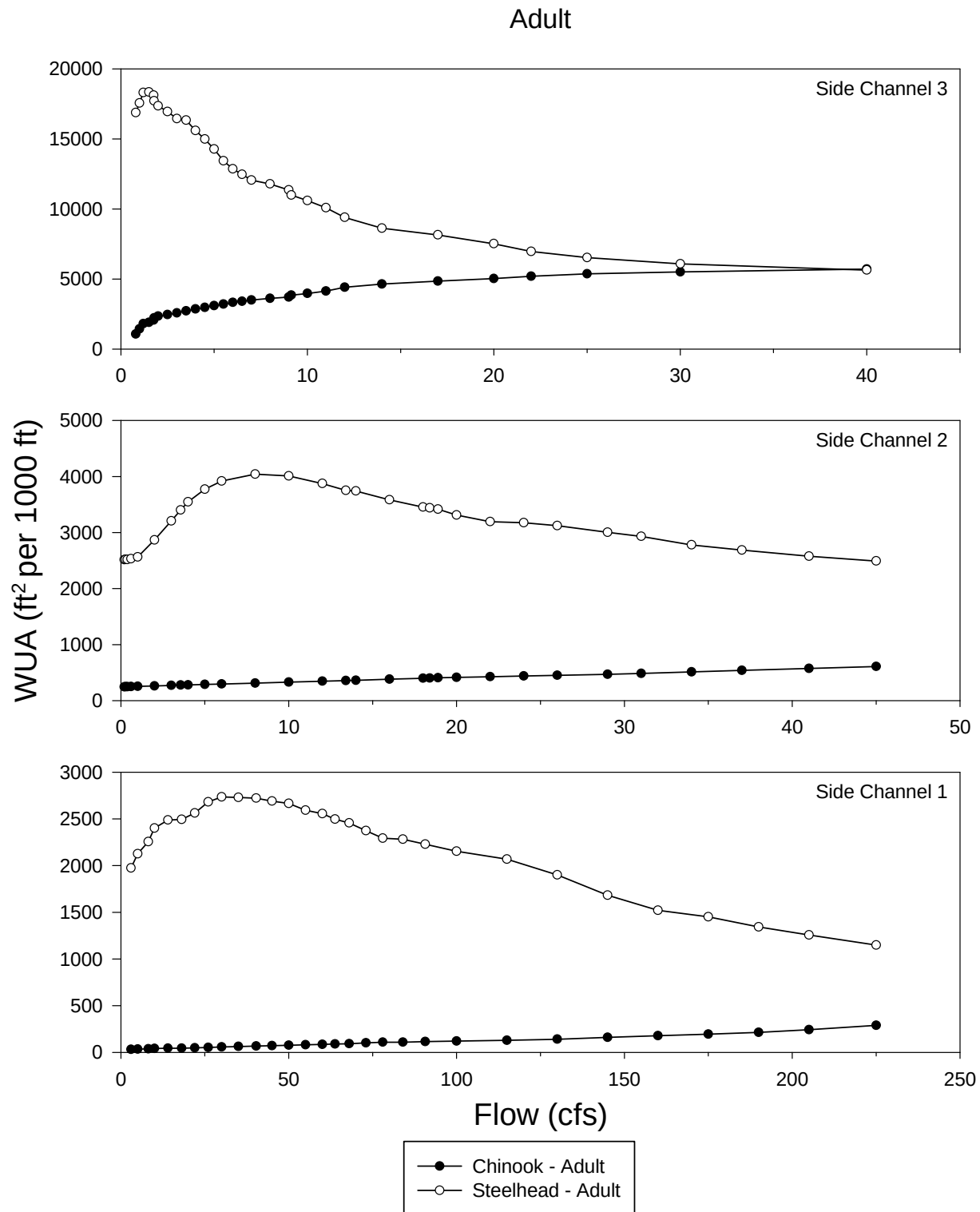


Figure D5-3. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat within the three side channels of Reach 1 of the Sultan River, Washington.

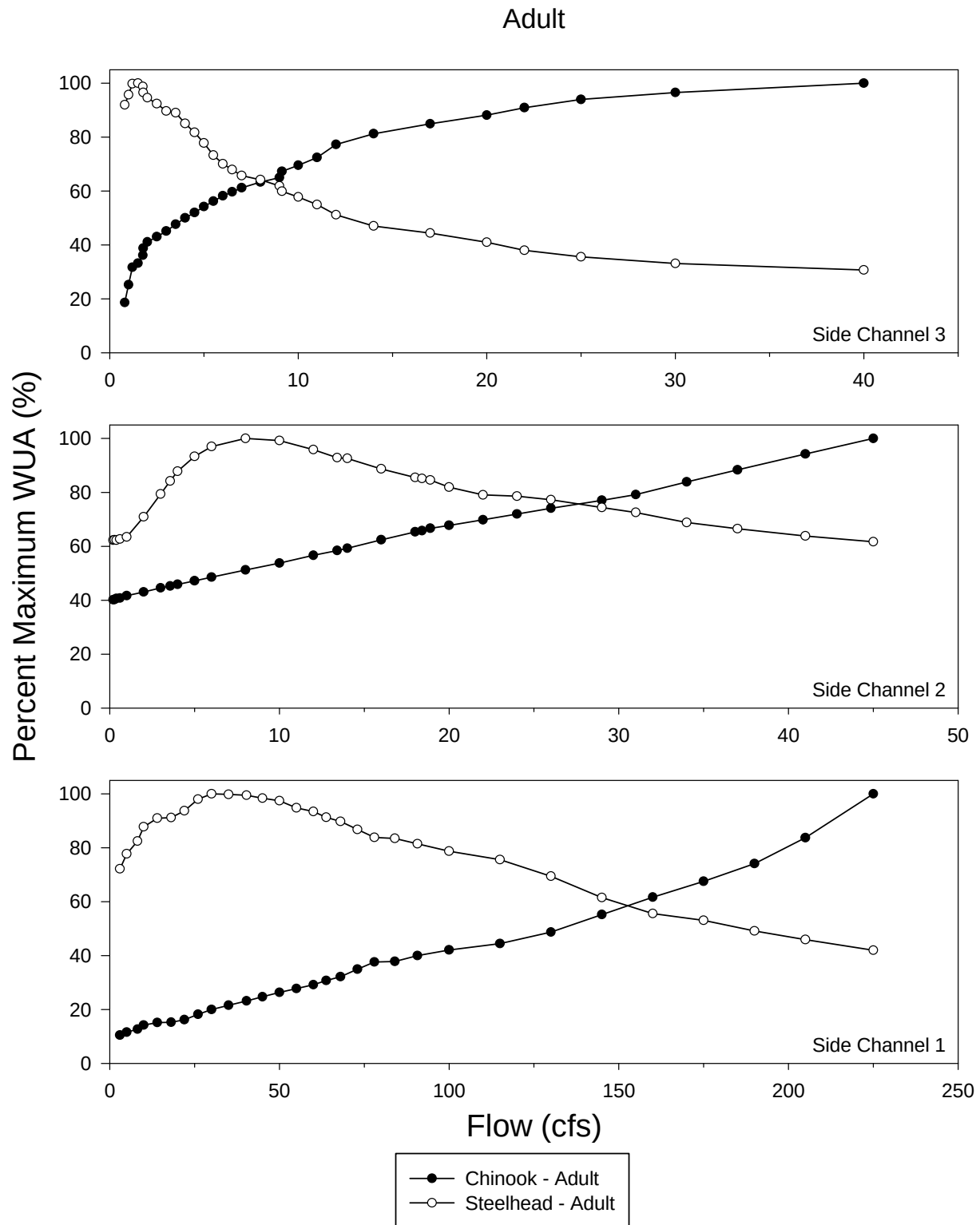


Figure D5-4. Weighted Useable Area (WUA)(ft²/1000 ft) versus flow (cfs) relationships for Chinook salmon and steelhead trout adult habitat within the three side channels of Reach 1 of the Sultan River, Washington.