Stock Origins of Chinook Salmon in Incidental Catches by Groundfish Fisheries in the Eastern Bering Sea, 1997–1999

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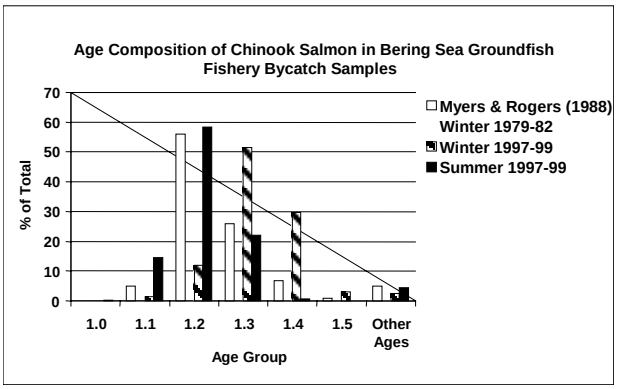
The effect on western Alaska chinook salmon (*Oncorhynchus tshawytscha*) of incidental catches by commercial groundfish fisheries has been a major concern since 1977, when the U.S. National Marine Fisheries Service (NMFS) began to monitor and estimate salmon bycatch by groundfish vessels operating in the U.S. Exclusive Economic Zone (EEZ; Berger 2003). Most (> 99%) of the chinook salmon bycatch is taken by the walleye pollock (*Theragra chalcogramma*) trawl fisheries operating in areas with bottom depths of 100 m to 200 m, and high bycatch rates can occur in any location throughout the Bering Sea and Aleutian Islands (BSAI) area (Witherell et al. 2002).

Myers and Rogers (1988) used scale pattern analysis to estimate the age, regional stock composition, and interceptions of western Alaska chinook salmon in incidental catches by foreign and joint-venture groundfish fisheries operating in the BSAI area of the U.S. EEZ in 1979–1982. This was a period (1977–1986) of high abundance of western Alaska chinook salmon, and an estimated 60% of the total chinook salmon bycatch in the Bering Sea groundfish fisheries was western Alaska stocks (Myers and Rogers 1988). During the late 1990s returns of chinook salmon to western Alaska rivers declined to record lows. Because of this decline in abundance, Witherell et al. (2002) hypothesized that the stock composition estimates of Myers and Rogers (1988) may overestimate the contribution of western Alaska chinook salmon to the groundfish bycatch in recent years. When salmon returns to rivers are low, however, even relatively low incidental catches of salmon by non-target marine fisheries may reduce local utilization of chinook salmon resources and impede management and conservation efforts in western Alaska.

We used scale pattern analysis (Myers and Rogers 1988; Patton et al. 1998) to estimate the age and stock composition of chinook salmon in 1997–1999 BSAI groundfish fishery bycatch samples collected by the North Pacific Groundfish Observer Program, NMFS. Scale measurement data (14 variables) from mature chinook salmon returning to major production regions in Asia and North America were used to establish five brood-year specific baselines (BY 1991–1995). Maximum likelihood estimates (MLE) of the proportions of regional (Russia, Western Alaska, Central Alaska, and Southeast Alaska/British Columbia) and western Alaska subregional (Yukon, Kuskokwim, and Bristol Bay) stock groups in the fishery (mixture) bycatch samples were calculated (Millar 1987, 1990). Accuracies of the brood-year models were evaluated by computer simulations and by test mixture samples of baseline scales that were not included in the 4-group regional models.

During the period of our study, the largest bycatch samples were taken during winter (January and February) and late summer–fall (September and October) in the BSAI area east of 170°W. The 1997–1999 bycatch samples were dominated by age 1.2 fish in summer and ages 1.3 and 1.4 fish in winter (Fig. 1). In contrast, Myers and Rogers (1988) found that younger (age 1.2) fish dominated winter bycatch samples in 1979–1982. This difference may be related to an eastward shift in the fishery area from offshore areas (west of 170° W) in 1979–1982 to inshore areas (east of 170° W) in 1997–1999. In winter, immature ocean age-.2 chinook salmon may be distributed farther offshore than older age groups of immature and maturing fish.

Fig. 1. Estimated age composition of chinook salmon in eastern Bering Sea groundfish fishery bycatch samples.



Our results indicate that western Alaska was the dominant regional stock of chinook salmon in bycatch samples from the U.S. groundfish fishery in the eastern Bering Sea in 1997–1999 (Fig. 2). The estimated regional stock composition of chinook salmon in the five brood-year strata averaged 56% Western Alaska, 31% Central Alaska, 8% Southeast Alaska–British Columbia, and 5% Russia (BY 1991,

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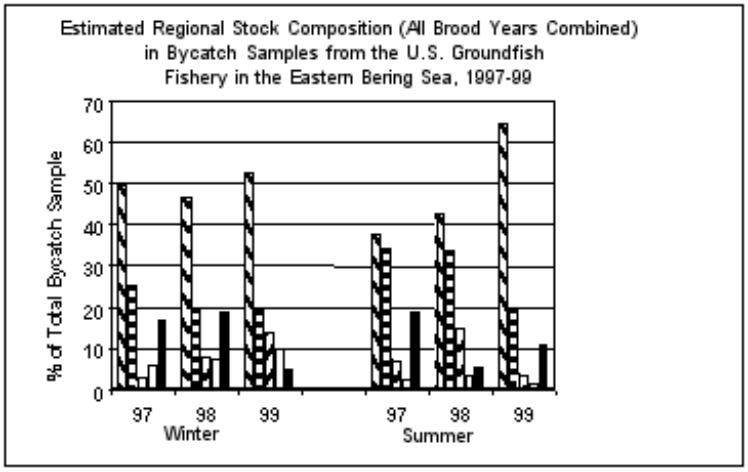
Fig. 2. Estimated regional stock composition of chinook salmon in eastern Bering Sea groundfish fishery bycatch samples, 1997–99.



n = 373 fish; BY 1992, *n* = 530 fish; BY 1993, *n* = 1,111 fish; BY 1994, *n* = 762 fish; BY 1995, *n* = 481 fish). In winter age-1.4 western Alaska chinook salmon were largely from the Yukon and Kuskokwim subregions, and percentages of Bristol Bay fish were highest in samples of age-1.3 fish (Fig. 3). In summer age-1.2 western Alaska chinook salmon were predominantly from the Kuskokwim and Bristol Bay subregions (Fig. 4). In ongoing analyses, we are calculating estimates of interception (numbers of fish) of Yukon, Kuskokwim and Bristol Bay chinook salmon by the BSAI groundfish fishery and evaluating the effects of the salmon bycatch in 1997–1999 on western Alaska chinook salmon runs using methods similar to Witherell et al. (2002).

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Fig. 3. Estimated sub-regional stock composition of western Alaska chinook salmon in eastern Bering Sea groundfish fishery bycatch samples, winter 1997–99.

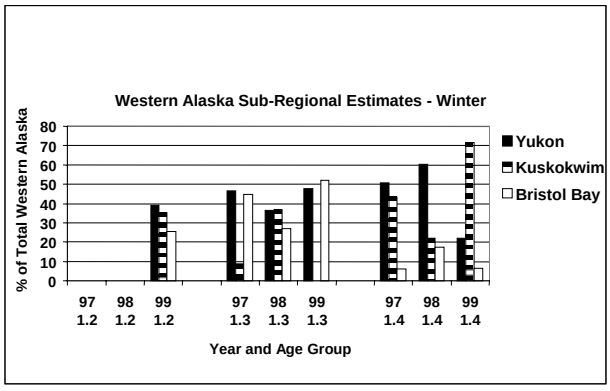
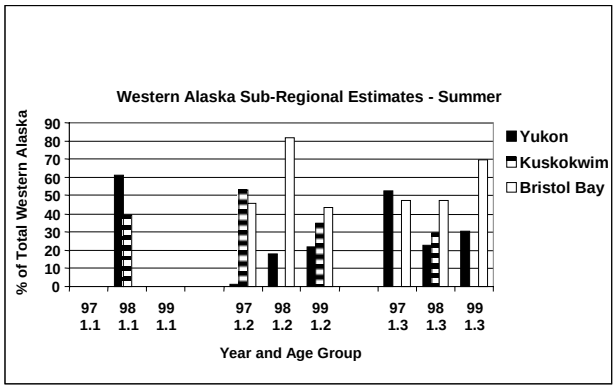


Fig. 4 Estimated sub-regional stock composition of western Alaska chinook salmon in eastern Bering Sea groundfish fishery bycatch samples, summer 1997–99.



REFERENCES

Berger, J. 2003. Incidental catches of salmonids by U.S. groundfish fisheries in the Bering Sea/Aleutian Islands, Gulf of Alaska, and the Pacific Coast, 1990–2003. (NPAFC Doc. 700.) 11p. Alaska Fisheries Science Center, U.S. National Marine Fisheries Service, Seattle.

Millar, R.B. 1987. Maximum likelihood estimation of mixed stock fishery composition. Can. J. Fish. Aquat. Sci. 44: 583–590.

Millar, R.B. 1990. Comparison of methods for estimating mixed stock fishery composition. Can. J. Fish. Aquat. Sci. 47: 2235–2241.

Myers, K.W., and D.E. Rogers. 1988. Stock origins of chinook salmon in incidental catches by groundfish fisheries in the eastern Bering Sea. N. Am. J. Fish. Manage. 8: 161–171.

Patton, W.S., K.W. Myers, and R.V. Walker. 1998. Origins of chum salmon caught incidentally in the eastern Bering Sea walleye pollock trawl fishery as estimated from scale pattern analysis. N. Am. J. Fish. Manage. 18: 704–712.

Witherell, D., D. Ackley, and C. Coon. 2002. An overview of salmon bycatch in Alaska groundfish fisheries. Alaska Fish. Res. Bull. 9: 53–64.

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