Dynamic in-lake migration patterns observed for homing sockeye salmon

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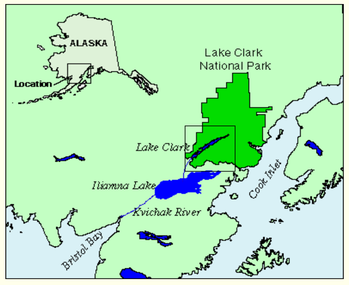
Abstract

Precise homing by salmon to natal habitats is considered the primary mechanism in the evolution of population specific traits, yet few studies have focused on this final phase of their spawning migration. We radio-tagged 142 female sockeye salmon as they entered Lake Clark, Alaska, and tracked them every 1-10 days to their spawning habitats. Contrary to past research, no specific shoreline migration pattern was observed (e.g. clockwise) nor did fish enter a tributary unless they spawned in that tributary. Tributary spawning fish migrated faster (mean net speed=4.7 km/day, SD = 2.7, versus 1.6 km/day, SD=2.1) and more directly (mean linearity= 0.8, SD=0.2, versus 0.4, SD=0.2) than Lake Clark beach spawning fish. Migration into a large, glacially turbid river coincided with a descending thermal and turbidity cycle explaining, in part, how sockeye salmon exploit such inhospitable habitats. Although radio-tagged salmon generally migrated to within 5 km of their final spawning location in an average of 21.2 days (SD=13.2), some fish migrated five times the distance necessary and over 50 days to reach their spawning destination. These results demonstrate that the final in-lake spawning migration of sockeye salmon is more dynamic than past research indicated and supports studies indicating a higher degree of homing precision by tributary spawning fish.

Introduction

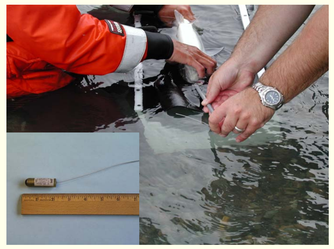
A large body of evidence demonstrates that Pacific salmon and trout (*Oncorhynchus* spp.) home to natal habitats to spawn. This behavior reproductively isolates populations which may lead to the evolution of population specific traits and speciation. Studies focused on sockeye salmon (*O. nerka*) indicate a high degree of homing precision to natal lakes, where fry reared prior to smoltification while genetic, otolith microstructure, and displacement studies indicate varying levels of homing precision to natal habitats within the rearing lake and associated tributaries.

Study Area



Methods

Adult sockeye salmon were captured with a beach seine as they entered Lake Clark and radio-tagged with an esophageal tag (n= 157).

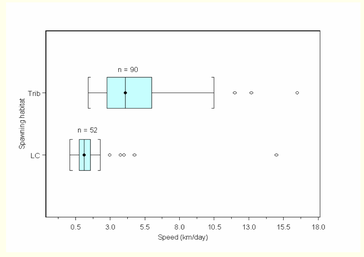


Salmon movements were tracked through the lake system every 1-10 days by boat or airplane.

Verified spawning and estimated spawn time by visual observation or seining.

Calculated speed and linearity of migration to within 5 km of spawning area or spawning stream.

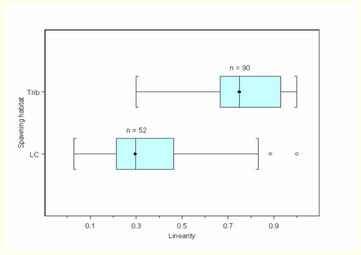
Results



Mean net speed (Trib) = 4.7 km/day, SD = 2.7; LC mean = 1.6 km/day, SD=2.1)

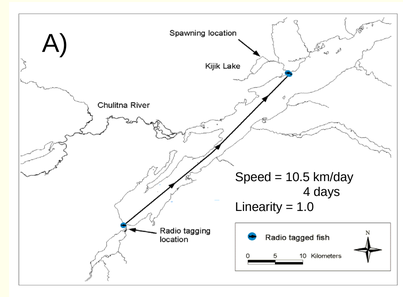
Tributary spawning fish (Trib) migrated faster (one-way ANOVA ,alpha = 0.05, P<0.001) than Lake Clark beach spawning fish (LC).

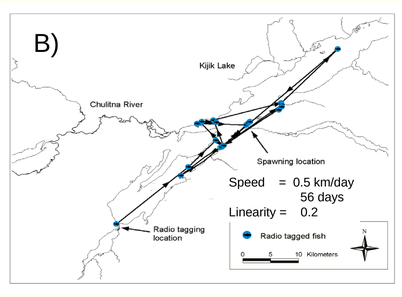
Tributary spawning fish (Trib) migrated more directly (one-way ANOVA, alpha = 0.05, P<0.001) than Lake Clark beach spawning fish (LC).

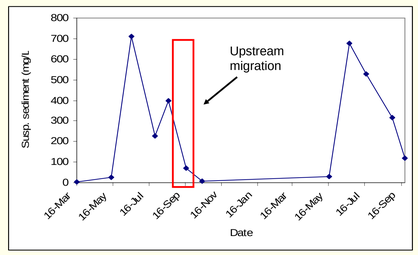


Mean linearity (Trib) = 0.8, SD=0.2; LC mean = 0.4, SD = 0.2

Example of radio tagged sockeye salmon that migrated directly (A) and indirectly (B) to spawning locations. Linearity was calculated as the shortest distance in water from the tagging site to within 5 km of the spawning location or mouth of the spawning stream divided by the straight-line distance between all re-location data points.







Suspended sediment data collected by Brabets (2002) on the Tlikakila River. The period of upstream migration was determined at a fixed telemetry receiver on the Tlikakila River.

Spawning migration into a large, glacially turbid river coincided with a descending thermal and turbidity cycle.

Conclusion

The final in-lake spawning migration of sockeye salmon is more dynamic than past research indicated. Although radio-tagged salmon migrated to within 5 km of their final spawning location in an average of 21.2 days (SD=13.2), some fish migrated five times the distance necessary and over 50 days to reach their spawning destination. No specific shoreline migration was observed which is contrary to observations by Burger et al. (1995). Tributary spawning fish migrated faster and more directly than Lake Clark beach spawning fish which supports genetic, otolith microstructure, and displacement studies indicating a higher degree of homing precision by tributary spawning fish.

Literature Cited

Burger, C.V., J.E. Finn, and L. Holland-Bartels. 1995. Pattern of shoreline spawning by salmon in a glacially turbid lake: evidence of population differentiation. Trans. Am Fish. Soc., 124:1-15

Acknowledgements:

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