

# Homing and straying by anadromous salmonids: a review of mechanisms and rates

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**Abstract** There is a long research history addressing olfactory imprinting, natal homing, and non-natal straying by anadromous salmon and trout (Salmonidae). In undisturbed populations, adult straying is a fundamental component of metapopulation biology, facilitating genetic resilience, demographic stability, recolonization, and range expansion into unexploited habitats. Unfortunately, salmonid hatcheries and other human actions worldwide have affected straying in ways that can negatively affect wild populations through competitive interactions, reduced productivity and resiliency, hybridization and domestication effects, and outbreeding depression. Reduced adult straying is therefore an objective for many managed populations. Currently, there is considerable uncertainty about the range of ‘natural’ stray rates and about which mechanisms precipitate straying in either wild or human-influenced fish. Research in several disciplines indicates that adult straying is affected by endocrine physiology and neurological processes in juveniles, incomplete or interrupted imprinting during rearing and emigration, and by complex interactions among adult maturation processes, reproductive behaviors, olfactory memory, environmental conditions during migration, and senescence physiology.

Reported salmonid stray rates indicate that the behavior varies among species, among life-history types, and among populations within species. Most strays enter sites near natal areas, but long-distance straying also occurs, especially in hatchery populations that were outplanted or transported as juveniles. A majority of past studies has estimated straying as demographic losses *from* donor populations, but some have estimated straying *into* recipient populations. Most recipient-based estimates have substantiated concerns that wild populations are vulnerable to swamping by abundant hatchery and farm-raised strays.

**Keywords** Imprinting · Olfaction · *Oncorhynchus* · Orientation · Philopatry · *Salmo*

## Introduction

Our understanding of homing and straying by anadromous salmonids (*Oncorhynchus*, *Salmo*, and *Salvelinus* species) has primarily been derived from studies of fish physiology and behavior under the purview of hatchery management. Far less is known about wild populations and there is considerable disagreement about the rates of “natural” versus management-related straying. Our objectives in this review are to: (1) consider adult salmonid homing and straying within broad evolutionary, ecological, and management contexts; (2) summarize the mechanisms

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