

Coming Home, by Bill Hauser, continued

After one or more years in the ocean for feeding and maturing, salmon navigate across the North Pacific probably, or possibly, with the aid of earth's geomagnetic field. However they accomplish this navigation challenge, as they approach the coastal waters they begin to encounter the sensation of freshwaters. And then, how do they find their way to the spawning ground?

It has become accepted knowledge that after salmon navigate to nearshore waters, olfaction, or odor, or sense of smell is used by salmon to get back to their "home stream" (sometimes called "stream of origin" or "natal stream") and spawn. How do they do it? All evidence suggests that they use odor find their way back to their home stream. It is believed that they imprint on organic chemicals in freshwater. That is easy to say but there is more to this. One to several years have elapsed since these fish have been exposed to their freshwater origins. Before salmon can use odor to find a way home, while immature, they need to create a map or a memory they can use to follow when they return as adults.

The memory – or "olfactory imprinting" – is said to occur during the smolt stage... but there is increasing evidence that imprinting begins earlier in life. Many sockeye salmon, for example, spawn in inlet streams of lakes. The emergent fry migrate downstream from the inlet into the lake to rear for one or more years until they become smolts. Adults return one or more years later and return or "home" to the inlet stream to spawn. If imprinting begins during the smolt stage, they would have no memory of spawning habitat upstream from the lake. Also, for some fishery projects, salmon, stocked in lakes as fry, returned as adults to the stocking location rather than the spawning habitat. Finally, juvenile coho salmon usually are spawned in a different part of a stream drainage than where they rear and become smolts.

How does this work for the fish? A fish's nose, or olfactory organ, is like a U-shaped flow through tube with nerve endings that lead to the "olfactory lobe" in the brain. Water flows through the tube and stimulate nerve endings and the olfactory lobe. The early sensory experience or imprinting is stored in the brain for recall as returning adults. As the stream/lake odors change during the smolt migration, the sequence is recorded. When the adults return, the

sequence is recalled in reverse order. Homing among returning varies greatly but is about 95% accurate.

Most of the research to learn how salmon accomplish this was done in the 1950's and 1960's with an elegant series of field and laboratory experiments. In one experiment, salmon were taken from one tributary of a river and returned back downstream but half had plugged noses. That tributary and an adjacent tributary had weirs to recapture the fish. Salmon with plugged noses returned randomly but those with no nasal impairment homed successfully to the correct tributary.

So homing within a stream requires early life exposure and imprinting to stream odors and odor detection as adults. But to fully explain successful homing to their natal stream, imprinting of some sort must occur before the smolt stage.

Do you have a question for FISH TALK? Contact Bill at karelbill@gci.net.

Bill has published ***Fishes of the Last Frontier***, *Life Histories, Biology, Ecology, and Management of Alaska Fishes* and ***Letters from Alaska***, *The Inside to the Outside*. Read sample chapters and find other information at www.billhauserbooks.com.