Which Way Home?

Franklin B. Titlow and **Robert T. Lackey***

*Department of Fisheries and Wildlife
Oregon State University
Corvallis, Oregon 97331

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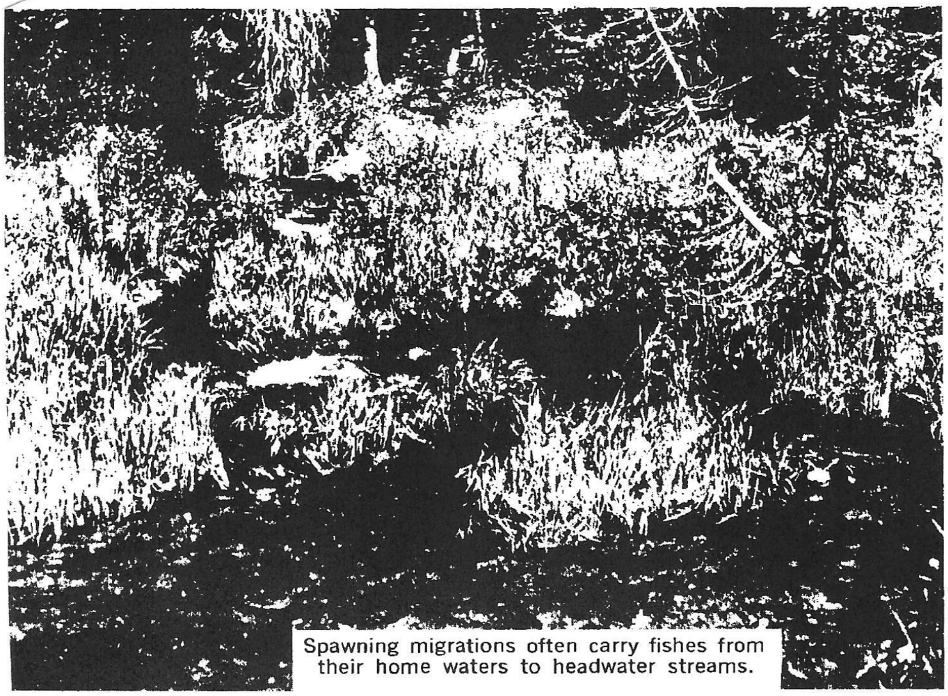
Email: Robert.Lackey@oregonstate.edu
Phone: (541) 737-0569
Web: http://fw.oregonstate.edu/content/robert-lackey



Spawning migrations often carry fishes from their home waters to headwater streams.

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By FRANKLIN B. TITLOW and ROBERT T. LACKEY

CAN a salmon *smell* his homestream while traveling thousands of miles away from land? Do largemouth bass *see* their way across a lake? Are schools of cod able to maintain a yearly migrational pattern by *drifting* with ocean currents? These and many other questions about migrating fishes have puzzled fisheries scientists for many years.

Migration is characteristic of many fish species. Perhaps the best known examples are those of the salmon. Pink salmon from southeastern Alaska and British Columbia have been known to travel over 4,000 miles per year. Chinook salmon cover even greater distances while returning to the Columbia River from south of the Aleutian Islands.

One of the longest distances traveled by a single fish was recorded for a tagged bluefin tuna which traveled from Cat Cay (Bahamas) to the Norwegian coast, a distance of over 5,000 miles. Other extensive travelers include albacore, white marlin, swordfish, sailfish, tuna, eels, and dogfish.

Many freshwater fishes also demonstrate migratory behavior. Extensive studies on white bass, largemouth bass, rainbow trout, cutthroat trout, and bluegill have been made to learn *how* fish find their way.

Theories as to the direction-finding mechanism employed by fishes include: (1) passive drift, (2) random search, (3) sun orientation, (4) odor orientation, (5) orientation to visual landmarks, (6) orientation to electrical fields, (7) orientation to water currents, and (8) orientation to physical and chemical gradients. Evidence has been found to both support and cast doubt on each of these theories.

The authors are with the Department of Fisheries and Wildlife Sciences, Virginia Polytechnic Institute and State University, Blacksburg.

Can fishes migrate simply by *drifting* with currents? Migrational patterns—from spawning grounds to rearing areas to feeding grounds—of herring in the North Sea appear to be controlled by ocean currents. The seasonal direction of movement of herring parallels the prevailing current direction in each locality. However, the passive drift theory fails to explain salmon migrational speeds of over thirty miles per day in the North Pacific Ocean. Current velocities in the North Pacific average only 1-4 miles per day. Also, upstream migration cannot possibly be the result of passive drift.

Do fishes find their way by searching for their destination in a *random* fashion? Tagged largemouth bass have been observed to move at random when released in the center of a lake. Recaptures indicated that over fifty percent of these tagged bass returned to the area of original capture. In similar studies, over ninety-five percent of the tagged brown and cutthroat trout used returned to their home stream. It is doubtful that random search procedures alone could account for extremely high homing percentages.

Can fishes use the *sun* to guide them? Both field and laboratory studies have provided evidence that fish can use the sun for direction finding. The theory is that fish possess an internal compass-like mechanism which is controlled by the position of the sun. However, migrational movements of fish have been observed at night and on extremely overcast days. Sun orientation fails to explain fish migration during periods when the sun is not visible.

Can fishes *smell* their home area? This theory proposes that each home area possesses a unique odor which fish learn in the early weeks of life. Adult fish use this learned odor to guide their return to the home area. Research has shown that many fish do rely on their sense of smell to detect their home area, but experiments with cutthroat trout provide evidence against the absolute necessity of smell in homing. In these studies, trout with nose plugs were able to home as successfully as trout without nose plugs.

Do fishes follow a series of *visual* landmarks during migration? Several studies in Yellowstone Lake, Wyoming, suggest that cutthroat trout are able to follow the lake shoreline to the entrance of their home stream, but experimentally blinded cutthroat trout were able to find their home stream as easily as normal trout.

Can fishes detect and follow differences in *electrical voltage* in the aquatic environment? Water is an electrical conductor which produces voltages by moving through the earth's magnetic field. Sturgeon swimming in the Snake River in Idaho avoid passing directly under a high voltage power line. Sharks and rays can detect weak electrical stimuli in the ocean, but most migrating fishes do not possess electrical sensory devices, which would allow orientation to electrical fields.

Can fishes follow the *boundaries* of currents in a body of water? The migrational patterns of some oceanic fishes are probably governed by currents, but direct detection of current boundaries by migrating fish seems unlikely because of the immense volume of water that would have to be traversed.

Are fishes able to detect and follow physical and chemical *gradients?* Slight variations in the amount of dissolved gases, solids, acidity, and temperature exist within any body of water. However, the differences between points miles apart are usually not great enough to be detected by sensory organs.

Some scientists have hypothesized that fishes possess a distinct homing sense which controls migrations without the aid of any environmental stimuli. Others believe that navigational ability in fishes is genetically controlled and passed from generation to generation.

However fish find their way home, they possess an impressive record for not getting lost.

The incredible journey of the salmon is one of the most spectacular examples of fish migration, but even local species like the largemouth bass and bluegills do some traveling.