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Chemical Stimuli and Reproduction in Fish

Introduction

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In studying animal communication human observers focus on sensory modalities that are predominant in their own lives. Thus, ethologists have elaborately investigated visual and auditory communication systems whereas other modalities, such as chemoreception, have attracted less attention. Bird navigation and homing are controlled by various modalities and the fact that many problems in this field are still unsolved may at least partially be due to our reluctance to consider 'unconventional' sensory modalities and cues. In addition, ethologists tend to overlook other modalities once an animal, such as a cichlid fish, has been classified as, for example, mainly visual and its communication system has been 'explained' in terms of visual cues. However, in many cases animals communicate in several modalities (cf. TAVOLGA's contribution) even though exclusion of a single modality may not severely limit their behavior.

This collection of contributions regarding the role of chemical stimuli in reproductive behavior of fish should stimulate research in such 'neglected' modalities. As will be demonstrated in these articles, chemical stimuli have a variety of functions in the reproductive behavior of fish. They may guide salmons to their breeding ground, serve the recognition of young by a cichlid parent, and control aggressive and sexual motivations in gobiid, anabantid and cichlid fish. However, only a few species have so far been studied, and the chemical nature of the stimuli involved is generally unknown. Due to their long-term persistence, chemical stimuli may be particularly significant in tonic control of behavioral and physiological states in animal communities.

Chemical Cues for Homing Salmon

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It has long been established that salmonids return from the open waters of lakes or oceans with great specificity to their homestream to spawn (reviewed by HASLER[1] and HARDEN-JONES[2]). This migration is usually divided into two phases: 1. open-water migrations and 2. migrations near or in the homestream. We will only deal with the second phase here. Early speculations by BUCKLAND[3] and later by SCHEER[4] suggested that the uniqueness of the chemical charateristics of the homestream enables the adults to recognize this homestream upon returning from the sea. In a more advanced formulation of this idea, HASLER and WISBY[5] proposed the olfactory hypothesis. The use of olfaction for homing requires that: 1. each stream must have a characteristic and persistent odor perceptible by the fish, 2. fish must be able to discriminate between the odors of different streams, and 3. fish must be able to retain an 'odor memory' of its homestream during the period which intervenes between downstream and homing migration. At least

[1] A. D. HASLER, *Underwater Guideposts – Homing of Salmon* (University of Wisconsin Press, Madison 1966), p. 155.
[2] F. R. HARDEN-JONES, *Fish Migration* (St. Martin's Press, New York 1968), p. 325.
[3] F. BUCKLAND, *Natural History of British Fishes* (Unwin, London 1880), p. 420.
[4] B. T. SCHEER, Q. Rev. Biol. *14*, 408 (1939).
[5] A. D. HASLER and W. J. WISBY, Am. Nat. *85*, 223 (1951).