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## Communication in fishes

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### Introduction

The chemicals employed for intraspecific communications are known as pheromones. Pheromones are secreted into the external environment and alter the behaviour and physiology of the recipients either by ingestion, absorption, gustatory or through olfactory pathways. Chemically, they are organic compounds having low molecular weight as compared to those secreted into the aquatic environment.

In general, pheromones are substances that are secreted to the exterior by an individual and received by a second individual of the same species, in which they produce one or more specific reaction.

Pheromone systems have been implicated in various aspects of fish behaviour including schooling, individual recognition, aggression of other sex, knowledge of the offspring or the parents, crowding influenced depression of viabilities, recognition of predators and alarming. The term "Pheromone" was first coined by Karlson and Luscher in 1959 to replace ectohormone.

Peter Sorensen of the University of Minnesota, St. Pauls, USA remarked that "Living in an aquatic environment generally devoid of

visual cues but rich in dissolved compounds, fish have evolved highly developed chemosensory and pheromonal signalling systems". Pheromones are odoriferous chemical messengers in a wide variety of animal groups and serve as means of intraspecific communication and sex attractant.

The alarm pheromones of fish communicate the presence of nearby danger to its conspecifics. Phylogenetically, such chemical alarm signals have been identified from the sea anemones to the tadpoles of toads. The noted German ethologist, Karl Von Frisch (1938) accidentally discovered the fright reactions in the European minnows (*Phoxinus phoxinus*).

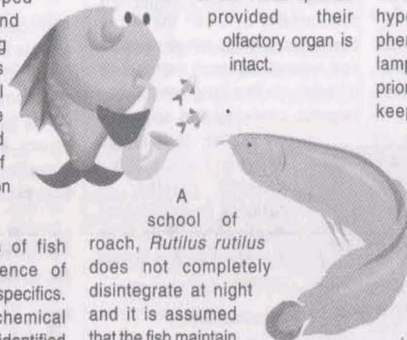
When he introduced a mechanically injured fish to the school of minnows, all members became frightened, retreated and took refuge in a hidden place within 30 seconds to 1 minute.

### Role of pheromones in various activities

#### 1. Schooling

The pheromone system has been implicated in schooling of fish, in which they may depend upon detection of chemical cues. Wrede (1932) observed that the mucus of

European minnows (*Phoxinus phoxinus*) attracts conspecifics. Blinded rudd, *Scardinius erythrophthalmus*, stays in the vicinity of other individuals of the same species provided their olfactory organ is intact.



A school of roach, *Rutilus rutilus* does not completely disintegrate at night and it is assumed that the fish maintain contact through olfactory cues. Miles (1968) found that the presence of adult American eels (*Anguilla rostrata*) in a stream, rendered it more attractive to migratory evers, whereas the presence of large numbers of other evers reduced the attraction.

William McFarland and Stanford Moss (1967) of the Cornell University, Ithaca, USA speculated the possibility of the involvement of pheromones in school formation. John Tecter (1980) has also hypothesised the existence of pheromones in aggregating adult lampreys (*Petromyzon marinus*) prior to upstream movement or to keep them together during the migration.

#### 2. Individual recognition

Some fishes display social organisation. Since individual recognition is the cornerstone of the sociality, its members must be recognised from the individuals of other societies of species. John. H. Todd *et. al* (1967) of USA have demonstrated that the yellow bullheads, *Ictalurus natalis*, a nocturnal visually deficient fish, recognise individuals of its own group by means of pheromones secreted in the skin mucus.

It has been proposed that there are four possible mechanisms for kin recognition (Blaustein, 1983; Holmes and Sherman, 1983; Waldman, 1988) which are as follows:

#### Spatial distribution

Relatives are distributed predictably in space, and altruistic behaviours are directed to individuals in a particular place.

#### Familiarity and previous association

Individuals of the same species may become familiar with features of the other members.

#### Phenotypic matching

An individual learns the phenotypes of relatives or itself. The individual later recalls the phenotype and is able to determine its relationship with other individuals by comparing the learned phenotype with that of the unfamiliar conspecific.

#### Recognition alleles

No learning is involved. Both the phenotype and its recognition have genetic bases. The species-specific odour emanated from individuals of a fish school and that this odour recognized by them. The minnow, *Phoxinus phoxinus* showed a preference for an aquarium-compartment in which the odour of conspecifics lingered. Yellow bullhead, *Ictalurus natalis*, recognizes individuals of their own species chemically through olfaction.

Bardack and Todd (1970) assumed that the skin contained the chemicals necessary for individual recognition. Kjell B. Doving of the University of Oslo, Norway and colleagues have suggested the faecal matter and specifically the metabolites of bile salts, in the individual recognition of the Arctic char, *Salmo alpinus*. The diets also alter the chemistry of the pheromones involved in the individual recognition among fishes.





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### Reproductive behaviour

Pheromones facilitating mating have been reported in a number of species. They may elicit courtship display by the male, they may be used in discrimination of sexes, they may attract the female to the male or more often the male to the female and they may influence aggression towards other males. It is suspected that the olfactory system is necessary for the above pheromonal responsiveness.

The role of pheromones in different reproductive activities is as follows:

#### a. Aggression

Stephen Colyer and Jenkins (1976) have shown the presence of an aggression-suppressing

pheromone in the Siamese fighting fish (*Betta splendens*). The mirror display activity of male Siamese fighting fish in clean water to mirror display activity in water is compared. The fish displayed and respired from the surface more frequently in water containing secretions collected from non-displaying male conspecifics.

#### b. Sexual behaviour

The sex pheromones are widespread among the fishes belonging to the family *Anabantidae*, *Blennidae*, *Gobidae*, *Salmonidae*, *Cichlidae* and *Cyprinidae*. The existence of a chemical produced by a gravid female that stimulates sexual activity in the male.

In the African catfish (*Clarias gariepinus*), females after ovulation are strongly attracted by the odour of male conspecifics. The most potent odorant, observed by measuring electrical responses from the olfactory epithelium and from the olfactory tract appears to be 3, 17, dihydroxy 5 pregnen-20-one-3 glucuronide. The pheromones play a

vital role in the sexual behaviour of fishes of different families.

### c. Parental behaviour

Reproductive behaviour can be extended to include parental behaviour. Parental behaviour in fish involves chemical stimuli.

### 3. Homing migration

Olfaction seems essential for homing migration of salmonids, at

least during their final riverine stage. The migrating Atlantic salmon (*Salmo salar*) prefers the river in which young ones of its own populations are living.

After exhaustive studies on *Salmo alpinus*, *S. trutta* and *S. salar*. Hans Nordent (1977)

rejuvenated the pheromone hypothesis. He wrote "Homeward navigation is an inherent response to population specific pheromone trails released from the descending smolts".

The role of pheromones in upstream orientations has been confirmed in the rainbow trout and sea lamprey (*Anadromous cyclostome*). The eelers of the European eel, *Anguilla rostrata* are attracted towards water of the streams containing the adults of their conspecifics.

B. Stabell (1992) considered that the "Specific homing to a native site is under genetic influence and the possible genetic contamination of pheromones due to hatchery escapes or random stocking programmes might seriously interfere with the homing performance and population structure.

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open mouth. The symptoms may resemble esophageal obstruction.

tremor and progressive paralysis starting from hind limbs leading to the arrest of the respiratory muscles followed by coma and death.

Whether hydrophobia a prominent symptom in animals?

Hydrophobia, which is feature of human rabies, is not observed in wild animals. Rabid dogs can drink enormous quantities of water and even swim across the river.

Is there any possibility of man-to-man transmission of rabies?

Man-to-man transmission of rabies has been observed. The only route, which has been well documented, is through corneal transplantation.

Can man develop rabies after drinking the milk of a cow that has been bitten by a known rabid dog?

As long as the cow is in incubation phase of rabies, no virus is present in the milk and hence there is no transmission. Nevertheless, raw milk of a rabid cow may contain rabies virus, which may be dangerous as the virus may be absorbed through the mucous membrane of the mouth or through abrasion in the oropharynx. The boiling of the milk inactivates the virus.

Can a vaccinated dog transmit rabies?

Dogs effectively vaccinated against rabies cannot suffer and transmit the disease. But, it is difficult to say with

certainty that a particular dog immunized with specific vaccine is immune against rabies unless a serological test confirms it.

✦ What are the first aid managements to be taken in case of dog bite?

The bite wound should be immediately washed thoroughly with plenty of soap water (20% soap solution) as this can reduce the risk of infection by about 90 percent. Spirit or any lipid solvent can be applied as all these inactivate the rabies virus. As far as possible do not stitch the wound as it inflicts additional trauma, which may accentuate the passage of virus into the nerves. Antibiotics and Tetanus prophylaxis should be administered as per the merit of the individual.

✦ A pet dog immunized against rabies died suddenly. What should be done to the dog and to the family members in contact?

Ideally, the dog should be subjected to postmortem examination and tested for the presence of rabies virus and the contacts should start vaccination. If the dog is diagnosed as having died of rabies, the contacts should start post-exposure treatment continue with the course of treatment. The treatment can be withdrawn if it is proven that the dog had succumbed to evils other than rabies.

✦ From where can we get information about rabies and its vaccination schedules?

One can get the information about rabies from nearby veterinary dispensaries or from primary health centers. Queries can also be mailed to rabinet@who.int

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## Pet Shop Talk

