SOME ASPECTS OF BEHAVIOUR

Fishes as they live in an aquatic media provide a vast array of diversity in their form and function. Especially in tropical freshwaters the diversity is remarkable. Keeping in tune with the different habitats such as a fast flowing stream, a meandering river, a sluggish rivulet or a nullah or a deep reservoir, manmade or natural, a pond, a tank or even a small rain-water ditch - each one of these harbour fish species of several kinds and each one of them is adapted for the parameters that the habitat provides.

Catfishes in particular exhibit several types of adaptations for their life in a river, reservoir or a pond. The paired pectoral spines with a median dorsal spine in most Siluroid genera and more particularly in Mystus is itself a protective adaptation from being swallowed by a larger animal. The 3 spines in an erect condition form a formidable trident for any predator to approach them. In a similar manner, the barbels function as a fine sensory apparatus. The mandibular barbels on the ventral side test the bottom and disturb the gravel or sand so that minute hidden insects and other animal matter are thrown up for the fish to eat. The nasal barbels test the quality of water that enter the fish. The maxillary barbels act as radars and also as direction finders. Often times they gauge in advance the width of a crevice or a hole through which the body of the fish has to traverse.

Jayaram (1978) has elaborated the functional responses of catfish barbels. Behavioural studies in respect of catfishes are very few. It is known that fishes perform a number of movements which are easily recognizable functions concerned with social actions as seen during feeding behaviour, locomotion, respiration, comfort movements and fright behaviour.

These motor patterns have been given a wide variety of names and it is said that these are determined largely by the central nervous system. The behaviour is
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thus said to characterise the species and at times even larger categories such as genera and families and they are heritable. The first naturalist to observe the behaviour pattern in any Mystus species is Francis Day (1877). He observed Mystus vittatus and stated that when an example was touched while on wet ground where it appeared much irate, excited, erecting it's dorsal fin, it made a noise resembling the buzzing of a bee. When one of these fishes was put into an aquarium containing small carps, they rushed at the smaller fish, siezed it by the middle of it's back and shook it like a dog killing a rat, all the time with it's barbels stiffened out laterally like a cat's whiskers.

Saigal and Motwani (1962) has studied the life history, nest building activities and connected behaviour patterns in Aorichthys seenghala (Sykes). Subsequent to this not much work seems to have been done on behaviour patterns of catfish. In order to investigate the behaviour patterns of Mystus, Mystus gulio, a common species found in the Hooghly-Matlah estuary was selected.

Mystus gulio is a hardy species and it is the only species of the genus which enters the sea also. It is common in estuaries and in Matlah river at Port Canning, it is landed in good numbers. It is able to tolerate different ranges of pH also. In view of these, this species was selected for my observations.

**Material and Method:** 25 live specimens of Mystus gulio ranging in size from 55.2 - 123.7 mm in total length, were collected from Port Canning fish market, reported to be caught from Matlah river, a tributary of Hooghly river and brought to the laboratory in plastic buckets and earthen pots. They were obtained early in the morning at around 4.30 a.m. and brought directly by road to Calcutta 44 km. away.

The aquarium was then set and allowed to stabilize itself for 48 hours.
Setting up of the aquarium: A rectangular aquarium tank measuring 60 cm (24 inches) length x 45 cm (18 inches) breadth x 45 cm (18 inches) height with a capacity of 55 litres (14.5 gallons) approximately was obtained. The sides of the tank was made of glass and its bottom fitted into a metal frame made of angle iron by means of bitumen. The tank was kept on a firm table so that it did not rock. A corner spot in the laboratory, little away from the window where sufficient amount of diffused sunlight was available was selected for placing the tank.

A layer of about 3 cm of well-washed slightly coarse sand was spread at the bottom of the aquarium. It was spread in a sloping manner from back to front, so that the mulm, etc. rolled down in front of the glass wall where it could be easily seen and removed.

At first the tank was filled with water brought from Port Canning, so that the fishes could adapt themselves quickly, but it was found to be unsuitable as the water was too muddy and the fishes could have perished due to lack of Oxygen. Therefore, the aquarium was emptied. Then, water was collected from a nearby pond, close to the Museum and it was poured into the aquarium and allowed to stand for a few days. After 3 days, the water turned cloudy and so this was also discarded. Next, the aquarium was filled with clear tap water and the water was again allowed to stand for a few days, to note any change in its temperature and pH of tap water was noted down. Temperature of tap water = 27.5°C and pH = 7.5. In a separate container, the fishes were released in tap water for acclimatization. They were kept under observation for 3 days and were found to remain quite healthy. Therefore, tap water was ultimately chosen as the medium for the aquarium tank.

The tank was then filled with tap water. In order to do so, a shallow pot was kept on the sand and water was then poured on to it. In this way, water overflowed
gently over the brim of the pot and filled the tank without disturbing the level of sand.

Normally in such aquaria, due to the absence of sufficient sunlight the plants tend to wither away. In order to prevent this, a 40 watt bulb was placed over the tank, in the front side of the aquarium and it was switched on for every 4 hours per day.

Some aquatic plants like *Vallisneria* and *Aponogeton* were selected for planting in the aquarium tank. These plants provide shelter and security to the fish. In the day time the plants absorb Carbon dioxide released by the fish and in turn liberate Oxygen which is utilized by the fish. The fishes also seem to enjoy nibbling the soft parts of leaves and dive in between the floating leaves. Before planting, these plants were disinfected by dipping them in a solution of Potassium permanganate for 20 minutes. Next, they were planted firmly in the sand so that their roots were completely buried in the sand. At this stage, the aquarium was allowed to stabilise for a week so that the plant's roots could hold on properly.

The fishes thrive best in a temperature range of 22° to 24°C (72° - 76°F). Hence in the winter months (December - February) an immersion heater of 50 - 60 wattage was used to keep the water warm at night. The heater was placed at the bottom of the aquarium tank so as to heat the lower colder layer of water and set up circulation of water in the tank. A thermometer in °C with sucker was fixed on to one of the walls of the aquarium to record the temperature of water in the aquarium tank.

In the summer the water in the aquarium had to be cooled to at least 29°C. This was done with the help of an aerator (air pump). Apart from lowering the temperature by causing evaporation of water, the aerator does another vital job - by circulating the water, it increases the rate of absorption of Oxygen at the surface. A feeding
cup to keep food consisting of *tubifex* worms was also kept in the aquarium. The tank was then covered on top by a metallic framework in the form of an elevated roof having ventilating windows for light and air. This arrangement prevented the water from condensing on the frame and light fixture and corroding them.

After the aquarium was set up for use, 25 examples of *Mystus gulio* of above sizes were released into the tank gently with the help of a hand net. They were maintained thus in the present aquarium tank for 15 days for acclimatization, before the observations were made. Food consisted of *tubifex* worms, fed twice per day, once in the morning and once in late afternoon. No food was supplied at night. The air-pump was started whenever necessary and the light was kept on throughout the night. The fishes were quite healthy and active.

**Observations:** The following behaviour patterns of the fishes were observed:

i) Whenever light is switched off, the fishes rush immediately to the bottom of the tank. This may be due to the sudden change in the environment from light to dark. The fishes get scared and they rush down to the bottom of the tank.

ii) As soon as the air-pump is switched off, the fishes swim slowly towards the bottom of the tank. Their activity again increases as soon as the pump is switched on. This may be due to the fact that when the air-pump is switched on, water in the tank is disturbed by the continuous production of air bubbles and therefore the fishes swim actively. But when the air-pump is switched off, water in the tank remains undisturbed and an atmosphere of tranquility sets in. Hence, the fishes tend to
swim down towards the bottom of the aquarium, perhaps, for taking rest.

iii) Sometimes the fishes rest at the bottom of the tank in a peculiar fashion. They spread out their pelvic fins, the anal fin gets slightly pressed and the lower lobe of the caudal fin anchors the fish. The fish remains in this position with its head slightly elevated at an angle from the surface and rests for sometime. Then it again starts to swim upwards.

iv) One of the fishes, which is of medium size, chased the smaller fishes and displayed some aggressive attitude towards the other fishes.

Action patterns of Mystus gulioph: The following different types of action patterns are usually observed in Mystus gulioph.

BITE: This term is self-explanatory, during this process one fish bites another fish, either as a sign of kinship or competition.

CHAMP: This type of behaviour is observed when the fish rushes forward quickly and bites at its adversary but without touching him. Generally champing is always accompanied with head-jerk. Champing was not restricted to any particular area of the body and the mouths of the fishes were never found locked together, as in the case of Cichlids.

CHARGE: It is an accelerated mode of swimming which is directed towards the other fish, approaching to within one body length. Each rebounding surge was considered as a separate charge.
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**CHAFE:** This is also an accelerated mode of swimming towards some object and when the fish strikes some portion of its body on the object it rebounds away from the object in a decelerating glide.

**DIG:** This type of behaviour is observed when the fish tilts down anteriorly and takes some gravel into the mouth but does not chew it. Then the fish tilts upwards slightly and expels the gravel from the mouth in a single puff. Sometimes it also swims 1 to 2 body lengths and then ejects the gravel from its mouth. Normally, the fish returns back to the same spot again for continuing the digging process.

**FORAGE:** Two different types of foraging were observed, but both of them serve the same purpose. One is a biting movement by the fish vertically or horizontally on the substrate without conspicuous rebound. The other is simply sucking in of floating objects by the fish.

**HEAD JERK:** During this process, the mouth of the fish is opened and again snapped shut. It is accompanied by a slight, quick, lateral movement of the head. At certain times, the male fish was found to jerk its head 2 to 3 times in quick succession, creating the impression of a quiver-like movement.

**LATERAL SPREAD:** In this type of behaviour the dorsal and anal fins are tautly spread. The pelvic fins are held straight down. The caudal fin and the lobes of the dorsal and anal fins continue to work in opposition of the pectoral fins most of the time. During this process, the head usually points straight ahead most of the time, although sometimes it may be turned towards the opponent, or away.

**NIP OFF:** In this type, the fish fixes from a distance of about a head length, on some upright surface. It then moves forward, contacting the wall with the mouth fully open.
and usually oval-shaped. At once it bites the wall and rebounds. This type of movement is repeated several times in quick succession.

**QUIVER:** Here, the fish appears to shiver. The shivers start from the head and pass back lateral waves along the body of the fish. These shivers die down as they travel towards the rear end. The quivering may last for 1 to several seconds, sometimes even interrupted by brief pauses.

**SKIM:** While skimming, the fish brings its ventral surface into contact with the vertical or even the overhanging wall. Then it starts to move in a slow meandering path along it.

**YAWN:** In this case, the fish opens and extends its mouth to form an O shape, while abducting the median and pelvic fins. It pauses for sometime and the mouth is snapped shut.

There are a number of stereotyped behaviour in *Mystus gulio* which has no specific function.

**FEEDING BEHAVIOUR**

*Mystus gulio* is mostly carnivorous. The movements associated with feeding vary considerably both in their amplitude and in the duration of the ongoing event. When *Mystus gulio* feeds on small *tubifex* worms, it undergoes a series of movements for extracting the worms from the sandy bed of the aquarium. The exact form of this movement varies in response to the strength of attachment of the worm. If the worm is loosely anchored to the bottom, then the fish simply swims forward and pulls the worm upward in a sudden movement. If the worm is deeply embedded in the bottom, the fish turns on its side and pulls the worm out of the bottom.
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It has been observed that even the juvenile fishes quickly learn to catch the worms as they are released from the feeding cup on to the surface of the water from where they sink down, or to pick up worms from the bottom of the aquarium, before the worm can dig into the sand.

Sometimes an adult fish may fix on a worm from outside of another's territory, then suddenly dart from its hiding place and snatch the worm, all in one circling dash.

Usually, 2 different techniques are observed for grasping the worms:

(a) First of all the fish swims towards the protruding tip of the worm. When its mouth is almost one head length from the worm, the fish pauses for a little moment. After briefly fixing on its prey, the fish lunges forward and seizes the worm. In majority of the cases this type of behaviour is observed only when the fish has not recently caught a worm, and when it is hungry.

(b) A less elaborate way of catching the worm is done by keeping the body in normal upright position while its long axis becomes inclined downward in the anterior region at an angle of about 45°. In the meantime, all the fins become tautly spread. The fish then forms a slight Sickle-shaped curve and then strikes forward grasping the free tip of the worm. This type of behaviour is almost the same as that used in capturing free-swimming prey except that it has a different orientation.

The upright approach is usually used in catching the first worm. However, if both the upright and on-the-side approaches occur in the same feeding bout, the on-the-side technique usually appears first and is subsequently replaced by the upright method.
The techniques used to pull the worms free from the substrate can be divided into 3 different types:

i) backward swimming
ii) forward swimming (including circling),
iii) lying on one side.

Swimming forward and backward are self-explanatory; the variation actually lies in the number of times the fish pulls out the worm and the amount of force exerted in doing so. The fish is able to use its body as a lever by lying on one side. The head is raised, pulling the worm free and a counteracting force is exerted downward by the swimming movements of the tail. Swimming forward or backward with the worm usually follows fixing in an upright position. Fixing from the on-the-side S-shape is normally followed by side-leverage. However, all types of combinations can be seen.

When a juvenile Mystus gulio is successful in pulling a worm free from the substratum, it starts swimming upwards in the water for sometime with the worm dangling from its mouth. Whereas a fully grown Mystus gulio swims backwards slowly with a cluster of worms protruding from its mouth. This type of movement helps to keep the free ends of the worms from touching the face. Catching and eating each prey continues at a fast rate and hence a lot of energy is used up.

Prey capture behaviour may persist in an animal which has fed to repletion (Lorenz, 1937, 1939; Raber, 1950; Thorpe, 1956). Mystus gulio was never found to hunt after it had stopped eating even if hunting was not involved. However, it may continue to eat if it can pick up loose worms. Thus the threshold of hunting seems to rise faster than that of eating.
Forward Locomotion: *Mystus gulio* swims slowly in comparison to many other Bagrid fishes. At the slowest speeds, the pectoral fins undulate providing a forward thrust and series of vertical waves pass down to the rear end along the fins. This type of movement is referred to as sculling. The phasing of the waves between the right and the left paired fins appears to be alternate.

Fast swimming is brought about normally by the lateral undulations of the body. The waves are initiated by the head which almost imperceptibly turns to the left and right and as the waves pass posteriorly through the body they increase progressively in amplitude. The propulsive thrust of this type of movement is derived from the forward component of the force produced by the passage of the leading edges of the waves obliquely through the water (Gray, 1933a). Generally both the methods are employed by the fish for swimming ahead, sculling being implemented by occasional undulations.

When the fish is swimming rapidly forward, the dorsal and the pectoral spines are not held out rigidly as in attacking and the pelvic fins are usually folded against the body. The lobes of the dorsal and anal fins are held loosely open and they move in unison with the caudal fin, thereby increasing the surface area of the posterior portion of the fish. This type of arrangement of the fins is observed when the swimming movements of the fish are not disturbed by interactions with other fishes, predators or prey.

Backward Locomotion: In this case, alternate paddle-like Beatings of the pectoral fins push water forward. In a well developed backing all the paired fins remain folded except the lobe of the dorsal fin. Occasionally the caudal fin remains compressed and held to one side, sometimes it beats to that side, probably producing a steering effect. The loosely expanded lobe of the dorsal fin is usually used as a rudder.
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**Hovering:** During this process, the fish stands in the water nearly motionless. At this time, pectoral fins and sometimes the dorsal fin undergo sculling movements. The median and the pelvic fins may be either spread or depressed.

The tempo of the pectoral fin movements while hovering seems to indicate the state of excitation of the fish. Amongst sub-adults, the fastest tempos were always seen during encounters with other sub-adults and the slowest when left unmolested and full of food. Hence, it may be said that the faster the tempo, the greater may be the excitation.

**Starting:** In this case, the fish appears to change the pitch of the sculling of pectoral fins slightly and thereby, slowly directing the current of water to the rearside. If a faster start is required, the head initiated lateral trunk undulations in the manner typical for most fishes (Gray, 1933b) and the spread pectoral fins are clapped against the sides in unison. In either case, the fins form an arrangement as described for Forward swimming.

At certain times, the fish starts with an abrupt burst of speed. The most typical preparatory posture for a fast start in *Mystus gulio* is the sigmoid or S-shaped for an arrested swimming undulation. From this position, the fish is able to give maximum instantaneous forward thrust. The head is kept in a position enabling it to move through the greatest speed are possible. Consequently the largest lateral amplitude is produced in the tail-beat. The posterior portion of the fish has at the outset the proper angle for utilizing the greatest possible forward component of the beat.

The Sickle shape is a specialised expression of S-shape. By keeping the anterior portion of the body straight, the fish achieves greater control of the forward movement. The Sickle shape is usually used only when the fish intends to dart forward a short
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distance, lesser than its own body length and where considerable accuracy in the course is necessary. Sickle shape and S-shape are two extremes of locomotory movements and all types of intermediacy, e.g., L-shape, C-shape may occur.

Turning: The mechanisms of turning are very difficult to observe. Normally, turning is found to be brought about by the bending of the head in the direction of the turn while swimming. The pectoral fins probably exert maximum control in turning both in the horizontal and in the vertical position. The median fins do not seem to carry out any special part in turning other than helping in propulsion as well as stabilization. The caudal fin acts as a rudder in a ship and controls the direction of movement while turning.

Opening and closing of the fins: When the fish carries out its movements slowly, the raising or folding of the fins can be observed carefully. In folding the dorsal fin against the body, the branched rays of the fin first incline somewhat to the rear. This type of movement imparts a relaxed appearance to the fin and the position is termed as loosely spread. The dorsal fin is found to collapse from front to rear and is erected in reverse order e.g., from posterior to anterior. The folding of the anal fin is found to take place from anterior to posterior, as the rayed dorsal fin. Moreover, the anal fin folds as a unit due to the short length of its base. It has been seen that the rays of the caudal fin may press together in exceptional cases to form a blunt point, when folded. The pelvic fins are simply brought in against the abdomen, when folded. In opening and closing of the fins, the excitation probably runs along the perimeter of the body of the fish.
MODE OF RESPIRATION IN OXYGEN DEFICIENT WATER

*Mystus gulio* responds to oxygen deficient water in a similar way in which many teleost fishes lack the ability to utilize atmospheric oxygen directly.

In order to observe their response, 10 specimens of *Mystus gulio* consisting of both juveniles and young adults were kept in a small plastic tub containing water from their aquarium. As the oxygen content of the water diminished, the fishes started moving upwards and ultimately stood directly just under the surface of water. Their bodies were tilted upward anteriorly at an angle of about 45°, which was just enough to bring their mouths into contact with the surface of water. The oxygen-rich surface film was then inhaled and passed over the gills. The opercular movements appeared to be the same as those seen in normal aquatic respiration.

COMFORT MOVEMENTS

The comfort movements include those movements which are meant to remove irritants or to serve the purpose of stretching, etc.

**Chafing:** In this type of movement, the fish slowly approaches a stationary object such as a plant, the bottom or the aquarium wall. Then with a quick movement near one side of the head, the fish is placed against the object and it darts forward to 2 to 3 body lengths; the rebound may be arching, or straight ahead and the fins remain folded.

**Flexing:** In this case, an exaggerated lateral flexure of the body is made and often the fish reverses directions. The fish may immediately straighten out again or the flexure may pass down the body of the fish as a wave.
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Coughing: This is a peculiar type of movement in which the gill covers are clamped down in a quick movement and the mouth is thrown open. In this process, a counter-current of water may be flushed through the buccal-cavity.

Yawning: During complete yawning, all the fins become fully spread, the mouth opens to its maximum stretch and the gill chamber becomes expanded. Then the following sequence of action takes place:

(a) the mouth of the fish is snapped shut,
(b) the floor of the mouth becomes depressed and then again it quickly recovers,
(c) the opercula also become abducted immediately,
(d) the fins remain spread out.

The above sequence of action takes place very quickly and in the process, a large volume of water is passed from the mouth out through the gills. In a less complete performance, the sequence remains the same but the extent of gaping is less, the floor of the mouth does not become so conspicuously depressed and the fins are also partially spread. Intention yawning, consisting of slight gaping and partial erection of the fins, may follow complete yawning.

FRIGHT BEHAVIOUR

Flight: During forward flight, the fish darts away with folded fins at top speed. The course of flight is usually directed towards the cover of plants, burrows or the corners of the aquarium. Sometimes, when shelter is too far away from the fish or the fish has become temporarily disoriented to find any suitable hiding place, it may swim down to the bottom of the aquarium and sit there motionless for sometime. In a similar type of situation, juvenile Mystus gulio are more apt to swim upward. If badly harassed
by another fish, an adult *Mystus gulio* will also swim upward as a last resort. Then it usually stands in a corner with its head up or it may stand among plants. When a juvenile fish swims upward or forward in flight, it's body normally swings down posteriorly at the end of the flight, if it is not in contact with the substrate. The angle of the body ranges form about 45° to 80° with respect to the bottom.

Backward flight is performed in the same way as normal backward swimming. In this case, the fish slowly and rarely travels more than 1 body length. There are 2 types of flight situations in which backing up is commonly observed. The less common type is sometimes observed when a juvenile *Mystus gulio* is confronted by a larger one and the smaller fish tries to avoid the bigger one. Under such circumstances the smaller fish was found backing away into some kind of shelter. This frequently goes over smoothly into a type of behaviour called Nestling forward. Backward flight appears to have different thresholds, that for backward being lower than that for forward, particularly when the fish is in it's shelter (Barlow, 1961). When a strange object is brought progressively nearer to the shelter, the fish first displays backing away, then swimming forward and ultimately fleeing from that place. Sometimes, the threshold of forward flight is extremely high-touching, entering or even lifting away the shelter may not produce immediate flight.

Pfiffer (1963) based on a number of experiments indicated that fright reaction occurred because of release of alarm substance when the skin is injured. Sato (1937) found *Plotosus anguillaris* recognising and reacting more by chemical sense such as the release of alarm substance. It thus appears that barbels play no part in fright reaction. My observation on *Mystus gulio* where the barbels were severed confirm this fact.

**Nestling:** The performance of nestling is variable because it depends upon the shape and light conditions of the shelter, as well as the disposition of the fish. The fish backs
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up while seemingly probing for a crevice with its tail. Then it presses its body, especially
the posterior part against the rear-most region of the shelter where light intensity is
low. The median and the pelvic fins become folded until the fish assumes a satisfactory
position. Then these fins are usually spread and the fish remains almost motionless.

**Movement suppression:** During this period, the fish becomes almost motionless and the
median and the pelvic fins are spread out. Sometimes, the dorsal spine is also erected.
If the fish is hovering in water, the pectoral fins continue to scull. If the cause of
the fright is relatively weak and the fish is resting at the bottom of the aquarium,
the pectoral fins continue to scull with a fast tempo. As the strength of the stimulus
increases, the pectoral fins cease to move and the amplitude of opercular beats also
diminishes. The fins also become more tautly spread.

Conditions which bring about suppression of movements can be categorised into
the following groups:

(a) when a predator is near,
(b) presence of open spaces,
(c) attack from another fish of similar type,
(d) while stalking food objects - this point has already been discussed elsewhere.

 Movements attract attention and thereby initiate feeding behaviour of predator.
Hence inhibition of movements in the presence of a potential predator and in open space
where *Mystus gulio* are vulnerable, provide protection.

Sometimes, in new surroundings the fish has a low fright threshold and inhibition
of movements can be observed although no predator is actually around. Often inhibition
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of movement is complete and the fish moves very slowly across the open space, just over the floor of the aquarium. When shelter is finally available at hand, the fish darts into it. Once the fish is safe inside it's shelter, it may turn around, probe the bottom, etc. The presence of cover inhibits the suppression of movement (Barlow, 1961).

Defense: Fleeing and hiding can be considered as a negative type of defense mechanism. Positive defense consists of spreading of the fins. This is followed by rotating the body slightly and erecting the dorsal and pectoral spines towards the object evoking the defense mechanism in the fish.

*Mystus gulio* expresses fright in more or less three kinds of behaviour. They are as follows:

i) avoiding,

ii) concealing,

iii) aggregating.

Defense mechanism is observed in all the above 3 cases.

The most extreme type of avoiding is panicky flight, which may be either forward or backward, away from the stimulus. The extreme manifestation of concealing is complete absence of movements. Backward flight may be simple avoiding, but often it is influenced by a need for concealing. Intermediate behaviour between avoiding and concealing is nestling. Aggregating behaviour can also be considered as flight behaviour, because in this case, the movement is directed towards the fellow *Mystus gulio*. The individuals in an aggregation exhibit considerable suppression of movement and hence concealing can also be said to set in.
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Fright expression may be considered in the following way

FRIGHT

Avoiding  Concealing  Aggregating

Flight
Forward  Flight  Suppression
Backward  of Movement

It is possible to demonstrate suppression of movement in Mystus gulio by placing it in a small aquarium with inadequate shelter and then tapping on the glass. By tapping on the glass wall of the aquarium with one finger and varying the strength and distance of tapping, the experimental fish may be made to lie still, or suddenly jump forward and immediately go back and so forth.

In Mystus gulio Fright behaviour is an integrated performance involving both avoiding and concealing and sometimes rarely aggregating. Thus the behaviour of the fish switches back and forth rapidly between the possible expressions of Fright.