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MIGRATORY BEHAVIOUR OF FISH

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INTRODUCTION

The fish migration techniques is a very diverse, ecologically significant and beneficial evidence about biological diversity. The migration of some fishes is a regular journey and is truly an innate animal behaviour. The individual species and groups show variation and flexibility in migration which make it a noble model system for understanding the ecological and evolutionary processes. The purpose of migrating fish may depend on individual characteristics and ecological conditions. It takes countless shapes and can be described based on the utilization of different biomes, reproduce, find food, and avoid enemies. There is link between environmental change and migration strategies which involves threats associated with overexploitation, environmental makeovers and management actions that differently influence the vulnerability of individuals, populations and species depending on the variation and flexibility of their migration strategies. Many types of fish migrate on a regular basis, on time scales ranging from daily to annually or longer and over distances ranging from a few metres to thousands of kilometres. The patterns of migration are of great interest to the fishing industry.

The migratory fish offer sound model systems for investigating about the biological systems respond to and cope with environmental heterogeneity and change. Being important predators, competitors and prey to other species, migrating fish affect lakes, rivers, coastal ecosystems and open oceans. In some areas, migrating fish represent important "vectors" by transferring nutrients or pathogens between habitats as in mass migration and post-spawning death of Pacific salmon that brings energy from resource-rich marine habitats to less productive rivers. The migrating fish also comprise an essential resource of considerable socioeconomic value targeted by commercial and recreational fisheries worldwide.

MOVEMENT OF FISHES DURING THE MIGRATION

1. **Drifting movement:** It is a passive movement of fish along with water currents.

2. **Dispersal movement:** It is a random locomotory movement of fish from a uniform habitat to a diverse direction.

3. **Swimming movement**: It is an orientated movement of fish either toward or away from the stimulus source.

4. **Denatant and Contrantant movement:** It is an active swimming movement in water. The denatant movement is swimming with the water current, while contrantant movement is swimming against the water current.

SIGNIFICANCE OF FISH MIGRATION

- ✓ To find suitable feeding and spawning ground
- ✓ To protect them from predators
- ✓ To survive from extreme climatic conditions
- ✓ To increases their genetic diversity
- ✓ To have an adaptation character for survival and existence.

TYPES OF FISH MIGRATION

Anadromous Migration

It is the type of long distance migration generally found in case of marine fishes from sea to fresh water for spawning. The fishes employ most of their life living and feeding in sea. They only migrate during breeding season to the river for spawning ground. ▪ Eg. Salmon, Hilsa, Lamprey, American shad, Striped bass etc.

The salmon migrate for breeding during winter from sea to river. While migrating, the mature salmon faces some of the physiological changes like starving during journey and changing the colour from silver to dull reddish brown. They select suitable spawning ground and make a saucer like nest in which female lays eggs and male releases sperm over them. Juvenile larva hatched out from the egg known as Alevins (a newly hatched salmon when still attached to the yolk sac). The alevins then transform into a juvenile fish called parr and metamorphose into adult when return to the sea. These salmon hatch in small freshwater streams. From there they migrate to the sea to mature, living there for two to six years. When mature, the salmon return to the same streams where they were hatched to spawn. Salmon are capable of going hundreds of kilometres upriver, and humans must install fish ladders in dams to enable the salmon to get past.

Catadronous Migration:

It is the migration of fishes from river to sea during breeding season for spawning. The freshwater eels are catadromous fish that make large migrations. Eg. Eel *(Anguilla Anguilla, Anguilla vulgaris* and *Anguilla rostrata)* migrate from the continental rivers to Sargasso Sea off Bermuda in south Atlantic for spawning, crossing Atlantic Ocean.

Before and during migration some physiological changes occur in their bodies. Deposit large amount of fat in their bodies which serves as reserve food during the journey Colour changes from yellow to silvery grey. Digestive tract shrinks and stops feeding Eyes get enlarged and vision sharpens. Other sensory organs also become sensitive. Skin serves respiratory organ. Gonads becomes matured and enlarged. The lay eggs in suitable spawning ground and are fertilized by males. After spawning they die. The larva hatch out and develop into young ell and finally return to river. The subsequent larvae can drift in currents for months and even years before returning to their natal rivers and streams as glass eels or elvers.

Diadromous Migration

It is the regular type of migration of fish between sea and freshwater to have perfect osmotic balance.

Oceanodromous Migration

It is the migration of fish within sea in search of suitable feeding and spawning ground. .The fish are born near spawning grounds, then drift on ocean currents as larvae before settling as juveniles to grow

into adults before migrating back to spawning grounds. These high trophic level oceanodromous species undertake migrations of significant but variable distances across oceans for feeding often on forage fish or reproduction and also have wide geographic distributions. Thus, these species are found both inside the 200 mile exclusive economic zones and in the high seas outside these zones. They are pelagic species, which means they mostly live in the open ocean and do not live near the sea floor, although they may spend part of their life cycle in nearshore waters. Eg. *Clupea, Thummus, Tuna etc.*

Spawning Migration

The reproductive or breeding migrations involve reproductively mature fish from foraging areas to where they will place their gametes. For a spawning environment to be productive, it should provide abiotic and biotic conditions favourable for the development and survival of fertilized eggs, embryos, hatched larvae, and young juveniles. The differential needs and demands depending on size and age, the nursery habitat progressively becomes suboptimal. As the fish grow larger and older, they eventually leave the nursery grounds favouring more productive foraging grounds that likely join the adult population. It may involve crossing the borders between fresh, brackish and saline water bodies but can occur within such biomes, such as between or within lakes and rivers.

Diel Vertical Migration

It is a common behaviour in many marine species which moves to the surface at night to feed, and then return to the depths during daytime.

Alimentary / Feeding migration: It is a migration for search of feeding ground. It occurs when food resources get exhausted.

Gametic or spawning migration: It generally occurs at the time of breeding season for searching the proper spawning ground.

Osmo-regulatory migration: It generally occurs for in migration for water and electrolytes balance from sea to fresh water and viceversa.

Climatic or seasonal migration: It is a type of migration in search for appropriate climatic condition.

Juvenile migration: It is the type of larval migration from spawning ground to the feeding habitats of their parent.

Latitudinal migration: It is the climatic migration of fish from north to south and vice-versa. Eg. Sward fish migrate north in spring and south in autumn.

Vertical migration: It is a daily migration of fish from deep to the surface and vice-versa for food, protection and spawning. E.g. Sward fish usually move vertically downward to greater depth for food.

Shoreward migration: It is the migration of fish from water to land. However, it is a temporary migration. E.g. Eel migrate from one pond to another pond via moist meadow grass.

Forage fish migration (Icelandic capelin): The marine forage fish often make great migrations between their spawning, feeding and nursery grounds. The movements are associated with ocean currents and with the availability of food in different areas at different times of year. The schools of a particular stock usually travel in a triangle

between these grounds. The wide triangular journeys is necessary because forage fish cannot distinguish their offspring while feeding.

HAZARDS TO MIGRATING FISH

Unfortunately, many migrating fish species are under increasing threat due to management action in commercial and recreational fishing involving the habitat modification, fragmentation and destruction of spawning and nursery habitats, pollution, and overexploitation, dispersal barriers, overfishing, and ongoing climate. These factors have put many species of migrating fish in jeopardy. Apart from immediate negative effects associated with declining populations, changes in distribution ranges, and local extinctions exploitation can induce long-term evolutionary shifts in behaviours, individual growth trajectories and life-history strategies. They also affect the recruitment, size-structure and dynamics of populations. The efforts designed to compensate for overexploitation and mitigate the devastating effects of dispersal barriers via removal of dams, construction of fish ways, compensatory breeding and supplemental stocking may have unintentional and unforeseen negative consequences. The alterations in river connectivity caused by the building and removal of dams or the construction of fishways brings the changes in community composition and species interactions and in rapid loss of local adaptations. The connectivity changes can also affect the directions and rates of gene flow with consequences for genetic diversity and inter-population hybridization.

Similar to fisheries induced evolution, the altered severity of migration caused by constructed fish ways may influence the characteristics of successful migrants and impose selection and evolutionary shifts in traits that directly define migration or dispersal capacity, as well as in other traits that may impair population growth. The selection that gives rise to local adaptations generally reduces phenotypic and genetic variance. This can be detrimental because diversity brings many benefits. The theory and empirical evidence concur that flexibility and variance reducing bet-hedging strategies within individuals and genotypes can increase geometric mean fitness in changing and heterogeneous environments

There is a need to have of knowledge in this emerging area and explore the patterns, causes, and implications of variety and flexibility in fish migration that are scientifically intriguing and address crucial topics in the context of evolution and biological diversity maintenance. The future research and development of informed management is needed to ultimately promote sustainable utilization and protection of migrating fish and their ecosystems. The migratory fish showcase a scientifically interesting example of biological diversity of considerable ecological and socioeconomic importance. Some of the important challenges is need to be addressed in this contribution including the identification of different ecological drivers influencing the evolution and variation of migratory behaviour. There is also need to illuminate about genetic polymorphism, developmental plasticity and intra-individual flexibility of migratory behavior influence the response and ability of individuals, populations and species to cope with environmental change.

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