Role of *Anabas testidinesious* in local aquatic food webs of Seemanchal wetlands

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Abstract: *Anabas testudineus*, commonly known as the climbing perch, plays a vital role as an opportunistic carnivore, biocontrol agent, and intermediate predator in the local aquatic food webs of Seemanchal wetlands. Due to their ability to breathe air using a labyrinth organ, they occupy heavily vegetated stagnant water bodies, including wetlands, swamps, rice fields, and shallow pools characteristic of the Seemanchal region. *Anabas testudineus* is a hardy, habitat-generalist species that thrives in the low-oxygen, high-turbulence, and often heavily vegetated environments of the Seemanchal wetlands, ensuring its active role in both wet and dry season aquatic food dynamics.

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1. Introduction: *Anabas testudineus*, commonly known as the climbing perch or Koi, plays a significant role in local aquatic food webs as an **opportunistic carnivore/omnivore**, acting as a top predator in shallow, seasonal, and oxygen-depleted habitats. Its ability to breathe air and travel over land allows it to colonize isolated habitats, where it acts as a key ecological actor.

Anabas testudineus, belongs to the order perciformes and family anabantidae [1]. Fish is the major protein source in the diet of the Bangladeshi people. Fish contributes about 60% of the available protein in the diet and the rest 40% protein comes from livestock and poultry. It indicates the importance of fish in contributing to the level of nutrition of the people of Bangladesh [2]. Local koi was more carnivor having comparatively wider mouth gap, larger premaxilla, maxilla and dentari, long oesophagus, short stomach, lesser length of intestine, thus noticed higher amount of protein than Thai koi. Again Thai koi showed two times greater value of intestine having too long folded villi that indicate more absorptive capacity of intestine of the variety than local koi. Thus it showed having greater value of minerals from artificial feeding [3]. Nutritionally both of the varieties are valuable food items with high levels of protein, lipid and minerals. Both the fishes might be good nutrition source for weak and convalescent patients [3]

Anabas testudineus – Climbing Perch

These fish have an elongated torpedo-shaped body and can grow to about 25 centimetres long. This is somewhat reminiscent of a perch in shape. The base of the dorsal fin is longer than the base of the anal fin. These fins form into the tail fin, bending back towards the body. Two strong spines grow on each gill cover. The fish are olive to grey. Young fish have a dark spot on the base of the tail. This is one of the reasons why the young are often confused with Ctenopoma species.

The spines on the gill covers are a defense mechanism for the fish. These spines are very painful. Therefore, great care must be taken with these fish. Another remarkable characteristic of these fish is that they can move between different pools using their fins, tails, and gill covers. To protect themselves, they do this mainly at night. Here, entire groups of Anabas testudineus come out of the water simultaneously. Individuals who go out alone are rarely found.

The fish got their common name, Climbing Perch, thanks to a myth. According to this myth, specimens of this species were found in the tops of trees. They were supposed to be able to climb these trees by themselves. However, this ability has not been scientifically proven. If it is the case that they were actually seen in trees, then it is more likely that birds left them there.

Anabas testudineus (Bloch, 1792)

In their natural habitat, Climbing perch are found in small streams and occasionally in brackish waters. However, for optimal health, it is best to keep them in freshwater. Their common name comes from myths suggesting they can climb trees, but in reality, they do not possess this ability.

Climbing perch are relatively low-maintenance but require some specific conditions in their aquarium. It's crucial to leave some air space between the water surface and the top of the tank, as they need to breathe atmospheric air. Ensure this space is kept humid to protect their primitive lungs. While they do well under dim lighting, they can also adapt to brighter setups if aquatic plants are included in the tank.

Anabas testudineus are skilled jumpers, so a tightly fitting lid is essential for large tanks. High-quality filtration is necessary due to their high waste production, and regular water changes are required. These fish can be aggressive, though behavior may vary between individuals. They can be kept in groups if the tank is spacious enough, but avoid housing them with smaller fish, as they may see them as food. Instead, pair them with similarly sized and tempered species.

Climbing perch require a varied diet to stay healthy. Provide high-quality flakes and pellets, and include vegetables like lettuce, spinach, and peas. Supplement their diet with meaty foods such as chopped earthworms and bloodworms. Once they are accustomed to their new environment, they are generally not picky about food. However, a balanced diet that includes both meaty and vegetable items will enhance their color and support their long-term health.

Review of Literature:

The climbing perch (Anabas testudineus Bloch, 1792) plays a significant role in fisheries and aquaculture practices because of having a high market value as important food fish, not only in Indonesia (Akbar et al., 2016) but also in Lao PDR (Sokheng et al., 1999), Cambodia (Sverdrup, 2002), Vietnam (Van & Hoan, 2009), southern Thailand (Chotipuntu & Avakul, 2010), Malaysia (Zalina et al., 2012), the Philippines (Bernal et al., 2015), Bangladesh (Hossain et al., 2015a; Uddin et al., 2017), and India (Kumar et al., 2013). It is rich in iron and copper that support haemoglobin synthesis (Sarma et al., 2010) and has high quality poly-unsaturated fats and many essential amino acids (Kohinoor et al., 1991). It also provides 19.50% of protein and 2.27% of lipid (Ahmed et al., 2012). In nature, they can be found in all freshwater bodies such as rivers, streams, swamps, ponds, lakes, canals, reservoirs, and estuaries (Sarkar et al., 2005; Rahman & Marimuthu, 2010), and can also be cultured at cages, tanks and ponds (Long et al., 2006; Mondal et al., 2010; Kumar et al., 2013) with different culture strategies (Trieu et al., 2001; Phu et al., 2006; Chotipuntu & Avakul, 2010; Putra et al., 2016). Some of studies are dedicated to describe on breeding biology (Hafijunnahar et al., 2016), boldness (Binoy, 2015) or morphometric characteristic of this species (Hossain et al., 2015b). Statistically, climbing perch contributes about 12% (8.31 tons) of total inland capture fisheries production (69.97 tons) in South Kalimantan Province. It is abundantly found in three different types of swamp areas, namely “monotonous swamp” located on Hulu Sungai Selatan District (452.704 ha), “rain reservoir swamp” in Banjar, Tanah Laut, and Pulau Laut Districts (169.094 ha), and “tidal swamp” in Barito Kuala, Tanah Laut, and Kota Baru Districts (372.637 ha). A. testudineus is locally called “papuyu” and is well-known as an indigenous air breathing freshwater species and is capable of spending days out of water provided the breathing organ remains moist (Storey et al., 2002) as function of labyrinth organ (Rahman et al., 2015). In Australia, Papua New Guinea and India, the presence of them is exactly expected to out-compete native freshwater and estuarine species such as birds, reptiles, animals and predatory fish by using their

sharp dorsal and opercular spines (Storey et al., 2002; Hitchcock, 2008; Paliwal & Bhandarkar, 2014). Indiscriminate harvesting of fry and fingerlings, habitat modification, reduced water flow, growing human interventions on wetlands are the main threats to this species (Rahman et al., 2012; Kalita & Deka, 2013; Hossain et al., 2015b).

A. testudineus encompasses a divergence feeding behaviour. They are a fierce predator, and will also eat other fish if they can master them. Some are omnivorous, feeding on invertebrates, fish and plants. Local fishermen usually utilize their feeding behaviour to attract them into the traps or the nets with or without baits (Iwata et al., 2003; Bernal et al., 2015; Hossain et al., 2015b; Kumary & Raj, 2016; Irhamsyah et al., 2017). At the same time, study on the light-induced behavioral response in A. testudineus is completely lacking in these publications. By learning from previous studies (Ahmadi & Rizani, 2013; Aminah & Ahmadi, 2018) and combining with the present study, we believe that trapping with lights shows the promising option to harvest them from both culture pond and wild sources. It is therefore improvement of the harvesting procedures is essential. For this reason, we carried out a series of trapping experiments to investigate phototactic responses of A. testudineus to various intensities and colors of light emitting diode (LED) underwater lamps in the pond, as well as to analysis the size distribution, length-weigh relationship and condition factor of this species.

2. Local Aquatic Food Web of Seemanchal wetlands

- **Intermediate Predator and Carnivore:** *A. testudineus* is predominantly carnivorous, with its diet consisting of aquatic insects, crustaceans (shrimps), protozoans, rotifers, and fish larvae. As they grow, they tend to move towards a more carnivorous diet, acting as a check on the population of smaller aquatic organisms.
- **Biocontrol Agent (Mosquito Larvae Control):** In the wetlands and surrounding paddy fields of Seemanchal, this species plays an essential ecological role by feeding on insects at the water surface, specifically acting as a natural control for mosquitoes.
- **Inter-seasonal Habitat Utilization:** Unlike many other fish, *A. testudineus* can survive under dried mud in the marshy wetland areas during the dry season using its aerial respiration. This allows them to quickly re-establish themselves, maintaining their position in the food chain when water returns.
- **Prey for Higher Trophic Levels:** Despite their defensive spiny scales and operculum, they are a significant source of protein for larger carnivorous fish, birds, and snakes within the wetland ecosystem.
- **Impact on Fisheries/Polyculture:** They can be detrimental to aquaculture in local ponds because, as opportunistic feeders, they prey on the fry and fingerlings of other fish, such as carps, often affecting the survival rates of stocked fish in communal ponds.

3. Anabas testudineus Farming in Natural Ponds and Impact on Subsequent Crop

Anabas testudineus (Bloch 1792), belonging to the Perciformes order and Anabantidae family, is widely found across the globe particularly in tropical and subtropical Asian continents (Khatun et al 2019). The peculiar walking/climbing ability makes it a different fish and is commonly called a Climbing perch. This fish is called 'Koi' in Bangladesh and India (Chakraborty et al 2012). It inhabits confined water bodies such as canals, lakes, ponds, swamps, and estuaries (Hossain et al 2015). Anabas possesses the ability to live in low saline water bodies also. The body of Anabas is slender with large scales and spines on the gill cover. This fish has the adaptive ability to survive in adverse climatic conditions such as low dissolved oxygen, high turbid water, extreme pH, high temperature, etc. They can also live without water for a short period by resting under the mud during dry seasons (Tay et 2006, Paliwal et al 2014) and have aerial respiration using paired suprabranchial labyrinthiform organs. It is a carnivorous air-breathing species using a labyrinth organ to take oxygen directly from the atmosphere. Anabas is an omnivore that primarily feeds on fish larvae and shrimps rather than algae (Mustakim et al 2020). This fish was used as a biocontrol agent against mosquitoes in confined water bodies, including rice fields (Bhattacharjee et al 2009) and can feed on insects at the water surface. The seed production of Anabas is standardized, and hatchery-produced seeds are being used for its farming. Anabas breeds at sizes 70-100 mm with the onset of monsoon. Paddy fields and seasonal ponds having low water columns are their breeding grounds. Anabas is farmed commercially in rice fields, ponds, and artificial tanks. Slow-growing local strain and fast-growing Koi strain are the two strains of Anabas popular in India. Local strain reaches only 80-100 g in 8 months, whereas Koi strain reaches 300-400 g in 8 months. Those farmers who take up polyculture are facing issues due to the predation of Anabas on tiny fish larvae and fries. This issue is more predominant

in natural ponds than artificial ponds. Complete eradication of Anabas is difficult due to its hibernation ability. Anabas predation is a growing issue for those freshwater fish farmers who are farming in ponds where complete drying is impossible.

4. Anabas testudineus in local aquatic food webs

Anabas testudineus, commonly known as the climbing perch, plays a significant, versatile role in local aquatic food webs across South and Southeast Asia, acting primarily as an **opportunistic omnivore with a strong inclination toward carnivory**. Due to its ability to breathe atmospheric air, it thrives in shallow, turbid, and stagnant waters such as paddy fields, swamps, canals, and flooded fields, often dominating these habitats.

Here is an analysis of *Anabas testudineus* in local aquatic food webs:

1. Trophic Position and Diet

Anabas testudineus operates in the middle-to-high trophic levels (roughly 2.14–2.98), feeding on various food items.

- **Juveniles/Fry:** Primarily consume plankton, including rotifers and small crustaceans.
- **Adults:** Primarily carnivores, feeding on invertebrates (worms, insects), small crustaceans (shrimps), mollusks (snails), and fish fry. They also consume plant matter and detritus.
- **Foraging Behaviour:** They are active feeders (often at night) that use a "food collecting" method, storing food in their mouths. Their sharp teeth and feeding habits indicate a highly predatory role, even attacking the fingerlings of other fish species.

2. Role as a Predator

Anabas is a significant predator within its niche.

- **Impact on Species:** They are known to feed on snails, which can help manage snail populations, but they are also detrimental to fish farming, as they eat the eggs and fry of other fish species (like carps) in shared water bodies.
- **Impact on Ecosystem:** Their foraging behaviour involves digging in mud, which can affect the benthic structure of their habitat.

3. Role as Prey

Despite their spiny nature, they are consumed by:

- **Larger Piscivorous Fish:** Other predatory fish, though they can sometimes pose a risk of choking the predator due to their spiny operculum.
- **Birds and Reptiles:** Common prey for predatory birds and snakes in wetland ecosystems.

4. Interactions and Adaptation

- **Hardy Competitor:** *Anabas* is extremely hardy and can survive in extremely unfavorable water conditions (low oxygen) and even survive out of water for long periods.
- **Niche Overlap:** In many habitats, their dietary overlap with other native fish is low, but they can outcompete others due to their ability to survive in poorer water quality, allowing them to occupy areas that others cannot.
- **Parasite Host:** They act as a reservoir for several parasite species, including trematodes, nematodes, and acanthocephalans, which can be transmitted through the food web to other aquatic animals.

5. Interaction with Humans (Food Web Impact)

Anabas testudineus is a highly valued food fish, heavily targeted by local fisheries and aquaculture.

- **Rice-Fish System:** They are often found in rice paddies, feeding on insects that might harm the crops, acting as a natural pest controller, while being harvested for food.

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