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OBSERVATIONS ON HABITAT PREFERENCES OF CRAYFISH SPECIES *Pontastacus leptodactylus*

ABSTRACT

This study, conducted between 2016 and 2023, utilized photographs, videos taken during scuba diving, and expert opinions to provide a comprehensive overview of each period. Despite *Pontastacus leptodactylus* not being a native species of Keban Dam Lake, it has adapted to the environment over the years and has become economically important for fishing. This article aimed to identify various shelter types used by this crayfish species in Keban Dam Lake. It has been observed that crayfish in Keban Dam Lake utilize a wide range of shelters, including natural rocks, crevices, and even discarded objects such as submerged plastic bottles. The sizes of these shelters vary, ranging from 10 to 15 cm in diameter, and depths range from 20 to 40 cm. Therefore, it is recommended to conduct experimental studies in natural environments to explore the use of shelter types in natural habitats.

Keywords: Shelter Type, *Pontastacus leptodactylus*, Keban Dam Lake, Habitat Preferences, Diving

1. INTRODUCTION

In nature, just as there are relationships among different species living in the same habitat, there are also interactions among individuals within the same species. Freshwater crayfish species, which inhabit the same freshwater environments, engage in competition for shelter, reproduction, and food throughout their lives. Among the reasons for this competition is the need to protect themselves from predators and secure food sources through the use of shelters. In environments where shelters are scarce, there is a high risk of becoming prey for other species or even conspecifics. Competition among individuals of the same species often leads to the widespread use of shelters. Therefore, it is necessary for freshwater crayfish, both in aquaculture settings and in areas where they are harvested naturally, to have access to sheltered areas where they can seek refuge. The natural crayfish species of our country, "*Astacus leptodactylus* Esch, 1823" is native to the lakes of Eğirdir, Beyşehir, Akşehir, Eber, Çivril, Apolyont, and Manyas, and has subsequently been introduced to other water sources [1 and 2].

Crayfish are various, abundant, and globally distributed omnivorous invertebrates found in both lentic and lotic ecosystems. In addition to their ecological importance, their use as a luxury food also increases their significance. Due to their economic value, demand for crayfish continues to rise [3, 4 and 5]. In most cases, *Pontastacus leptodactylus* prefers slow-moving or stagnant waters and inhabits water bodies with silty or sandy clay bottoms. Some studies have focused on

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the vital activities, reproductive behaviors, and feeding habits of different crayfish species in shelters [6]. Crayfish face many problems both in their natural habitats and in aquaculture conditions. In addition to diseases and parasitic infections, pollution, unsuitability of environmental conditions, and cannibalism are notable issues. Crayfish use shelters for cannibalism, protection from other predators, feeding, molting, and reproduction purposes. Due to their nature, crayfish find it difficult to survive in environments without shelters. Therefore, the use of shelters is essential both in aquaculture and natural habitats. Significant fishing yields have been achieved for the crayfish species introduced later into the Keban Dam. Crayfish populations have reached a sufficient level because they were not initially hunted. Numerous studies have been conducted on fishing yields in other wetlands in our country. Research has been conducted on fishing yields, growth, catch rates, and the use of undersized species as bait [7, 8, and 9].

Studies on crayfish shelters in natural habitats have been limited [10]. To utilize crayfish in our country's waters more efficiently and sustainably in their habitats, they need to have shelters to ensure their protection, and reproduction, and to prevent intra-species competition. Therefore, it is necessary to use shelters of appropriate size and quantity both to increase fishing yields in natural habitats and to increase productivity in aquaculture conditions [11]. Crayfish are benthic organisms, meaning they must live on the bottom of their habitat. To protect themselves from external factors, crayfish use shelters. Some crayfish species can build nests if there are no natural shelters available in the environment. However, some species require shelters to sustain their vital activities. Additionally, crayfish undergo molting, during which they are extremely vulnerable. During this period, they instinctively seek shelter for protection.

Cannibalism is common among crayfish, especially in crowded conditions. Large and mature individuals exert pressure on younger ones. It is known that shelters in the environment reduce aggression in all crayfish species. Shelters are among the most important concepts for crayfish survival rates and sustaining their vital activities. Although crayfish consumption is not prevalent in our country, exporting them abroad contributes significantly to the national economy [3 and 4]. In a study conducted by Mazlum and Uzun in 2008, the use of shelters in the production of *Pontastacus leptodactylus* was demonstrated in laboratory experiments. Despite the significant effects of shelter use on crayfish farming and natural harvesting, observations in natural habitats have been limited. Crayfish use shelters not only during molting but also for protection from predators. They do not want to leave the shelters they find and prefer to use them throughout their lives. Therefore, some researchers have observed a strong relationship between shelter size and crayfish size for shelter selection [12]. Crayfish face many challenges throughout their lives in their natural habitats. The main problems include unfavorable environmental conditions such as pollution and drought, predators, and cannibalism. To protect themselves from these problems, crayfish either use naturally formed shelters in their habitats or create their own shelters. Studies have found that crayfish use shelters to avoid bright environments and generally argue that crayfish would not be able to carry out their vital activities in environments without shelters. In general, crayfish spend their daylight hours in shelters, while they leave their shelters at night to find food.

2. RESEARCH SIGNIFICANCE

Throughout their lives, crayfish require shelter types for growth, molting, protection from cannibalism, and to safeguard themselves from other carnivorous species. This study specifically investigates the



types of shelters utilized by crayfish in the context of the Keban Dam Lake. The research aims to identify the specific types of shelters crayfish use in this habitat and to understand their preferences among these shelter types. By examining the shelter preferences of crayfish in the Keban Dam Lake, we can gain insights into their behavior and habitat requirements, which is crucial for conservation efforts and the management of crayfish populations in this ecosystem. Understanding crayfish shelter preferences can also provide valuable information for aquaculture practices, aiding in the development of effective strategies for crayfish farming and habitat enhancement initiatives.

Highlights:

- Crayfish can be an important source of income through both farming and catching.
- For this purpose, artificial reefs suitable for crayfish should be built.
- Studies should be carried out on what artificial reefs should be with experimental studies in nature.

3. MATERIALS AND METHODS

This study was conducted in the Keban Dam Lake based on photographs, videos, and expert opinions gathered through scuba diving expeditions conducted between 2016 and 2023, aiming to reflect various seasons during this period. Dives were conducted primarily in depths ranging from 0 to 20 meters, where crayfish are predominantly found. SCUBA diving equipment with independent diving apparatus (BAD) was used for dives. The NORTH EDGE Aqua professional diving computer watch was utilized for depth and temperature measurements during dives. Since crayfish are known to be more active at night, dives were conducted both during the day and at night. *Pontastacus leptodactylus*, the crayfish species studied, is not a native species to the Keban Dam Lake. Over the years, this species has adapted to the environment of the Keban Dam Lake and initially, its economic exploitation was not significant. However, it has gradually become more widespread, especially in the Ağın Fishing Cooperative, and later in the Çemişgezek, Keban, and Pertek regions, eventually becoming economically important. Therefore, previous studies in the area have primarily focused on fishing yields, studies related to the target species, food quality, and biological research. Consequently, research on the habitats of crayfish in the Keban Dam Lake, their nesting habits, their preferred depths of habitation, and their feeding behaviors has been limited. These observations, coupled with the expectations of utilizing important information for both fishing and aquaculture purposes, form the basis of this study.

4. FINDINGS

Similar to many aquatic organisms, *Pontastacus leptodactylus* exhibits the behavior of building nests. They use these nests for both protection and feeding purposes. While the Keban Dam Lake serves as a natural habitat for this species, an attempt has been made to determine the types of nests they use through an article. Crayfish, especially during molting and the juvenile stage, are vulnerable to attacks from other aquatic organisms. In addition to other aquatic organisms, larger individuals of their own species also negatively impact the lives of juvenile crayfish. Therefore, crayfish use nests in their habitats without fail. Based on observations, it has been determined that crayfish in the Keban Dam Lake use a wide range of habitats, from natural rock crevices to plastic bottles submerged underwater. Generally, larger crayfish inhabit their nests alone. However, some crayfish use their nests either individually or in colony form. The sizes of the nests

vary, with widths ranging from 10 to 15 cm and depths ranging from 20 to 40 cm. During the months of June to August, they inhabit depths ranging from 8 to 18 meters. In contrast, they prefer depths of 2 to 16 meters from September to May, coinciding with lower water temperatures. An important characteristic is their preference for nests facing the direction of water flow. This preference is thought to be due to the potential presence of both food and oxygen carried by the current. Photographs and videos of crayfish, which typically exhibit nocturnal feeding behavior, were observed through night dives. It was observed that crayfish tend to abandon their nests during night dives either for feeding purposes or when they sense a threat.



Location: Çemişgezek Fishing Zone

Temperature: 18°C

Depth : 12 meters

Habitat : Sandy-Rocky

Figure 1. The shelter type created by a solitary crayfish within a rocky crevice

During the diving observations, an adult crayfish was found naturally occupying a crevice in a rock. Given the sandy and rocky environment, it is likely that the crayfish is using this shelter.



Location: Çemişgezek Fishing Zone

Temperature: 20°C

Depth : 12 meters

Habitat : Sandy-Rocky

Figure 2. The nest made by a solitary crayfish inside a plastic bottle

This adult crayfish species has utilized a discarded plastic bottle as a shelter. This unnatural shelter type has transformed into an area where the crayfish carries out its vital activities.



Location: Çemişgezek Fishing Zone **Temperature:** 22°C
Depth : 10 meters **Habitat** : Rocky

Figure 3. The nest made by crayfish living in colonies inside a crevice made of stone

Underneath a natural stone in this rocky environment, multiple crayfish have created shelters. These shelters were likely formed by crayfish excavating underneath the rock. Due to the suitability of this rocky area for shelter formation, it is estimated that multiple crayfish continue to live in the same location.



Location: Çemişgezek Fishing Zone **Temperature:** 22°C
Depth : 10 meters **Habitat** : Rocky

Figure 4. The nest made by a solitary crayfish under a rock

Here, a solitary crayfish is observed living alone in a rocky area. This observation indicates that the crayfish is living solitarily.



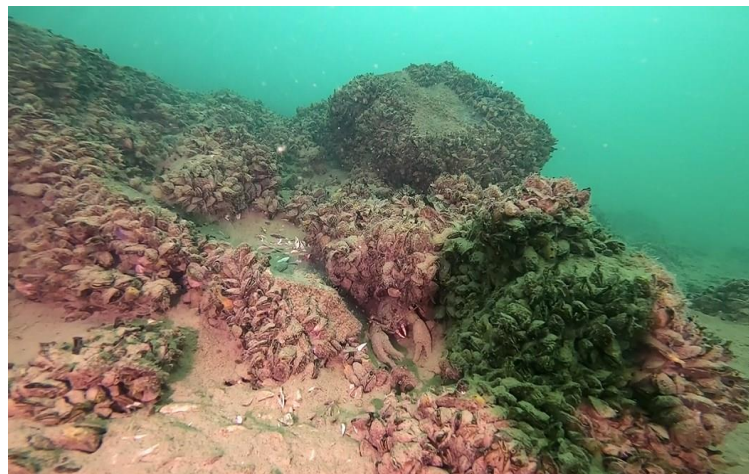
Location: Fatmalı Fishing Zone **Temperature:** 18°C
Depth : 09 meters **Habitat** : Rocky

Figure 5. The nest made by a solitary crayfish inside a crevice made of stone



Location: Çemişgezek Fishing Zone **Temperature:** 22°C
Depth : 10 meters **Habitat** : Rocky

Figure 6. A single crayfish species is found in a small crevice



Location: Aydınlar Fishing Zone **Temperature:** 20°C
Depth : 08 meters **Habitat** : Rocky

Figure 7. The nest made by a solitary crayfish inside a crevice made of stone



Location: Çemişgezek Fishing Zone **Temperature:** 22°C
Depth : 15 meters **Habitat** : Rocky
Figure 8. The nest made by a juvenile crayfish living alone inside a crevice made of stone



Location: Çemişgezek Fishing Zone **Temperature:** 20°C
Depth : 15 meters **Habitat** : Rocky
Figure 9. The nest made by a solitary crayfish inside a crevice made of stone

Observations have been made of crayfish using both a crevice in a stone and a metal pipe as shelters.



Location: Çemişgezek Fishing Zone **Temperature:** 22°C

Depth : 15 meters

Habitat : Rocky

Figure 10. The nest made by a solitary crayfish inside a crevice made of stone

Observation of crayfish living in a habitat formed by two rocks coming together side by side.



Location: Çemişgezek Fishing Zone **Temperature:** 20°C

Depth : 15 meters

Habitat : Rocky

Figure 11. Shelters where crayfish live collectively in rocky areas



Location: Çemişgezek Fishing Zone **Temperature:** 22°C

Depth : 15 meters

Habitat : Rocky

Figure 12. Shelters where crayfish live collectively in rocky areas



Location: Çemişgezek Fishing Zone **Temperature:** 18°C
Depth : 12 meters **Habitat** : Sandy
Figure 13. The shelter where a solitary crayfish lives in a plant husk



Location: Çemişgezek Fishing Zone **Temperature:** 18°C
Depth : 12 meters **Habitat** : Sandy
Figure 14. The shelter made by a crayfish on a water plant



Location: Keban Fishing Zone **Temperature:** 20°C
Depth : 10 meters **Habitat** : Sandy
Figure 15. A nest made inside a crevice



5. DISCUSSION AND CONCLUSION

The most significant factor in the density and distribution of crayfish in wetland areas is the presence of shelters, which vary depending on the habitat. Several studies have shown that crayfish change their locations throughout the day due to various reasons [25]., while others have reported that some species do not move from the same area [22].

In this study conducted at the Keban Dam Lake, based on the literature mentioned above, it was observed that some crayfish exhibit solitary behavior while others form colonies. In their study, [13] found that the species *Pontastacus leptodactylus* prefers shelters made of wood and stone. This preference is likely due to their natural inclination towards these materials. Additionally, they discovered that these crayfish also utilize shelters of plant origin, with smaller crayfish species showing a higher preference for plant-based shelters. Groza, Pop-Vancia and Mireşan emphasized the importance of conducting studies in natural environments, even though their laboratory experiments provided valuable insights [13]. In the study conducted at the Keban Dam, crayfish species were primarily found to inhabit stone crevices, gaps between rocks, and shelters of plant origin. One of the potential causes of mortality among juvenile crayfish is stock density. High stock density increases cannibalism rates, which can be particularly detrimental during vulnerable periods such as molting. Synchronizing the ages of juveniles within a production group can partially mitigate this issue. Stock density is considered a significant factor limiting the survival and growth of juveniles by many researchers [10, 12, 14, 15, 17, 18, 19, 20, 21, and 22].

Pontastacus leptodactylus, a widespread European crayfish species with both native and invasive populations, lacks comprehensive information about shelter usage in natural habitats. Despite using various shelter types in laboratory settings, [13] found that shelters made of stone and wood were more advantageous compared to other types. They also observed that these crayfish exhibited both nocturnal and diurnal activities, spending nearly 85% of their time inside shelters.

Based on observations of various shelter types used by crayfish species in the Keban Dam lake reservoir, attempts were made to identify the species' habitats. *Pontastacus leptodactylus* is not native to this reservoir but has been introduced later. Initially, it was commercially fished using traps. Despite the unsuitability of reservoirs for this species, they manage to sustain their vital activities by utilizing both natural shelter areas and artificial objects such as discarded plastic bottles and metal pieces in the water. These observations are deemed valuable for both aquaculture and natural habitat conservation efforts. Similar to marine environments, the proliferation of species-specific artificial reefs in freshwater bodies will contribute to the natural reproduction of crayfish. These artificial reefs should be strategically placed, not exceeding a depth of 20 meters. Additionally, shelters made of natural materials should vary in size to accommodate both juvenile and adult crayfish in the same environment. Therefore, shelter usage should be promoted for crayfish species. According to the results of this study, *Pontastacus leptodactylus* crayfish species:

- Generally construct shelters using natural materials but have been observed to use plastic and metal for shelter construction.
- Can live both individually and in colonies.
- Primarily feed during the night, often preying on *Alburnus mossulensis*. Observations also indicate that they feed on detritus from other fish species.



- Often position the openings of their shelters towards the flow of water, presumably to benefit from the influx of nutrients.
- Display defensive behaviors when they perceive danger, retreating into their shelters after an initial response.

AUTHOR CONTRIBUTIONS

The photographs in this article were taken by Nizam Kaya and his friends. Interpretation of the photographs and writing of the article was done by Tuncay Ateşşahin and Orhan Fulin.

CONFLICT OF INTEREST

The authors have no conflicts of interest to be disclosed.

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The authors declare that this study has received no financial support.

DECLARATION OF ETHICAL STANDARDS

The authors of this article declare that the materials and methods used in this study do not require an ethical committee.

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