Substratum preferences of juvenile Red belly Tilapia
(*Coptodon zilli*, Gervais, 1848)

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Abstract. Substratum preferences of the young of Alien fish species known as Red belly Tilapia locally known Bultee (*Coptodon zilli*, Gervais, 1848) [1] with 30–40 mm TL were studied in the laboratory. The work tested the hypothesis that fishes vary in habitat preference and that they make use of the differences in substrates' types within the water body in nature. Substratum preference for juvenile of *C. zilli* was calculated by the calculations of individuals noticed inside precise habitat kinds. The fish species demonstrated significant changes in their substrate choices. Muddy sand appears to be usually more appropriate settlement ground for juvenile of this fish. Pebble, Gravel, Sand and Mud were less favorable. Plastic floor was unfavorable and the fish would generally settle in the other substrates preference to it. This work proposed that the particle size of the substrate influences settlement preference of the fish.

Keywords: Substratum preference, laboratory experiment, habitat preference, juvenile, *Coptodon zilli*.

1. Introduction
Habitat structure has an important part in fish distribution influencing recruitment and post-recruitment developments by providing microhabitat requirements and protection from predation [1][2]. Therefore, evaluating of fish habitat preferences may help environmental authorities to plan policies for waterway source management by local and national levels.

Relationships between size-specific sediment choices and burial abilities and morphological characteristics in the juveniles of fishes have been studied. It was found from those studies that burial decreases activity and consequently raises the time that fish use up on sediments wherein they are able to bury. Therefore, habitat changes can have consequences for juvenile survival and afterward for recruitment to adult populations [3][4][5]. The differential availability of food and shelter are affected by habitat structure and topographic complexity which have essential part on fish community structure [6]. Physical parameters, for example light, can affect directly or indirectly the community structure [7].

The study of habitat preferences is important for understanding the distribution patterns of fishes. The association between fish and substrate kind has been studied in temperate regions [8] and reef environments [9]. These investigations suggested that fish species richness and abundance fluctuate between substrate kinds. Several species are suggested to occupy one precise habitat solely otherwise principally. Additional species are established in more than one habitat, also several can modify habitats depending on the life stage of the fish.

It is clear that the farming tilapia species on demanded. Therefore, Tilapia aquaculture creates a very strong contribution to people earnings, food production and employment generation in Iraq. The profitability of tilapia farming has been relatively high. More trial approach to understanding habitat choice is needed to state how fish to select a habitat. However, no much effort has been done to study habitat preferences in Red belly Tilapia *Coptodon zilli* (locally known Bultee) for different substrates. Therefore, the current study was carried out also to test the substratum type preferences of juvenile *C.*
zilli, with the hypothesis that selections are done on the basis of burial capabilities. Considering the conflicting results concerning which substrata type influence the survival and abundance of the fish in order to evaluate whether the use of an artificial substrate could offer a suitable culture scheme to reach a productive, potential benefits and sustainable fish aquaculture.

2. Materials and Methods
One hundred of C. zilli with 30-40 mm TL were collected from Marine science center fish farm, Basrah University. They were kept in a Fiberglass tank for an acclimation time of 3 days. The experiment was conducted for 24-h substratum preference trial in the laboratory at Marine Vertebrate Department from 1st May to 15 June, 2017. The physical and chemical properties of water during acclimation and experiment were kept as follows: dissolved oxygen at 6 - 8: mg. L⁻¹, pH at 7.3 - 7.6 and temperature at 25 -28 °C, following [10]. The fish were fed twice a day before the experiment. Uneaten food and dead fish were removed on a daily basis from the tank with siphoning out 25 % of water, which was replaced with new freshwater. Aeration was also supplied to the tank throughout experiment to protect the fish from the stress situation by using one diffuser air stone.

This work included three separate experiments using different substrates in three tanks as:

**Experiment 1.** Mud (3.9–62.5 μm), sand (0.062-1.00 mm), gravel (1.00-2.00 mm) and plastic floor.

**Experiment 2.** Mud (3.9–62.5 μm), sand (0.062-1.00 mm), pebbles (2.00-8.00 mm) and plastic floor.

**Experiment 3.** Mud (3.9–62.5 μm), Muddy Sand, sand (0.062-1.00 mm) and pebbles (2.00-8.00 mm).

The used substrata were collected from natural river Pebbles gravels, sands and mud. It was cleaned with tap water a number of times. They were totally inorganic, therefore reducing possible effects of food. Mud and Sand were mixed together to form a Muddy Sand substrate.

The border of Pebbles, Gravels, Sand, Mud and Muddy sand were prepared by carefully separating these substrates with glass plates which were detached before each experiment on substrate choice started.

Observations were taken each 3 hours over a 24 hours time which included determines the place of every fish inside the substrate as well as burying behaviour. The place of the fish was reordered on Pebbles, Gravels, Sand, Mud, Muddy sand and Plastic floor, or in the water column or in additional positions such as between the tanks and the sediments.

Statistical analyses were carried out to assess substrates preferences [4]. The distribution of these fish on four different substrate types was also tested against the null hypothesis of equal distribution using the X² test.

3. Results

3.1. Experiment 1
In all cases, considerable number of the fish juveniles was significantly recorded (P < 0.05) on the gravel and Mud substrates (Figure 1) and the fish juveniles spent consistently more time on gravel (39.5 %) and Mud substrate (38.4 %) more than other tested substrates (see Figure 1). Sand substrate recorded about 18.3 % of the total fish total (Figure 1). It could be assumed from this finding that the experimental fish trying to bury in sand was not completely flourishing and attained only fractional X² test revealed that C. zilli were distributed unequally (P ≤ 0.005) among the substrate types Therefore, the results suggested that the fish strongly preferred gravel, Mud, and sand over Plastic floor (1 %).

3.2. Experiment 2
The Percentage of total fish recorded on the four different substrate types (Pebble, Sand, Mud and Plastic) are given in Figure 3. The results found that the fish significantly preferred the pebble substrate (P ≤ 0.005). Indeed, the sand and mud substrates were less favorable. Plastic was very less favorable substrate (see Figure 2)
Figure 1. Different trends in settlement of juvenile *Coptodon zilli* in four different substratum types.

Figure 2. Different trends in settlement of Juvenile *Coptodon zilli* in four different substratum types (Pebble, Sand, Mud, Plastic floor).
3.3. Experiment 3
Comparison of selective preferences between Pebble, Sand, Mud and Muddy Sand substrates are shown in Figure 3. The results indicated that there was a significant difference between the numbers of experimental *C. zilli* on the substrates in general. Muddy Sand (72 %) was significantly (*P* ≤ 0.005) selected. Other substrate such as Sand (15 %) and Mud (11 %) were less favorable respectively. In fact, Pebble substrate (2 %) were unfavorable as *C. zilli* individuals would frequently stay in the other substrates favorite to it (see Figure 3).

![Pie chart showing substrate preferences](image)

**Figure 3.** Different trends in settlement of Juvenile *Coptodon zilli* in four different substratum types (Pebble, Sand, Mud, Muddy Sand).
4. Discussion
The current work concentrates on habitat choice throughout the juvenile life time of C. zilli, which takes place in rivers and estuaries. Consequently, considerate the correlation between habitat use of juvenile C.zilli offer an essential plan in describing nursery needs for the juvenile life time. This study found that a significantly \( (P \leq 0.005) \) higher proportion of the juvenile C. zilli examined prefer the substrate compared with fish number occurred at water column. The results of previous publication in the field indicated that C. zilii commonly prefer shallow, vegetated regions in a tropical climate nevertheless also able to survive above sand, mud, or rock [11][12]. Moreover, the habitat choice by the fish is mostly aggravated with biotic factors for instance prey abundance and prevention of predation danger [13]. and also, by a biotic factor which are as well considered to have a significant part [14]. For that reason, Physical habitat is essential in determining the carrying capacity of juvenile C zilli within freshwater or marine water management. Moreover, there are several of previous field studies that confirmed the significant role of substrate type on fish population structure. [15][16]. As a result, [15]; [17]. suggested that important measures might be taken for the inshore habitat in sequence to sustain fish biodiversity. The present work stated that the kind of habitat was significant in changing the distribution of juvenile fish and their population. Fish correlated with Gravel, Mud and Sand (Figure 1) and Pebble, Sands and Mud (see Figure 2) was obviously distinct from the Plastic substrate type. Generally, Muddy Sand was noticed to be the mainly appropriate substratum kind for C. zilli (Figure 3). This finding of substrate choice could be related Burial capabilities. This activity could be deduced by the occurrence of predators which lead to significant selection for substrates wherein fish are capable to bury [4]. Nevertheless, internationally, various substrate kinds in fresh and marine ecosystems have been reported to maintain fish population structure. previously [18] reported that young plaice were capable to inter totally in sand, that could indicate their highest choice for sand. On the other hand, number of the fish were considerably lesser in sandy regions for all time and better on solid places, with seagrass environment giving middle importance [19][20]. Alternatively, rocky habitats offer many micro-organisms and great quantity of prey, deducing in bigger variety of fish groups [21]. Therefore, those studies support the role of substrate type on fish community characteristics which come in agreement with the present study conclusions.

5. CONCLUSION
Juvenile of tilapia (C.zilli ) demonstrated selectivity for substratum during the current work. Muddy sand substrate appears to be usually more appropriate settlement ground for juvenile of this fish. Pebble, Gravel, Sand and Mud were less favorable. Plastic floor was unfavorable for the fish.

6. Recommendation
The current study also suggested that the particle size of the substrate influences settlement favorites of the fish. However, more laboratory works are required on growth investigation of young tilapia in different substratum. Additional fieldwork is also needed to check the relationship among substratum type with the distribution and abundance of Juvenile tilapia. However, different feeding regime, the attendance of predators and dissimilar current speeds on substrate and sediment favorite of tilapia should be also investigated.

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