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Comparison of Catch per Unit Effort in three traps for fishing Common Rudd (*Scardinius erythrophthalmus*) in Anzali Lagoon, Iran

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ABSTRACT

In this study, catch per unit effort (CPUE) of three different traps were subjected to a comparison being used for catching the common rudd (*Scardinius erythrophthalmus*) in the Anzali Lagoon, Iran. The capture efficiencies and the catch rates of the cylindrical pot, the opera house trap, and the hokkaido pot were compared during 2017. The results showed significant differences among the cylindrical pot, opera house traps, and Hokkaido pot. The Hokkaido pot yielded similar performances in stations 2 and 3; however, it differed in station 1. The opera house trap produced different performances in all the three stations ($P < 0.05$), while for the cylindrical pot, the performance was similar in all the three stations ($P > 0.05$). In conclusion, the opera house trap proved its superior efficiency and is therefore recommended to be used for catching the common rudd in the Anzali Lagoon.

INTRODUCTION

The Anzali Lagoon is located on the southern coast of the Caspian Sea in the Guilan province and has four basins: Western, Eastern, Central, and South-West. These four sections are distinguished by having different physicochemical, ecological, and geographical parameters and represent different ecosystems **(Khanipour *et al*., 2020)**. The Anzali Lagoon location; being between the land and sea ecosystems and between freshwater and brackish ecosystems, forms a special ecotone embracing a unique blend of plant and animal communities **(Aminisarteshnizi, 2021)**.

The *Scardinius erythrophthalmus* (Linnaeus, 1758) is one species of the family Cyprinidae widely distributed in the Palaearctic region. Its distribution is found in the Caspian Sea, Anzali Lagoon, and Aras River in Iran. The *S. erythrophthalmus* is considered native to the Anzali Lagoon. In the Anzali Lagoon, the *S. erythrophthalmus* is classified in the Conservation Dependent IUCN categories with medium abundance **(Patimar *et al*., 2010)**.

In the present study, three types of traps; namely, the cylindrical pot, the opera house trap, and the Hokkaido pot were used for catching the common rudd (*S. erythrophthalmus*) in the Anzali Lagoon to study the fish biology (Fig. 1).

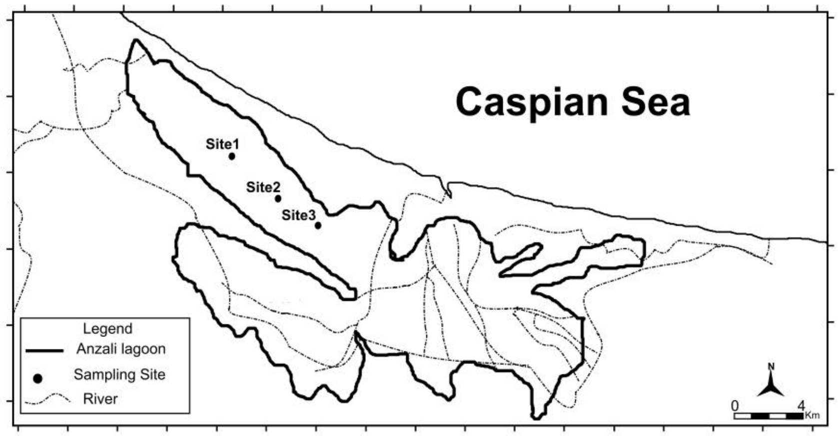

Fig. 1. Sampling area for *M. nipponense* in Anzali Lagoon, Iran

This study aimed to evaluate three different traps, anddetermine the capture efficiencies (in terms of CPUE) and compare the catch rates regarding weight and number of *S. erythrophthalmus* in the Anzali Lagoon, Guilan, Iran.

MATERIALS AND METHODS

Study area

In this study, three localities were addressed; namely, Site 1 (GPS coordinates: 37° 27' 9446.43'' N and 49° 22' 9944.18'' E), Site 2 (GPS coordinates: 37° 28' 28.8''N 49° 21' 03.5''E) and station 3 (GPS coordinates: 37°27'45.6''N 49°22'08.3''E) (Fig. 1), which is a perfect habitat for the species. Three types of traps were used, including: the cylindrical pot (Fig. 2), the opera house trap (Fig. 3), and the hokkaido pot (Fig. 4). Characteristics of the traps are presented in Table (1).

Table 1. Characteristics of three traps used for catching *S. erythrophthalmus* in this study

trap name and design	**Country of origin**	**Dimensions L × W × H (cm)**	**Frame**	**Mesh covering**	**Entrance**	**Weight of net in the water**	**trap volume**	**Weight of frame pot in the water**	**Net area**
Cylindrical	Germany	64 × 30 × 30	10 mm Galvanized Steel frame	8 mm (STR), Nylon netting	2 entrances with a 30cm ramp	17.6 g	45216 cm^3	902.5 g	43000 cm^2
Opera house	Australia	74 × 55 × 64	10 mm Galvanized Steel frame	8 mm (STR), Nylon netting	2 entrance with 32cm ramp	23.4 g	300000 cm^3	1455.7 g	103900cm^2
Hokkaido	Japan	50 × 40 × 35	10 mm Galvanized Steel frame	8 mm (STR), Nylon netting	1 entrance with 20cm ramp	23 g	53301.5cm^3	885.5 g	108300cm^2

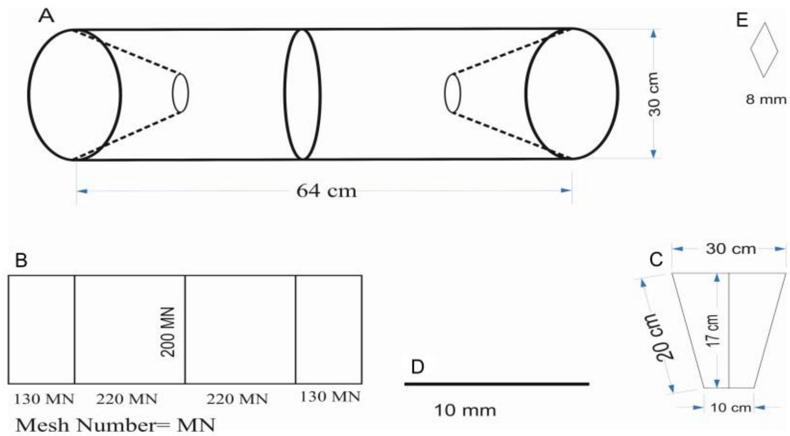

Fig. 2. Schematic presentation of the cylindrical pot, including: (A): measurements of the cylindrical trap; (B): number of mesh in the net; (C): entrance size; (D): diameter of galvanized rods in the skeleton traps; (E): mesh size

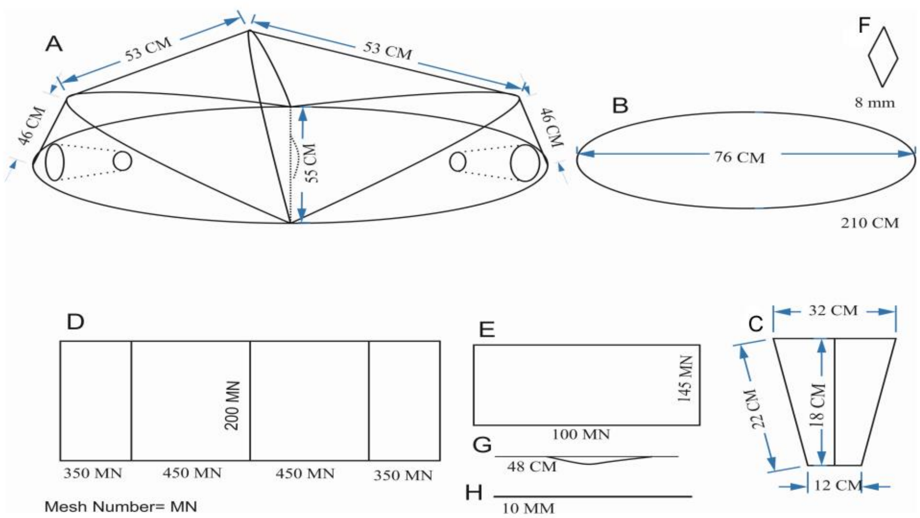

Figure 3. Schematic presentation of the Opera house trap, including: (A): measurements of Opera house trap; (B): bottom of trap; (C): the size of entrance; (D): number of the mesh in net for trap body; (E): number of mesh in net for trap bottom; (F): mesh size; (G): the position of bait; (H): diameter of galvanized rods in the skeleton traps

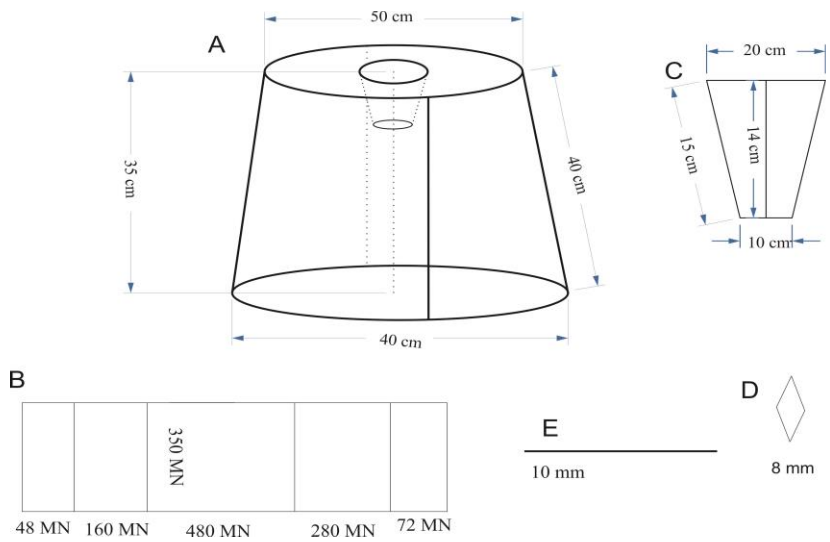

Fig. 4. Schematic presentation of the hokkaido pot, including: (A): Hokkaido trap size; (B): number of the mesh in the net; (C): the size of entrance; (D): mesh size; (E): diameter of galvanized rods in the skeleton traps

Samples collection

Twenty-seven (27) traps were randomly selected for the three sites. All the traps were used simultaneously for the sampling of the rudd fish in this study. The traps were checked every 24 hours, and the samples were collected at night for twenty-seven (27) nights per month for six (6) months (April 2017 to September 2017). All traps were set baited by bread.

Catch per unit effort

The collected samples were removed and placed in iceboxes and transferred to the laboratory for further analyses. Total weight was measured on a digital scale with 0.1 g accuracy. The CPUE was calculated by using the following equation **(White, 1987)**:

$$\mathrm{CPUE} = \frac{\text{Total catch}}{\text{Unit Effort}}$$

Unit Effort = Traps × Long-lasting trap in the water, Total catch = Total weight of the catch

Data analysis

Total catch was indicated in terms of the number or the weight of *S. erythrophthalmus*, whereas the unit effort forms one collection from the trap in 24 hours. Differences in catch rates among gear types were determined using the variance (ANOVA) analysis, and the CPUE differences for each gear type were determined using Duncan's multiple range test.

RESULTS

Objectively, the results indicated a significant difference in unit effort in terms of catch for each of the three traps (P < 0.05). The opera house trap and the cylindrical pot yielded the maximum and minimum unit effort, respectively (Fig. 5).

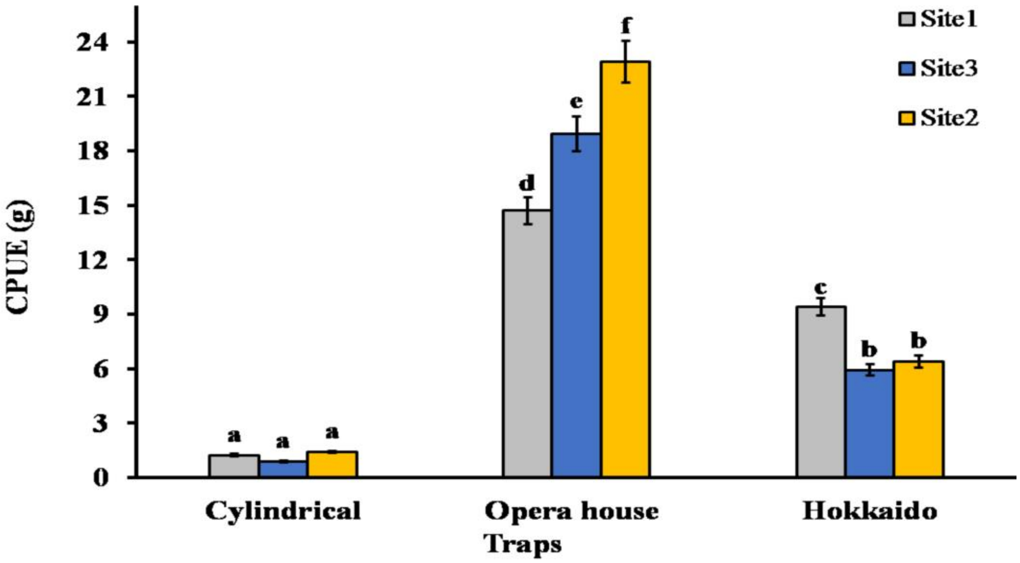

Fig. 5. Catch per unit effort (per gr in 24 hours) for three different trap models at three sampling sites

Comparison of the CPUE in each station for the various traps showed the maximum value for the opera house trap in Site 3 (22.1) and the minimum value for the cylindrical pot in station 2 (0.95). The Cylindrical pots delivered the same performance in all the three stations and showed no significant difference in catch average among the three stations (Table 2).

Table 2. Comparison between the traps at different stations

Trap (Site)	CPUE (mean±SE)
Cylindrical (1)	1.2 ± 0.2^{a}
Cylindrical (2)	0.92 ± 0.02^{a}
Cylindrical (3)	1.4 ± 0.1^{a}
Hokkaido (1)	9.3 ± 1.6^{c}
Hokkaido (2)	5.9 ± 1^{b}
Hokkaido (3)	6.3 ± 1.2^{b}
Opera House (1)	14.6 ± 2^{d}
Opera House (2)	18.9 ± 2.6^{e}
Opera House (3)	23.1 ± 2.8^{f}

The hokkaido pots at stations 3 and 2 showed a similar performance, but station 1 showed a significantly different performance. The opera house trap in all the three stations had different functions, and the catch average was significantly different between all the three stations (Fig. 6).

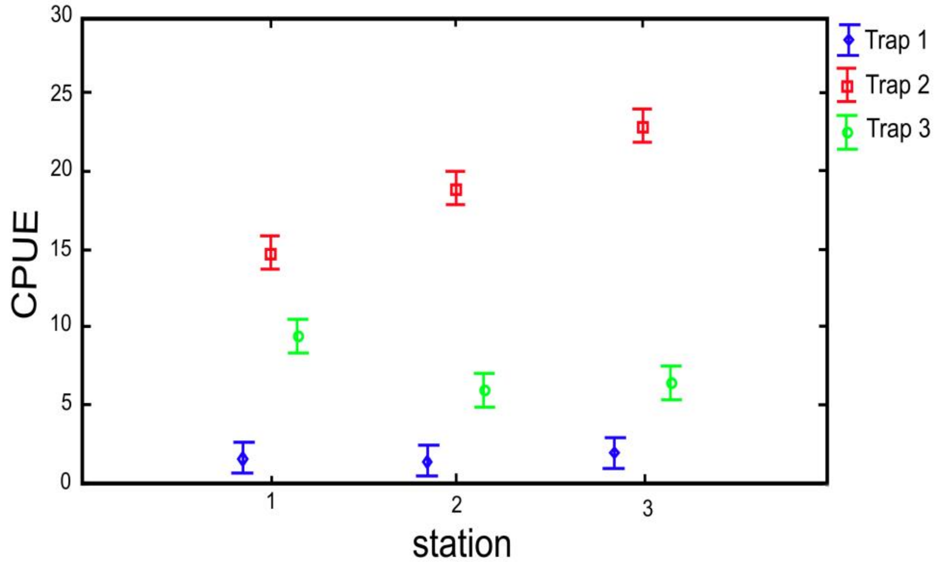

Fig. 6. Mean total for catch per unit effort (CPUE) for three different trap models at three sampling sites. Trap 1: Cylindrical, Trap 2: Opera house, and Trap 3: Hokkaido.

DISCUSSION

Trap fishing is a relatively simple method used traditionally by fishermen worldwide to lure and catch aquatic animals **(Wakefield, 2015)**. Using traps has several advantages providing a passive fishing, aligned with the fact that it can be left for several days, for instance, when the weather is bad, the catch will still be in good condition **(Bacheler *et al*., 2013)**. Operating expenses are fairly low. With the increasing demands for responsible fishing, traps may gain importance in the future due to their particular characteristics and advantages regarding the operation mode **(Major *et al*., 2016)**. The trap methods, used in this study, were operated in such a way as to minimize the masking by other variables due to the gear themselves. All gear types were spaced apart as far as possible to minimize interaction **(Attar *et al*., 2002)**. The catches' comparison per unit effort showed that most fishes were caught by the opera house trap and the lowest ones were recorded for using the cylindrical trap. It can be concluded that the Opera house trap can be used as an appropriate gear because of the efficient catches and income it will ensure for the fisherman in the Anzali Lagoon. **Khanipour and Melnikov (2007)** compared four traps' performance to catch crayfish in the Caspian Sea. They found that the best trap for catching crayfish was the opera house trap. **Attar *et al.* (2002)** compared the performance of three traps (collapsible ellipsoid trap, collapsible box-type trap and hoop net) for catching blue crabs (*Callinectes sapidus*). They reported that hoop net traps were the best gear. On the other hand, **Munro *et al.* (1974)** found that passive gear's capture efficiency depends on various factors, including species, habitat, size, behavior and gear attributes. The afore- mentioned authors suggested that the variability in catch may mainly be due to the fishes' conspecific species' attraction. Furthermore, **Budria *et al.* (2015)** compared the catch per unit effort among four minnow trap models in the three-spined stickleback (*Gasterosteus aculeatus*) fishery. They deduced that the uncoated metallic (Gee-type) traps are superior to the other commonly used minnow trap models in stickleback fisheries. In addition, **Khanipour *et al.* (2017)** compared three different traps for catching the oriental river prawns (*Macrobrachium nipponense*) in the Anzali Lagoon and reported that the best trap was opera house.

The present study's traps were designed and constructed according to the region's ecological and environmental sensitivity in the Anzali Lagoon. One of the most important factors in the traps is the entrance. The entrance muste be well- designed for individual entering and simultaneously prevents escaping. For this purpose, the opera house with two entrances at the sides was more effective than the hokkaido trap with an upper side entrance. Laboratory trials further revealed significant differences in escape probabilities among the different trap models. At the same time, the differences in escape probability can explain at least part of the differences in CPUE among the trap models (e.g., high escape rate and low CPUE in red canvas traps). The discrepancies between model-specific CPUEs and escape rates suggest that variation in entrance rate also contributes to the differences in CPUE (**Budria *et al.*, 2015**). The Cylindrical pot has two big entrances at the sides that make a high escape rate in this type of trap, but the trap's overall structure was unsuitable, so it failed. **Prado (1990)** showed that traps' entrance directly links animal behavior and body size. **Wheaton and Lawson (1985)** reported that the traps with too big entrance yielded reduced catch after three hours.

A few other structural trap features can be considered to affect catches such as the entrance angle **(Cruz & Olatunbosun, 2013)**. The Opera house trap entrance angle is less steep; that is why fishes can easily pass through the entrance and move to the inside of the trap. The bait placement to attract fishes is another essential factor for effective catching **(Major *et al*., 2016)**. In the opera house trap, bait is placed in the middle of the bottom of the trap. However, in the hokkaido pot, the bait is placed in the upper part of the trap causing a delay in the enterance of fishes. Compared to the other two types of traps, the opera house trap was more suitable for catching *S. erythrophthalmus* in the Anzali Lagoon.

CONCLUSION

In conclusion, comparing the three types of traps designed in this study for catching *S. erythrophthalmus*, the opera house trap was more suitable in the Anzali Lagoon.

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