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Effects of entrance design on catch efficiency of Hokkaido pot: a field experiment in Anzali Lagoon, Iran

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ABSTRACT
In this study, the catch per unit effort (CPUE) of Hokkaido pot was compared with the oriental river prawn (Macrobrachium nipponense) in the Anzali Lagoon, Iran. Capture efficiencies and catch rates of the Hokkaido pot were compared during 2015. This field experiment investigated the effects of different entrance designs on the catch efficiency of Hokkaido pot (H1) by fishing with commercial Hokkaido pot (H2) (entrance inclination angle and number were different). The experimental pot was identical, in size and design, to commercial pots, apart from some difference in the entrance (Pots: H1: $\alpha = 45°$ and 90°, three entrance; H2: $\alpha = 90°$, one entrance). Significant differences were detected between pots of H1 and H2 ($P < 0.05$). H1 pot yielded more than H2; however, no significant differences were recorded in the mean total length or the frequency distributions of the total length between both pot types ($P > 0.05$).

INTRODUCTION

Catch per unit of effort (CPUE) is an essential variable in the science of fisheries. It provides the researchers with the appropriate means to monitor size trends of population, and the relative abundance of species in different habitats and sites. In addition, it facilitates the process of comparing the efficiency of different fishing gear. It is worthy to mention that various environmental factors can influence CPUE. **Fuwa (1994)** reported profound seasonal variation attributed to the type of fishing gear used.

Traps and pots are widely used in fisheries worldwide because of their simple structure and convenient operation. However, many factors affect the catch rate of traps, and the most crucial factor is the trap entrance **(Li *et al.*, 2006)**. The entrance number, shape, size, and location significantly affect the catch. For example, **Matuda *et al.* (1984)** reported that catch rates were affected by the diameter of the entrance ring. **Furevik and Lokkeborg (1994)** found that pots with a narrow entrance tended to trap more Atlantic cod and cusk than pots with wider entrances. Side entrance traps are better suited than top-entrance traps for catching prawns and American lobster **(Kessler, 1969)**.

The oriental river prawn (*M. nipponense*) is natively distributed in the west of Asia, while the population of *M. nipponense* was recorded in 2006 in the Anzali lagoon **(De Grave & Ghane, 2006)** and was later on spread in the northern water basins of Iran **(Aminisarteshnizi, 2021)**. This species belongs to the phylum of Arthropoda (Order: Decapoda; Family: Palaemonida) **(De Haan, 1849)**. The behavioral responses of *M. nipponense* towards different types of traps and pots were studied **(Amini *et al.*, 2017)**. **Amini *et al*. (2017)** reported that the best trap for catching *M. nipponense* was the opera house trap, and one of the reasons was the side entrance.

The aim of this study was 1: to examine the effect of the number and inclination angle of the entrance to determine the capture efficiencies (in terms of CPUE) and 2: to compare the catch rates regarding weight and number of *M. nipponense* of Hokkaido pot (H_1) and the commercial Hokkaido pot ($H_{2)}$ in the Anzali Lagoon.

MATERIALS AND METHODS

Study area

Specimens of *M.nipponense* were collected from Talabgharb in three site; 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 Site 3 (GPS coordinates: 37°27'45.6"N 49°22'08.3"E) (Fig. 1).

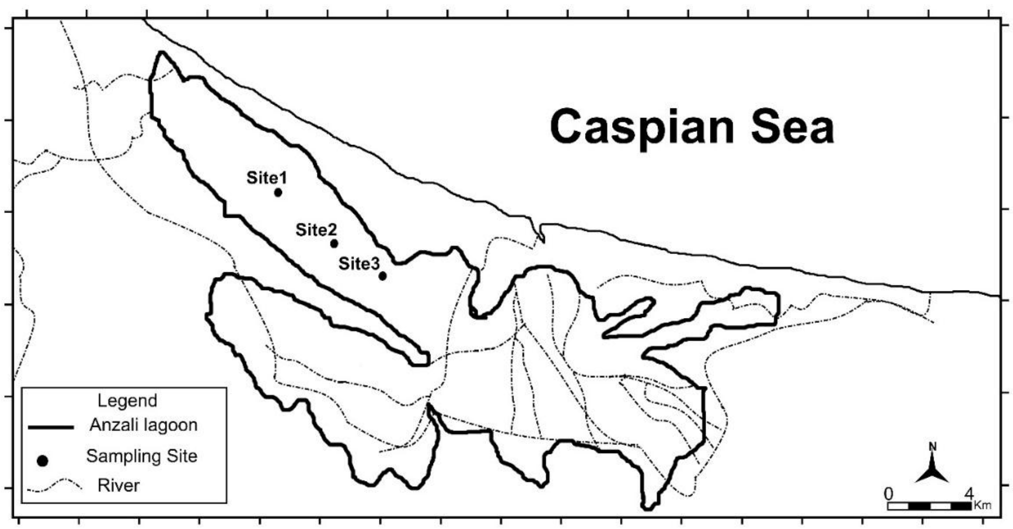

Fig. 1. Sampling area of *M. nipponense* in Anzali Lagoon, Iran

Trap design

The experimental Hokkaido pot had the same size and design as those of the commercial Hokkaido pot, apart from the different entrance inclination angles and the number of entrances (Fig. 2). Both the commercial and experimental traps were alternately set along the mainline. Individual traps were spaced approximately 12 m apart and were tethered to the mainline using a 1.5-m branch line.

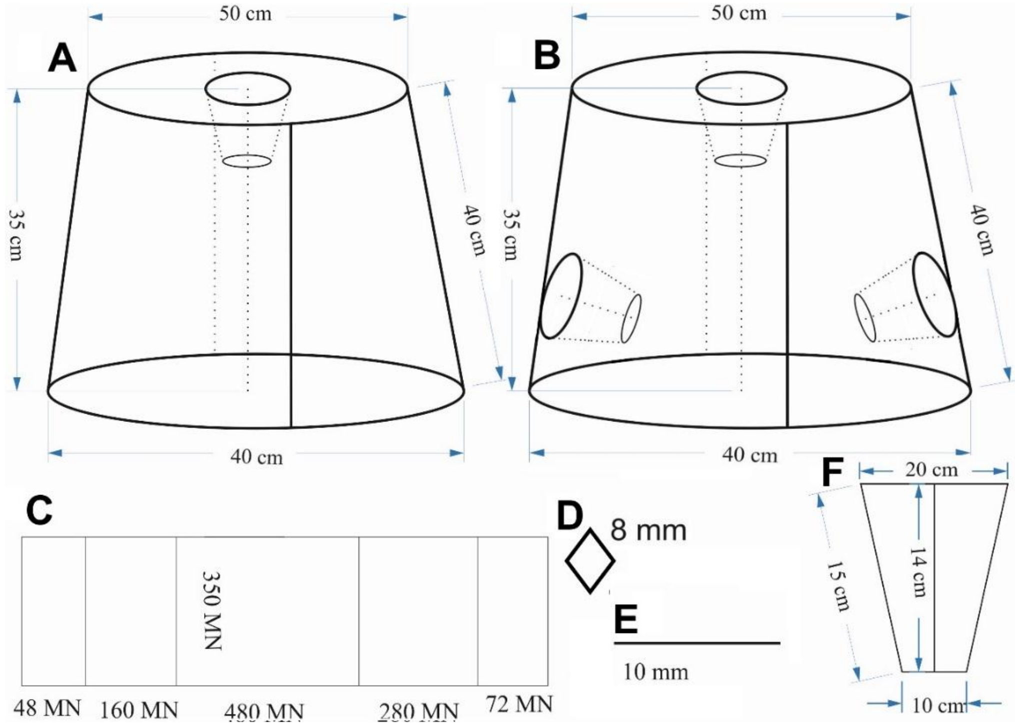

Fig. 2. Schematic presentation of the commercial Hokkaido (H_2) pot and experimental Hokkaido pot (H_1), including: **(A):** commercial Hokkaido pot (H_2) size; **(B):** experimental Hokkaido pot (H_1); **(C):** number of the mesh in the net; **(D):** mesh size; **(E):** diameter of galvanized rods in the skeleton traps; **(F):** the size of all entrance.

Specimens sampling

Eighteen (18) traps were randomly selected for the three sites in Talabgharb, Anzali Lagoon. In this study, all traps were used simultaneously for the sampling of prawns in this study. The traps were checked every 24 hours, and the samples were collected at night for twenty (20) nights per month for three (3) months (July 2015 to September 2015). All traps were set baited by bread.

All collected samples were immediately placed in iceboxes and transferred to the fish biology laboratory for further analyses. Samples were sorted into males and females. The total length (the distance from the rostrum tip to the end of telson) was measured for each sample with a Vernier caliper to the nearest 0.1 mm. The prawns were then weighed with a balance to the nearest 0.1 g. Samples taken each month were measured and preserved separately.

Catch per unit effort

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 computed by using the following equation of **White (1987)**:

CPUE = Total catch / Unit Effort

Unit Effort = Traps × Long-lasting trap in the water (24 h); Total catch = Total weight of the catch

Data analysis

Total catch is indicated in terms of the number or weight of prawn, and unit effort is one collection from the trap in 24 hours. Catch rate differences 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

The results indicated a significant difference in unit effort in terms of catch for each Hokkaido pot ($P < 0.05$). The mean of the CPUE for the experimental Hokkaido pot (H_1) was 5.2, and for commercial Hokkaido (H_2) pot was 2.47. Comparison of the CPUE in each month between H_1 and H_2 pots showed the maximum value for the H_1 in July (7.72) and the minimum value for H_2 in September (0.86) (Fig. 3).

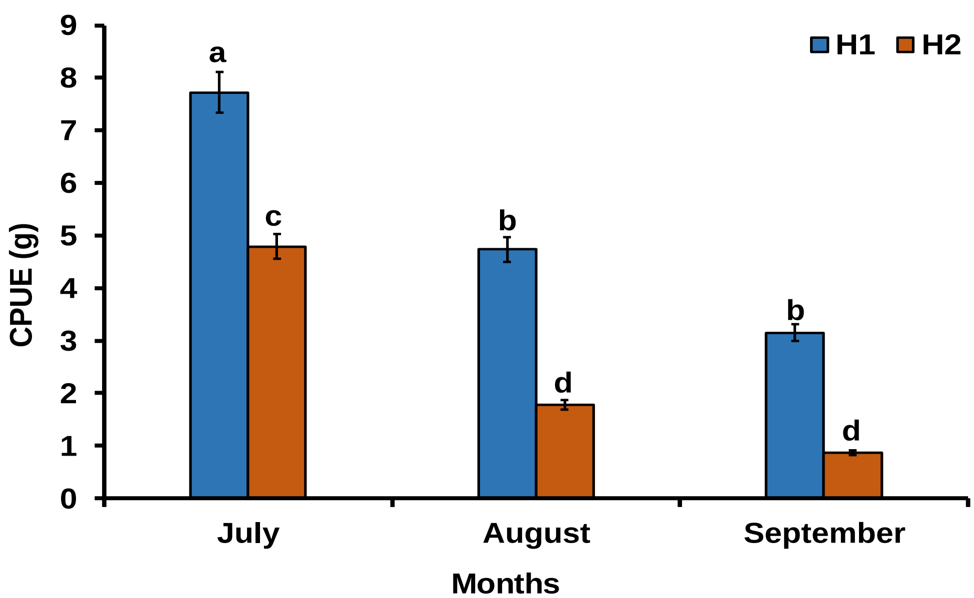

Fig. 3. Catch per unit effort (per gr in 24 hours) for experimental Hokkaido pot (H_1) and commercial Hokkaido (H_2) pot in three months

The best month and pot for catching *M. nipponense* was July and H_1, respectively. The result showed a significant difference in the average of the CPUE between H_1 and H_2 ($P < 0.05$) (Table 1).

Table 1. Comparison between CPUE values between experimental Hokkaido pot (H_1) and commercial Hokkaido (H_2) pot in different months

Trap/CPUE	July	August	September
H1	7.72 ± 0.2^{a}	3.15 ± 0.02^{b}	1.4 ± 0.1^{b}
H2	4.79 ± 1.6^{c}	1.77 ± 1^{d}	0.86 ± 1.2^{d}

The percentage of length-frequency distributions of *M. nipponense* showed no significant differences in either experimental Hokkaido pot (H_1) or the commercial Hokkaido (H_2) pot (Fig. 4).

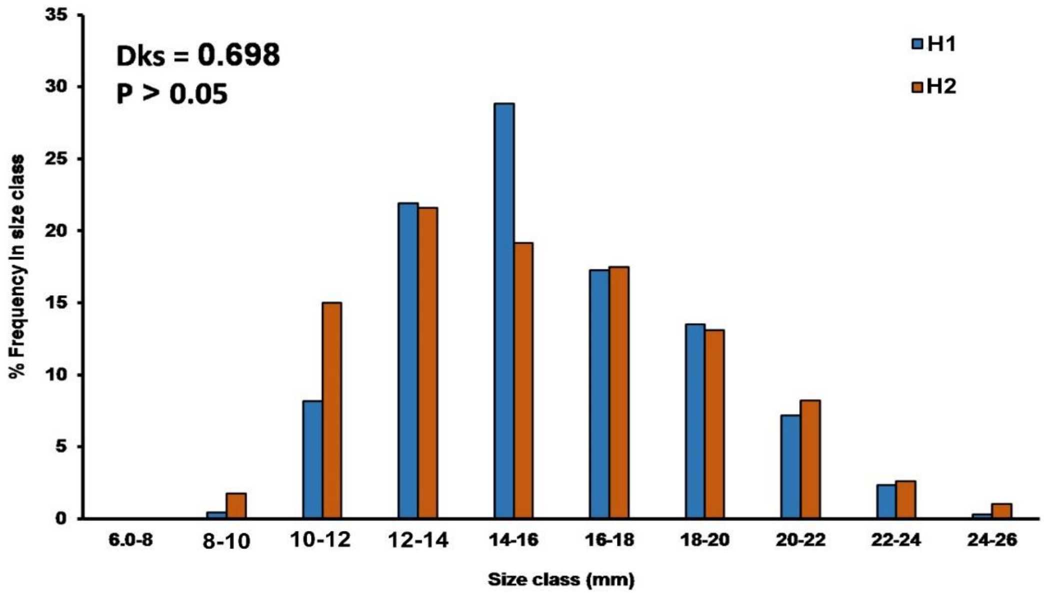

Fig. 4. Percentage of length-frequency distributions of *M. nipponense* in experimental Hokkaido pot (H_1) and commercial Hokkaido (H_2) pot. n = the number of prawns

DISCUSSION

Trap fishing is a relatively simple method used traditionally by fishermen worldwide to lure and catch aquatic animals **(Attar *et al*., 2002; Wakefield, 2015)**. Using traps has several advantages; among which a passive fishing is provided and the capability of leaving the trap for several days is considered. For instance, when the weather is bad, the catch will continue being in good condition **(Bacheler *et al*., 2013)**. Moreover, the expenses of trap operating are notably low. Traps may gain importance in the future because of the increasing demands on responsible fishing due to their particular characteristics and their advantages regarding the operation mode **(Major *et al.*, 2016)**. The current results indicate that the inclination angle and the number of entrances of the pot can greatly alter the catch. In addition, the changing tendency between the overall means of the CPUE and the inclination angle was similar to that of the passing ratio and the inclination angle of the entrance model observed in a laboratory experiment in the study of **Li (2006)**.

It was noticed that the catch efficiency of the H_1 pot was recorded the highest. One reason for the high efficiency of H_1 compared to H_2 was the shape of its entrance. Therefore, the number of entrance and the shape of the entrance are essential in affecting the CPUE. **Kessler (1969)** reported that the side entrance traps are better suited for catching prawns than the top-entrance ones.. Remarkably, modification of the funnel design may significantly affect trap performance. Furthermore, the symmetrical funnel can be considered easier for fish to enter the trap than the unsymmetrical funnel. The H_1 pot had a symmetrical funnel entrance, while H_2 had only one entrance.

Li *et al*. (2016) found out that passive gear's capture efficiency depends on various factors, including species, habitat, size, behavior and gear attributes. The present traps were designed and constructed in consideration of the region's ecological and environmental sensitivity in the Anzali Lagoon. Prawns are benthic, omnivorous, and they take refuge amidst the plants. They are more inclined to crawl on the floor looking for food during the night **(New *et al*., 2010)**. Consequently, the traps were placed on the floor, and crawl feature on the floor caused the trap's entrance to be crucial. For this purpose, H_1 with two entrances at the sides was more effective than H_2 with its upper side entrance. **Prado (1990)** showed that traps' entrance directly links animal behavior and body size. Other structural trap features can be considered to affect catches such as the angle of the entrance **(Cruz & Olatunbosun, 2013)**. **Amini *et al.* (2017)** reported that the best trap for catching *M. nipponense* was the opera house trap, and one of the reasons was the side entrance. H_1 side entrance angle is less steep; that was why prawns could easily pass through the entrance and move to enter the trap. However, in H_2, the entrance angle is 90 degrees; hence prawns need to swim actively to find the entrance to move andenter the inside spot of the trap, which is more complicated.

CONCLUSION

The results demonstrate that the minor differences in pot appearance can have significant impacts on the CPUE. Side entrance traps are better suited than top-entrance traps for catching prawns. H_1 was more suitable for catching prawns in the Anzali Lagoon.

REFERENCES

Amini, M.; Khanipour, A.A.; Noori, A. and Kamrani, E. (2017). Comparison of three different traps for catching oriental river prawn (*Macrobrachium nipponense*). Iranian Journal of Fisheries Sciences, 26 (3) :193-196. 10.22092/ISFJ.2017.113560

Aminisarteshnizi, M. (2021). Length-Weight Relationship and Fulton's Condition Factor of *Macrobrachium nipponense* (De Haan, 1849) in Siah Darvishan River, Iran. Egyptian Journal of Aquatic Biology & Fisheries, 25(2): 551 – 560

Attar, H.H.; Olmez, M.; Bekcan, S. and Secer, S. (2002). Comparison of three different traps for catching Blue crab (*Callinectes sapidus Rathbun* 1896) in Beymelek Lagoon. Turk Journal Vet Anim Science, 6: 1145-1150.

Bacheler, N.M.; Schobernd, C.M.; Schobernd, Z.H.; Mitchell, W.A.; Berrane, D.J.; Kellison, G.T. and Reichert, M.J.M. (2013). Comparison of trap and underwater video gears for indexing reef fish presence and abundance in the southeast United States. Fisheries Research, 143: 81-88.

Cruz, Y.M. and Olatunbosun, O. (2013). Comparative study on the efficiency of three different types of crab pot in Iceland fishing ground. UNU-Fisheries Training Program, 4:1-25.

De Grave, S. and Ghane, A. (2006). The Establishment of the Oriental River Prawn, *Macrobrachium nipponense* (de Haan), in Anzali Lagoon, Iran. Aquatic Invasions, 4: 204-208.

Furevik, D.M.L. and Ôkkeborg, S. (1994). Fishing trials in Norway for torsk (Brosme brosme) and cod (Gadus morhua) using baited commercial pots. Fish. Res, 19: 219–229.

Fuwa, S.; Shimomura, Y.; Ishizaki, M. and Imai, T. (1994). The fishing mechanism of fish pots for Puffer. Nippon Suisan Gakkaishi, 60: 455–460.

Kessler D.W. (1969). Test-tank studies in shrimp-pot efficiency. Fish. Ind. Res. U.S. Nat. Mar. Fish. Serv. 5: 151–160.

Li, Y.; Yamamoto, K.; Hiraishi, T.; Nashimoto, K. and Yoshino, H. (2016). Effects of entrance design on catch efficiency of arabesque greenling traps: a field experiment in Matsumae, Hokkaido. Fish. Sci, 72: 1147–1152.

Major, R.N.; Taylor, D.I.; Conner, S. and Conner G. (2016). Factors affecting bycatch in a developing New Zealand scampi potting fishery. Fisheries Research, 10: 55-64.

Matuda, K.; Suzuki. M. and Konehiro, H. (1984). Comparison of performance of mouth of trap model by water tank experiment of fish behavior. Nippon Suisan Gakkaishi, 50: 609–615.

New, M.B.; Valenti, W.C.; Tidwell, J.H.; D'Abramo, L.R. and Kutty, M.N. (2010). Freshwater Prawns Biology and Farming. Wiley-Blackwell 570 pp.

Prado, J. (1990). Fisherman's workbook. Fishing news books 185 pp.

Wakefield C.B. (2015). Length selectivity of commercial fish traps assessed from in situ comparisons with stereo-video: Is there evidence of sampling bias. Fisheries Research 161.

White, T.F. (1987). A Fisheries monitoring system for the Islamic Republic of Iran. IRA/83/013. FAO, Rome, Italy 56 pp.