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The efficiency of the Swedish trappy in catching freshwater crayfish *Pacifastacus leniusculus* and *Astacus leptodactylus*

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Abstract: The efficiency of the Swedish trappy in catching *Pacifastacus leniusculus* and *Astacus leptodactylus* was studied.

The results showed that the Swedish trappy was very effective at catching both *P. leniusculus* and *A. leptodactylus.* In the concrete tank study, 71.6% of the total crayfish in the *A. leptodactylus* tanks and 60% of the total crayfish in the *P. leniusculus* tanks had been caught with baited traps at the end of the experiment. On the other hand, it was found that there was considerable movement of crayfish in and out of the traps, and consequently a decline in the number of crayfish in some traps over time.

The results also showed that there was no significant difference in the total number of captured *P. leniusculus* and *A. leptodactylus* ($P>0.05$), but a significantly greater amount *P. leniusculus* escaped from the trap and changed traps than of *A. leptodactylus* ($P<0.001$). It was also observed that baited traps caught significantly more crayfish of both species than unbaited traps ($P<0.05$).

The present study reveals that in order to maximise catching efficiency it is better to empty the traps a number of times during the night. In addition, because the escape rate of *P. leniusculus* is significantly higher, the opening of the entrances of the Swedish trappy should be reduced for this species

Key Words: Crayfish, Pacifastacus leniusculus, Astacus leptodactylus, trapping, swedish trappy.

İsveç Tuzağının (Swedish Trappy) Tatlı Su İstakozu *Pacifastacus leniusculus* ve *Astacus leptodactylus*'u Yakalamadaki Verimliliği

Özet: İsveç tuzağının *Pacifastacus leniusculus* ve *Astacus leptodactylus*'u yakalamadaki verimliliği çalışıldı.

Sonuçlar İsveç tuzağının hem *P. leniusculus* hem de *A. leptodactylus*'un yakalamada oldukça etkili olduğunu gösterdi. Beton havuzlarda yapılan çalışmada, deney sonunda yemli tuzaklarda havuzdaki toplam *A. leptodactylus*'un %71.6'sı, *P. leniusculus*'unda %60'ı yakalandı. Diğer taraftan, kerevitlerin sık sık tuzakların içine girip tekrar dışarıya çıktıkları bulundu ve bunun sonucu olarak, zamanla bazı tuzaklarda kerevit sayısında bir azalmanın olduğu saptandı.

Sonuçlar yakalanan toplam *P. leniusculus* ve *A. leptodactylus*'un sayıları arasında istatistiksel olarak bir farkın olmadığını gösterdi ($P>0.05$), fakat önemli sayıda *P. leniusculus A. leptodactylus*'a göre tuzaktan kaçtı ve tuzak değiştirdi ($P<0.001$). Ayrıca her iki tür için de yemli tuzakların yemsiz tuzaklara göre istatistiksel olarak daha fazla sayıda kerevit yakaladıkları gözlendi ($P<0.05$).

Yapılan çalışma, yakalama verimliliğini artırmak için tuzakların gece boyunca bir kaç defa boşaltılmasının daha iyi olacağını gösterdi. Buna ilave olarak, *P. leniusculus*'un kaçma oranı önemli derecede daha fazla olduğundan İsveç tuzağının girişindeki açıklığın küçültülmesi bu tür için gereklidir.

Anahtar Sözcükler: Tatlı su istakozu, *Pacifastacus leniusculus, Astacus leptodactylus,* avcılık, İsveç tuzağı.

Introduction

Many types of traps are used to catch crayfish for harvesting and for scientific purposes. These traps are mainly cylindrical traps, seine nets and fyke nets. Differences among traps include construction materials and mesh sizes, physical dimensions, number of entrance funnels and the presence or absence of support rods, bait wells and retainer bands or collars (1).

In Turkey, cylindrical net traps with bait and funnel entrances at each end are used to catch *Astacus leptodactylus* (2). In the United States, cylindrical traps are generally used because of their high catch rate (3). These are approximately 1 m long and 0.5 m in diameter (4). For example, in the Sacramento-San Joaquin Delta, *Pacifastacus leniusculus* are caught with cylindrical traps with a 7.5 cm funnel opening, 61-76 cm in length and 30.5 cm in diameter, and constructed of 2.5x1.25 cm wire mesh (5). Approximately 20 years ago in Ukraine, before the use of selective crayfish trawls, large unselective fishing nets (gura), were used to catch *A. leptodactylus.* After that various types of traps were developed (6). Several decades ago in Lithuania, a kind of wooden trap (60-80 cm in length and 20-30 cm in width) was in use for catching *Astacus astacus,* although it was not very easily transported. After that, baited folding net traps were chosen to determine the number and density of the popolutaions of *A. astacus.* The tarps had three metal rings (25 cm in diameter) and were made of rustproof wire. The funnel entrances were 5-8 cm at both ends (7).

One problem with traps is that once the bait loses its attraction the crayfish start escaping (8, 9). According to Westman *et al.* (9) crayfish are skillful at escaping from traps with quite complicated entrances. These researchers designed a number of string-type cylindrical traps, including the Evo-trap. This trap had a narrow but flexible slit-like entrance and in tests proved to be more difficult for the fish to escape from than most other traps, although there was little difference in initial capture. One trap with a plastic tube entrance was better for retaining crayfish but the catch was reduced. In southern Finland, the Evo-trap was used to catch crayfish in a comparative study of the growth and moulting of *A. astacus* and *P. leniusculus* (10).

Many European countries, including Britain, use a trap known as the Swedish trappy, which consists of a plastic mesh sheet which can be folded into a cylinder 50 cm long and 20 cm wide and clipped into place. Funnels fit into each end and have an inner opening 4.5 cm wide. The mesh is diamond-shaped with a size of 2.5x3.5 cm. A metal clamp holds bait centrally.

No previous studies have been caried out on the effectiveness of the Swedish trappy in catching crayfish. Furthermore, no comparative studies have been done on their ability to catch *Pacifastacus leniusculus* and *Astacus leptodactylus.* The present study investigates these areas as well as the comparative efficiency of the Swedish trappy with and without bait.

Material and Method

This study is consisted of two parts: a field study involving *P. leniusculus* in Boxmoor Fishers (north of London), and a more controlled study involving both *P. leniusculus* and *A. leptodactylus* separately in concrete tanks at Nottingham University.

Field Study

Fifty baited traps were set at 10-metre intervals around the lake in September, 1993. They were left with their catch for three days and checkked each morning. Individuals present were given a special mark for each day with Tippex.

Concrate Tank Study

For this epperiment, four concrete tanks (approximately 1.5 mx2.5 mx1 m with, 0.5 m water depth and 5 litre/minute water flow) were used for nine days (28.09.93-08.10.93). Thirty crayfish (15 male/15 female) were put in each tank with two replicates for the two species. Adult specimens were chosen randomly. The smallest carapace length was 49 mm for *A. leptodactylus* and 54 mm for *P. leniusculus.*

To provide semi-natural conditions *Cladophora* and hides were placed into the tanks. In each tank there were six groups of 10 hides (bound together by plastic string) and six bircks, each with three holes. The plastic hides were 16 cm in length and 6 cm in diameter.

Five traps were set on the floor of the tank around 18.00 h, on 28.09.93. All traps were checked and crayfish were counted and marked with Tippex each morning (before 09.00 h) and afternoon (around 18.00 h) during the experiment. After counting and marking the specimens, they were kept in the traps overnight and during the daytime in order to observe their activity. The main aim was to see if crayfish would move out from the trap and if new crayfish appeared in the traps. For the first five days (28.09.93-02.10.93), the traps were used without bait, and thereafter with bait for comparison.

Table 1. Catch data from Boxmoor Fishery

Catch no.	Date	No. traps	Male	Female	Total	CPUE
1	13.09.93	18	69	140	209	11.61
2a	14.09.93	18	50	92	142	7.90
2b	14.09.93	50	123	170	293	5.86
3a	15.09.93	18	43	87	130	7.20
3b	15.09.93	50	97	183	280	5.60

CPUE = Catch per unit effort

To determine trap efficiency with and without bait and crayfish activity in traps, fish meat (sprats) was placed into the traps on 02.10.93 at approximately 09.00 h. The captured crayfish were counted at approximately 18.00 h and then released. After the crayfish were released, (at 18.00 h on 02.10.93), the traps were not used for one day (03.10.93) and baited traps were set up the following day (04.10.94) at approximately 18.00 h. Bait was changed every morning. Before the traps were tested with bait, all were emptied and Tippex marks were cleaned from the carapaces of the specimens.

Results

Field Study

Fifty baited traps were set on 12/09. On 13/09, the first 18 traps yielded 209 *P. leniusculus* (11.6/trap) with a ratio of 1 male: 2 female. The crayfish in traps 1-18 were all marked on the exoskeleton over the heart (with Tippex after drying the exoskeleton) and returned to the freshly baited traps. On 14/09 the first 18 traps yielded 142 *P. leniusculus* (7.9/trap) of which 110 were marked, indicating that 99 had escaped and that 32 new individuals had entered the traps. The remaining traps were examined and 293 crayfish (5.86/trap) recovered in total with a sex ratio of 1 male: 1.38 female. The exercise was repeated and all crayfish in the traps were marked on the head those with the original mark now had two different marks). On 15/09 all traps were again sampled and 280 *P. leniusculus* (5.6/trap) recoved, 130 of which were in traps 1-18 (7.2/trap). Of these 130, 61 had two sets of marks, having probably remained in the traps since the initial capture. Thus, 52.6% had remained in the traps over the first 24 h but only 29.2% after 48 h. Thus after 24 h the escape rate of the captured crayfish from the traps was significant ($P<0.001$, Chi-square test). Of the 32 crayfish in traps 1-18 that had received only a head mark, only 11 were still present on 15/09. However, 19 crayfish in the traps had only a heart mark, indicating that they had left the traps after the 13/09 marking but had returned after the 14/09 marking. In addition, some 39 new (unmarked) crayfish had entered the traps.

The results of the 3-day trap effectiveness study are shown in Table 1. It was found that there was considerable movement of crayfish in and out of the traps, and that after an initial heavy catch in some traps there was a decline over time. Indeed, in traps 1-18 the number of crayfish declined from 209 on Day 1 to 142 present on Day 2 to only 130 present on Day 3. However, overall there was little difference in the numbers caught on Day 2 (catch no. 2b) and Day 3 (catch no 3b).

Concrete tanks Study

There was no significant difference in the number of crayfish caught between the two replicates of the two species; therefore, data were combined to compare the species.

It was observed that the trappy was very efficient in cacthing *P. leniusculus* and *A. leptodactylus* both with and without bait. At the end of the experiment 71.6% of the total crayfish in the *A. leptodactylus* tanks and 60% of the total crayfish in the *P. leniusculus* tanks had been caught with baited traps (Figures 1 and 2).

There was no significant difference in the total number of *P. leniusculus* and *A. leptodactylus* captured ($P>0.05$, Chi-squared test), but there was a significant difference in the escapes from the trap and changing the

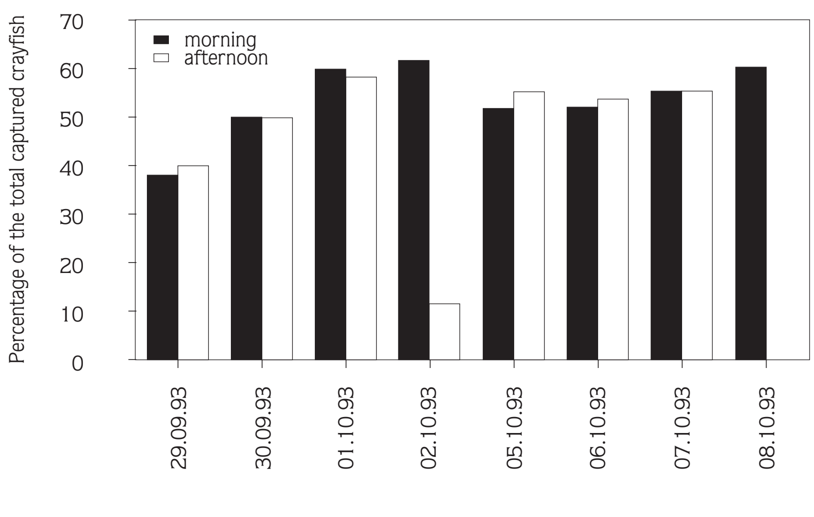

Figure 1. The percentage of the total captured *P. leniusculus* for morning and afternoon observations

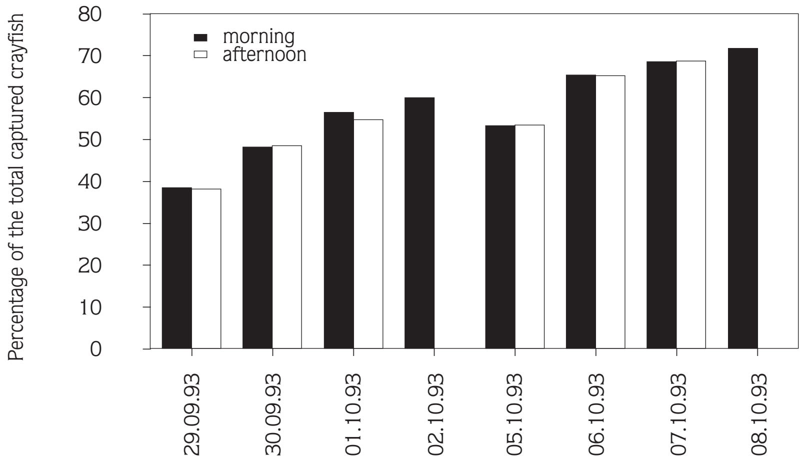

Figure 2. The precentage of the total captured *A. leptodactylus* for morning and afternoon observations

trap (P<0.001, Chi squared test). In both the morning and afternoon observations it was observed that *P. leniusculus* specimens were more active in the tanks and more capable of escaping from the trap than of *A. leptodactylus* specimens (Table 2 and 3). Accordingly, approximately 12% of the total. *P. lenisculus* were caught between 09.00 h and 18.00 h with the baited traps on 02.10.93, whereas no *A. leptodactylus* specimens were caught (Figures 1 and 2).

As far as bait is concerned, there was a significant difference (P<0.05, Chi-squared test) in the number of captured crayfish between baited traps and unbaited traps for both species. The number of crayfish captured with the baited traps for the two species was higher than with the unbaited traps on the first morning (29.09.93 for unbaited traps and 05.10.93 for baited traps). The baited traps caught 51.6% of the total crayfish in the *P. leniusculus* tanks on 05.10.93, whereas the unbaited traps caught 38.3% of the total *P. leniusculus* on 29.09.93. Similarly, the baited traps caught 53.3% of the total crayfish in the *A. leptodactylus* tanks on 05.10.93 whereas the unbaited traps caught 38.3% of the total *A. leptodactylus* on 29.09.93

Discussion and conclusions

The present study reveals that the Swedish trappy is very effective at catching both *P. leniusculus* and *A. leptodactylus.* However, unless the traps are emptied and rebaited frequently much of the catch may escape. Therefore, it would appear that in order to maximise yield, it is better to empty the traps a number of times during night rather than leave them for days. In addition to these, because the escape rate of *P. leniusculus* from

Table 2. Total captured crayfish (out of 60 crayfish) for morning and afternoon observations in *P. leniusculus* tanks

Date	captured crayfish morning (09.00)	female -male	new crayfish in(f-m)	from another trap(f-m)	out from the trap (f-m) (18.00)	captured crayfish afternoon	female male	new crayfish in (f-m)	from another trap (f-m)	out from the trap (f-m)
29.09.93	23	8-15	8-15	-	-	24	9-15	1-0	0-0	0-0
30.09.93	30	9-21	3-4	0-3	2-1	30	9-21	0-0	0-0	0-0
01.10.93	36	11-25	2-4	0-2	0-2	35	11-24	0-0	0-0	0-1
02.10.93	37	15-22	5-1	0.-1	1-4	7	4-3	-	-	-
05.10.93	31	13-18	13-18	-	-	33	12-21	0-2	0-1	1-0
06.10.93	31	12-19	0-0	0-0	0-2	32	12-20	0-0	0-1	0-0
07.10.93	33	12-21	0-3	0-0	0-2	33	12-21	0-0	0-0	0-0
08.10.93	36	12-24	0-4	0-1	0-2	-	-	-	-	-

Table 3. Total captured crayfish (out of 60 crayfish) for morning and afternoon observations in *A. leptodactylus* tanks

Date	captured crayfish morning (09.00)	female -male	new crayfish in(f-m)	from another trap(f-m)	out from the trap (f-m) (18.00)	captured crayfish afternoon	female male	new crayfish in (f-m)	from another trap (f-m)	out from the trap (f-m)
29.09.93	23	14-9	14-9	-	-	23	14-9	-	-	-
30.09.93	29	16-13	2-4	0-1	0-1	29	16-13	0-0	0-0	0-0
01.10.93	34	19-15	3-2	0-0	0-0	33	18-15	0-0	0-0	1-0
02.10.93	36	20-16	2-1	2-0	2-0	0	-	-	-	-
05.10.93	32	15-17	8-6	-	-	32	15-17	0-0	0-0	0-0
06.10.93	39	21-18	6-2	0-0	0-1	39	21-18	0-0	0-0	0-0
07.10.93	41	22-19	1-2	0-1	0-2	41	22-19	0-0	0-0	0-0
08.10.93	43	22-21	0-1	1-1	1-0	-	-	-	-	-

the trap is significantly higher, the Swedish trappy should be emptied two or three times during night and the opening of the entrances should be reduced for this species. Westman *et al.* (9) and Huner and Barr (1) also state that trap efficiency can be increased by reducing the diameter of the circular entrances or by setting a pipe or a retainer ring at the end of the funnels to prevent escape. In a field study, in the period of 24 hour trapping, funnel traps with circular retainer rings (at the end of the funnels) caught 15 to 20% more crayfish than funnel traps without circular retainer rings (1).

It seems that the major advantage of using Swedish trappies is that they are easy and quick to set. Thus, the time required for this exercise is shortened. They are not heavy so the work load is reduced. Therefore, a crayfisherman can set many traps in a short time. Further advantages are that they can be placed on different substrates and transported easily (occupying little space). They also have a very good catching efficiency (71.6 percentage of the total *A. leptodactylus* were captured at the end of the experiment). They can be emptied and rebaited quickly. In addition, trappies have an advantage over seine nets in that they cause less stress during capture.

Another factor affecting crayfish catches is where the traps are actually placed. In a filed study (in Boxmoor) they were placed among marginal vegetation where *P. leniusculus* tended to forage. Traps set in deeper water (>1.5 m) caught very few caryfish (Holdich, D.M., pers. comm.) In the wild, *A. leptodactylus* is distributed uniform densities on the offshore region, mainly occupying habitats under plants. In this case, to catch the maximum number of *A. leptodactylus,* traps should be placed as near as possible to hides and vegetation areas.

Crayfish behaviour is an important factor in trapping. According to Arrignon (11) female *P. leniusculus* are trap-shy from March to late May but after September they can be caught more easily. Despite the fact that egg-bearing females are generally trap-shy, a large number of egg-bearing *Austropotamobius pallipes* can still be caught in traps (12). In southern Finland, a comparative study of the growth and moulting of Astacus astacus and *P. leniusculus was carried* out by trapping in August. It was observed that there was a high activity of females and males in this month (10). Köksal (2) reported that the males of *A. leptodactylus* were more active than the females. She also reported that females were inactive during the breeding season (November to June) and the proportion of females per catch ranged from 29-43% from November to the end of June. In the present study, during the field study the females of *P. leniusculus* showed a higher activity than the males. The sex ratio of captured crayfish was 1 male: 2 female in the first catching (for the first 18 traps), 1 male: 1.38 female in the second catching (50 traps) and 1 male: 1.88 female in the third catching (50 traps).

The behaviour of *A. astacus* in response to six difeerent kind of traps was investigated by Westmann *et al.* (9). They tested a standart trap, one-entrance trap, one-entrance trap, protected-bait trap, narrow entrance trap (Evo-trap), plastic tube-entrance-trap and a bristle-entrance trap. The greatest number of crayfish were caught and retained with the narrow entrance trap. The narrow opening did not have and adverse effect on the catching of crayfish and although crayfish tried to escape, it was observed that they were unable to get out. The second most efficient trap was the standard trap with two 7-9 cm circular entrances. The number of crayfish entering was just under that of the narrow entrance trap's catch. However, approximately two-thirds of the total crayfish caught escaped from the standart trap. None were able to leave the plastic tube entrance trap which had a 12 cm long and 7 cm diameter black plastic tube at the end of the entrance (9).

Another factor to consider is the traps' utility. Under normal commercial working conditions, crayfisherman tend to force wire traps, causing them to deform or break (1). Furthermore, professional crayfisherman have to spend a half of their total expenditure for harvesting crayfish (8).

Several factors were determined to be important in the design of economic crayfish traps: (i) they must have a very good catching efficiency; (ii) they must be easily transferred; (iii) they must be efficient on all substrates, (iv) they must be damage-resistant. In addition, Huner and Barr (1) suggest that traps made from plasitc material should be used, and Kossakowski (13) suggests that crayfish traps should be easily constructed and dismantled for transport. Because the Swedish trappy possesses these features, therefore, it can be used efficiently in catching both *A. leptodactylus* and *P. leniusculus.*

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