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Fishing Performance of an *Octopus minor* Net Pot Made of Biodegradable Twines

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Abstract

Gillnets and net pots are made of synthetic fiber as polyester (PE) and polyamide (PA). These are often lost by heavy weather or trawling of the active fishing gears. Lost gears result in the ghost fishing because these are non-degradable in seawater and damage to spawning grounds or habitats. To address these problems, biodegradable nets composed of aliphatic polyester were developed. This study describes four types of biodegradable net pots for capturing *Octopus minor* in Southern Korea, which is an area associated with high rates of net pot loss. The fishing performance of the biodegradable pots was compared to that of commercial net pots. The net pot with a synthetic body and biodegradable funnel (PE/Bio) produced approximately 50% of the catch collected using a commercial net pot (PE/PA). Conversely, net pots with a biodegradable body and a synthetic funnel (Bio/PA) produced the same amount of catch as the commercial net pot. The completely biodegradable net pot (Bio/Bio) caught 60% of that using the commercial net pot. These findings suggest that net pots consisting of a biodegradable body and PA funnel may be effective in capturing *Octopus minor*. Partially biodegradable net pots (Bio/PA) are as effective as commercial net pots, yet uniquely allows a method of capturing *Octopus minor* without affecting the marine environment.

Keywords: *Octopus minor*, fishing, Southern Korea, gillnets.

Introduction

Approximately 77,000 fishing boats currently ply Korean waters, of which 21,000 (27%) are gill net fishing boats and 8,800 (11%) are pot fishing boats. Gill net and pot fisheries are widely used on the coast because of its ease and simplicity in operation and smaller fishing boat requirements compared to the large-scale fisheries that involve trawling and purse seining (MIFAFF, 2012). The utilization of fishing gears has recently increased in response to the need to identify additional fishery resources. One common fishing gear is the net pot, which is used to catch *Octopus minor*; net pots are generally used in fishing boats weighing less than 1 to 5 tons. Approximately 2,000–3,000 net pots per fishing boat are used in every fishing operation.

Octopus minor is one of the important cephalopods fishery resources in Korea, together with squid and octopus. Approximately 14,000 tons of *Octopus minor* was caught in 1993; however, due to a sharp decrease in fishery resources, *Octopus minor* was designated in 2005 as a target organism for fishery resource enhancement.

Approximately 8,625 tons of *Octopus minor* was harvested in 2007, compared to 6,445 tons in 2011, reflecting a 25.3% decrease in the total harvest within 5 years. During this 5-year period, average 2,926 tons (40.1%) was caught using pots (MIFAFF, 2012).

Several methods have been used for catching *Octopus minor*, with net pots and long-lines considered as the most common. *Octopus minor* net pots are drum-shaped, with three sites for entry on its side.

The net pots are usually immersed to catch for *Octopus minor* put into baits for a period of 7 to 14 days in sea. Because most fisheries operations are concentrated in major fishing grounds, minor incidents may occur while securing an area, resulting in the loss of pots. Furthermore, pots may be incidentally lost as a result of heavy weather.

The commercial netting used in the manufacture of *Octopus minor* pots generally consists of polyester (PE) and polyamide (PA), which are synthetic non-biodegradable materials. Lost or disposed fishing gear at sea thus continue to function as pots, which is also known as ghost fishing, causing environmental problems such as destruction of spawning grounds and marine habitats (Tschernij and Larsson, 2003; Ayaz *et al.*, 2006; Brown and Macfadyen, 2007). To solve this problem, several research studies have developed and evaluated biodegradable polymers for use in the marine environment (Kang *et al.,* 1996; Kim *et al.*, 1996; Qiu *et al.*, 2003). In South Korea, biodegradable polymers are being increasingly applied to pots and gill nets as a countermeasure against ghost fishing. The primary objective of this study was to decrease the environment effects of ghost fishing and to protect marine ecosystems. To accomplish this, we compared the fishing performance of commercial and biodegradable pots in catching *Octopus minor*.

Materials and Methods

Characteristics of Biodegradable Twines

Biodegradable nets used in experimental pots consist of mesh-weaved netting twine containing 95% polybutylene succinate (PBS) and 5% polybutylene adipate-co-terephthalate (PBAT). PBS is a biodegradable aliphatic polyester that is produced by polycondensation of 1,4-butanediol with succinic acid (Bhari *et al.*, 1998; Doi *et al.*, 1996). It has high flexibility, excellent impact strength, and thermal and chemical resistance. Its specific gravity is 1.26, melting point is 114°C, with a number-averaged molecular weight of 45,480, and weight-averaged molecular weight of 129,720 (Park *et al.*, 2010; Fujimaki, 1998).

PBAT is an aliphatic co-aromatic co-polyester synthesized through the esterification of 1,4-butanediol with aromatic dicarboxylic acid and polycondensation with succinic acid. PBAT offers several advantages over all other biodegradable materials based on its high flexibility, excellent impact strength, and low melting point. PBAT has also exhibited significant biodegradation within one year in soil, water with activated sludge, and seawater (Rantze *et al.,* 1998; Witt *et al.*, 1996; Uwe *et al.*, 1995; Witt *et al.*, 1997).

Monofilaments (0.284-mm in diameter) are prepared by spinning 95% PBS and 5% PBAT; these polymers are degraded by microorganisms such as bacteria or fungi within two years (Ishii *et al.*, 2008), resulting in low-molecular weight oligomers, dimers, and monomers, and finally mineralized into CO_2 and H_2O in sea water (Tokiwa *et al.*, 2009).

Experimental Fishing Gear

The external features of the experimental net pots were based on the commercial net pot for catching *Octopus minor* in the southern coasts of Korea. The net pot is a drum-shaped, with top and bottom diameters measuring 40 cm, and a height of 12 cm; an 8.6-mm diameter iron frame was attached to the equipment, as well as three funnels on its side (Figure 1).

The spinning of monofilaments was conducted using 210 Td from 95% PBS and 5% PBAT (called Bio hereafter), allowed to polymerize; 12 monofilaments were then twisted into a single knot to create a mesh weave. The hanging ratio of the net was 70%, and the mesh size was 22 mm, which is the regulated mesh size based on the fishery regulations for *Octopus minor* net pots. Considering that *Octopus minor* is stereotactic to nets and baits (Well and Well, 1957), the funnels were thus made of two types of nets, either that consisting of biodegradable materials or PA to represent commercial net pots; a total of four types of experimental pots were thus used in this study. The funnel was made of PA (nylon) 210 Td/9F, with a mesh size of 18 mm, similar to that used in commercial net pots.

The commercial net pot consisted of a PE net body and a PA net funnel; this pot was compared to the experimental pot in terms of fishing performance. The materials used in the experimental pots are presented in Table 1.

To evaluate the physical properties of the netting twine, breaking strength, elongation, and softness were measured. Breaking strength and elongation were tested according to ASTM D 638, measured using a universal tester (Instron 3365, USA) to the 1/1000 g every 0.1 s.

To assess the tension of the netting twine, 400-mm intervals were defined along the net using grips, and peak load values were determined based on the elongation of 20 samples cut at the center of the

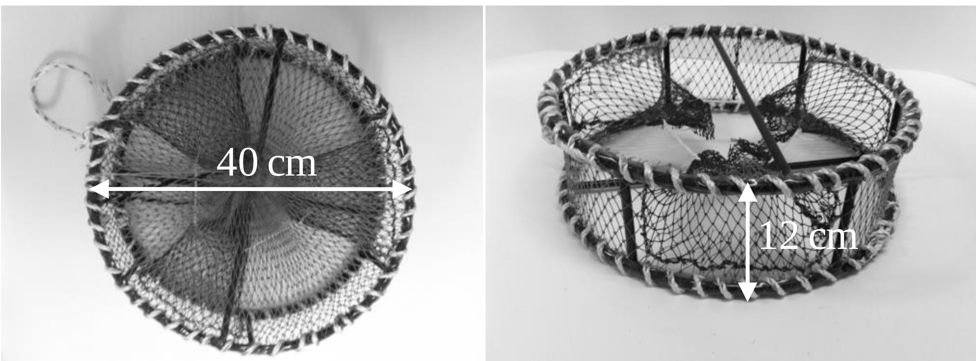

Figure 1. The net pot for *Octopus minor* used in the southern part of Korea.

specimen in tests. A softness test was conducted by using the Brandt method (Andre and Garrother, 1964), in which a sample was evenly wound 20 times on the PVC pipe of 40-mm diameter and then peeled. A softness test apparatus was used to measure the strength required to compress the specimen to a width of 25-mm, as shown in Figure 2.

The load cell used in the apparatus has a maximum capacity of 0.1 N. Measurements were conducted at 15 s intervals, which were relayed to the amplifier (SENTECH-20, Korea); sampling intervals were performed every 0.1 s, and the compression speed during the test was 2 mm/s. The test was conducted on 20 samples in both wet and dry conditions. The wet condition involved immersing the net in distilled water for 24 h. The temperature at the time of testing in the laboratory was 20 ± 2°C and relative humidity was maintained at 65 ± 2%.

Experimental Fishing Operation

The fishing performance of the biodegradable netting material for catching *Octopus minor* was tested in the coastal sea near the port of Sacho in Gangjin, Jeollanam-do, as shown in Figure 3.

A coastal net pot fishing boat with Fiber Reinforced Plastics (FRP) materials of 0.93 ton was used as experimental fishing boat. Experiments were conducted during the main fishing period between March and June of 2010 and performed 20 times. The sea trial assessed the net material in terms of fishing performance.

The four types of biodegradable net pots and the commercial net pot were arranged at intervals of 9–10 m. Twenty net pots of each type were setup, creating 100 net pots per line. Eight lines of pots of this particular array were constructed, thus generating a total of 800 net pots for the experiment. The arrangement of net pots is shown in Figure 4.

The fishing experiments were conducted in the same area using all experimental gear. The bait for *Octopus minor* pots was the Japanese ghost crab (*Macrophthalmus japonicus*). Ten to fifteen Japanese ghost crabs were placed in each pot; the average carapace length of the crabs was 20–25 mm. The soaking period employed was 7–10 days.

The catch from the experimental pots were distinguished for each experimental pot, classified into species; the number and weight of each catch were determined and measured. Weight was measured using an electronic scale (SW-1WS, CAS Korea) in units of 0.01 g.

By using the measured data from the experiments, catch per unit effort (CPUE; individuals/pot and g/pot) per experimental net pot was calculated and the fishing performance of each net pot was compared.

Results

Netting Twine Property Test

Properties of the PA monofilament and the biodegradable monofilament were examined in terms

Table 1. Netting materials of experimental pots

Experimental pot	Materials used per experimental pot	
	Body	Funnel
PE/PA[1]	PE	PA
PE/Bio[2]	PE	Biodegradable resin (PBS+PBAT)
Bio/PA	Biodegradable resin (PBS+PBAT)	PA
Bio/Bio	Biodegradable resin (PBS+PBAT)	Biodegradable resin (PBS+PBAT)

[1]Commercial pot commonly used in catching *Octopus minor*
[2]Biodegradable resin consisting of 95% PBS and 5% PBAT

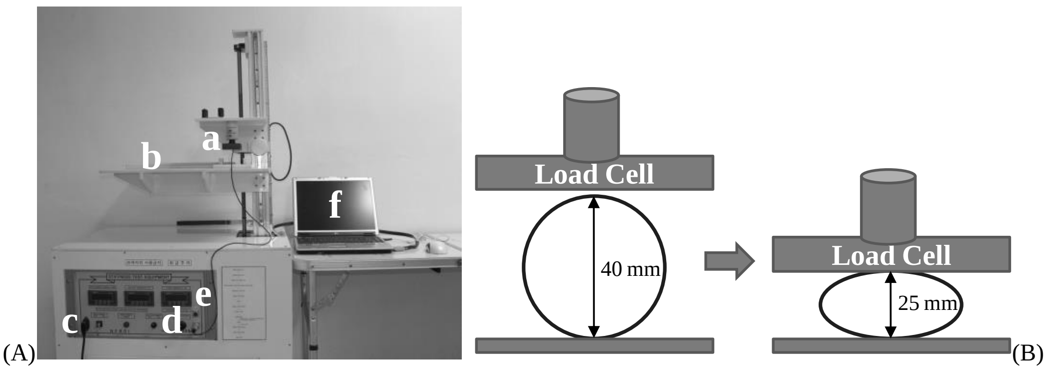

Figure 2. Apparatus for measuring the softness of monofilament samples. (A): Composition of apparatus for softness test. a: load cell; b: moving test bed; c: main power; d: motor speed controller; e: amplifier; f: apparatus control and data storage PC. (B): Softness test using the Brant method.

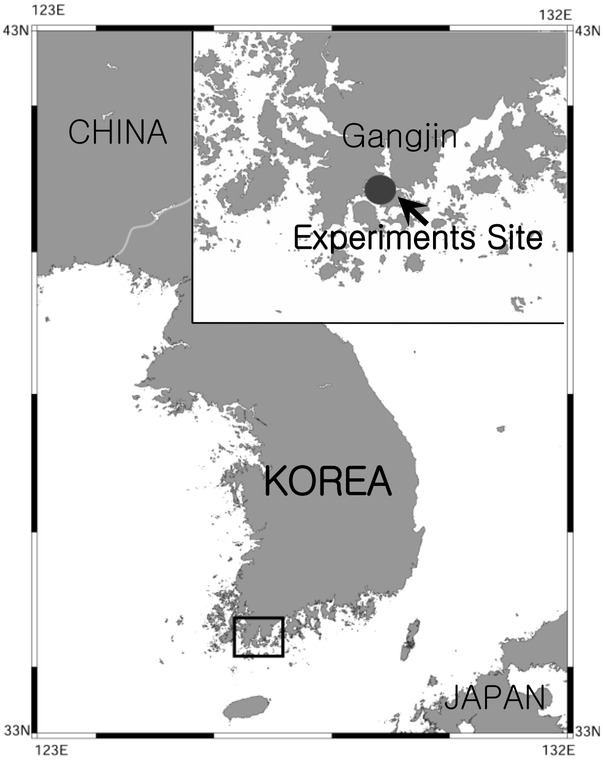

Figure 3. Location of the site for sea trials in Gangjin, Korea.

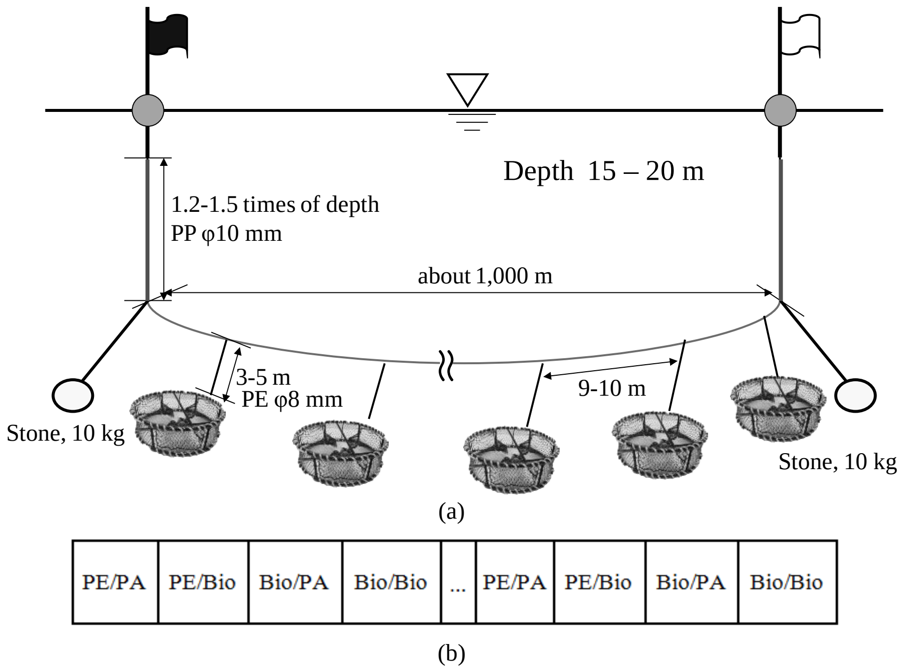

Figure 4. Composition and arrangement of the experimental pots for catching *Octopus minor*.(a): Composition of the experimental pots, (b): Arrangement of the experimental pots.

of line and knotted line breaking strength and elongation. The results derived from the specimens subjected to wet and dry conditions are presented in Figure 5 and Table 2.

The thickness of the biodegradable monofilament was 403.14 Td (diameter: 0.213 mm) and the physical properties during dry conditions showed a line breaking strength of 29.90 kg/mm^2 and an elongation rate of 37.57%. Minimal differences were observed in terms of the line strength and elongation rate after the specimen was immersed in the distilled water for 24 h. The control PA monofilament showed a thickness of 468.33 Td (diameter: 0.229 mm), and the line breaking strength

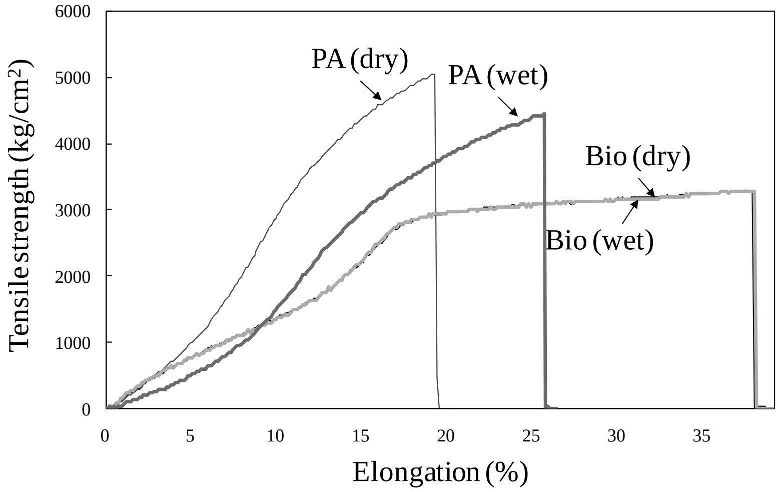

Figure 5. Strength and elongation curves of each specimen.
*Bio is the monofilament composed of 95% PBS and 5% PBAT.
*Dry denotes the dry condition that did not involve immersion in water; Wet denotes the wet condition that involved immersing the monofilament in distilled water for 24 h.

Table 2. Strength and elongation of Bio and PA monofilaments in dry and wet conditions

Material	Denier	Weight	Type of mono.	Breaking strength		Elongation	
	Td	g/m		Dry (kg/mm^2)	Wet (kg/mm^2)	Dry (%)	Wet (%)
Bio monofilament Diameter: 0.213 mm	403.14	0.045 ±0.0001	Knotless mono.	29.90±4.57	30.34±5.28	37.57±4.12	37.54±4.10
			Knotted mono.	26.81±2.44	26.03±1.60	18.71±2.41	17.20±0.85
PA monofilament Diameter: 0.229mm	468.33	0.052 ±0.0001	Knotless mono.	49.55±4.16	42.90±2.58	18.99±1.22	25.37±1.98
			Knotted mono.	36.86±4.34	34.58±5.32	13.47±1.42	18.77±2.90

during dry conditions was 49.55 kg/mm^2, whereas a 13.4% decrease in strength was observed during wet conditions, with a line breaking strength measured at 42.90 kg/mm^2. The elongation rate was 18.99% in dry conditions, whereas this was 25.37% in wet conditions, indicating a 34% increase. The biodegradable monofilament showed a 37.57% elongation rate during dry conditions, whereas a 37.54% elongation rate was observed during wet conditions, indicating no change in physical property. The PA monofilament showed a decrease in breaking strength and an increase in elongation rate during wet conditions compared to that during dry conditions.

The breaking strength and elongation rate of each knotted monofilament are shown in Table 2. The breaking strength of the knotted biodegradable monofilament was 26.81 kg/mm^2 in dry conditions, which was 89.67% of the line strength, whereas the elongation rate was shown as 18.71%, which was 50% of the value of the line elongation rate. The results obtained during wet conditions did not extensively differ from those of the dry conditions. The PA monofilament showed a breaking strength of 36.86 kg/mm^2 in dry conditions, showing 74% of the line properties; the elongation rate was 13.47%, showing 71% of the line properties. The breaking strength in wet condition was 94% of that of the dry condition, and a 140% elongation rate of that of the dry condition. The biodegradable monofilament had the breaking strength of 75% of that of PA monofilament in wet condition, and 92% of the elongation rate. Minimal differences in physical properties between dry and wet conditions were observed for the biodegradable monofilament, whereas PA monofilament showed a significant difference in physical properties between dry and wet conditions.The test results for monofilaments of experimental pots softness are shown in Figure 6.

The strength to compress a 40 mm diameter specimen to 15 mm increased with time, reaching a maximum compression at 14.0–14.5 mm, which then remained either constant or decreased slightly.

This result was observed among all Bio and PA monofilaments in dry and wet conditions. At a compression strength resulting in a 15 mm specimen diameter, the Bio monofilament 0.213 mm diameter did not vary in softness between the dry and wet conditions, as indicated by the 3.268 g weight during dry conditions, and that of 3.263 g during wet conditions. The PA monofilament 0.229mm diameter was 1.5 times softer during wet conditions, as shown by the 5.154 g weight during dry conditions and the 2.628 g weight during wet conditions. Net softness facilitates catching of fish, increasing the chances of these organisms to be confined within the fishing gear.

Sea Trials for Fishing Performance of Net Pots

Evaluation of fishing performance of various net pots was conducted in a nearby shore of Gangjin in Jeollanam-do for 20 times. The bait used in the net pot differed from that used in fish pots, in which the funnel was customized for fish to enter. Thus, bycatch other than *Octopus minor* is uncommon, and during the experimental fishing operation, bat seastars (*Asterina pectinifera*) and conger eels (*Astroconger myriaster*) were caught; however, the entire bycatch weight was about 0.6% of the total catch weight. The results of the *Octopus minor* catch in each net pot are presented in Figure 7.

The total number of catch using PE/PA net pots is 315 individuals (54,244 g), PE/Bio is 160 individuals (26,511 g), Bio/PA is 282 individuals (54,513 g), and Bio/Bio is 139 individuals (25,771 g). The number of *Octopus minor* caught by weight and net pot is shown in Table 3. The highest number of catch was within the 116–140 g weight class, whereas only a few individuals weighing more than 240 g were caught.

The PE/Bio net pot caught approximately half of the amount collected using the control PE/PA pots. Assuming that the test results follow a normal distribution (Kolmogorov–Smirnov test, P=0.2, >0.05), there was a significant difference in the 95% confidence interval as a result of the independent *t*-test regarding the number of *Octopus minor* caught in the two experimental pots (*t*-test, P=0.0001, <0.05).

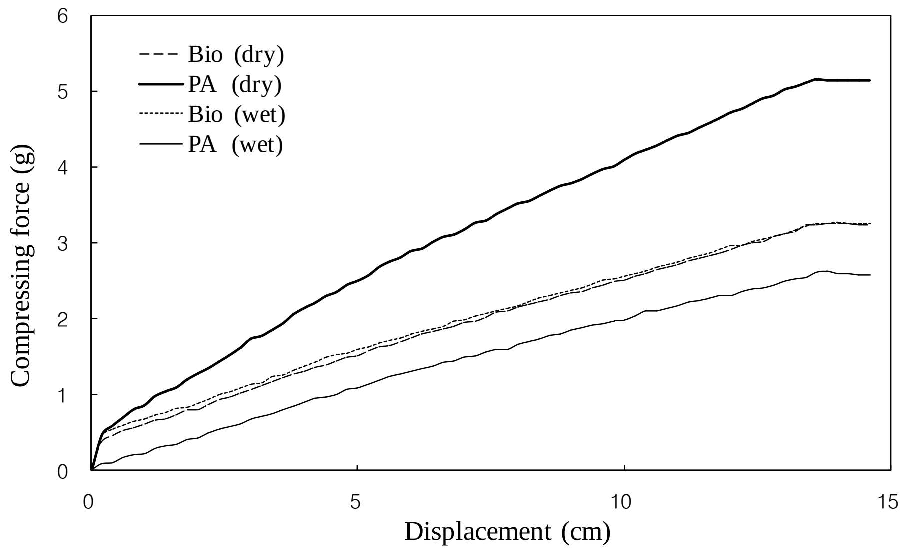

Figure 6. Softness curve of the Bio and the PA monofilaments for *Octopus minor* netting pots in dry and wet conditions.

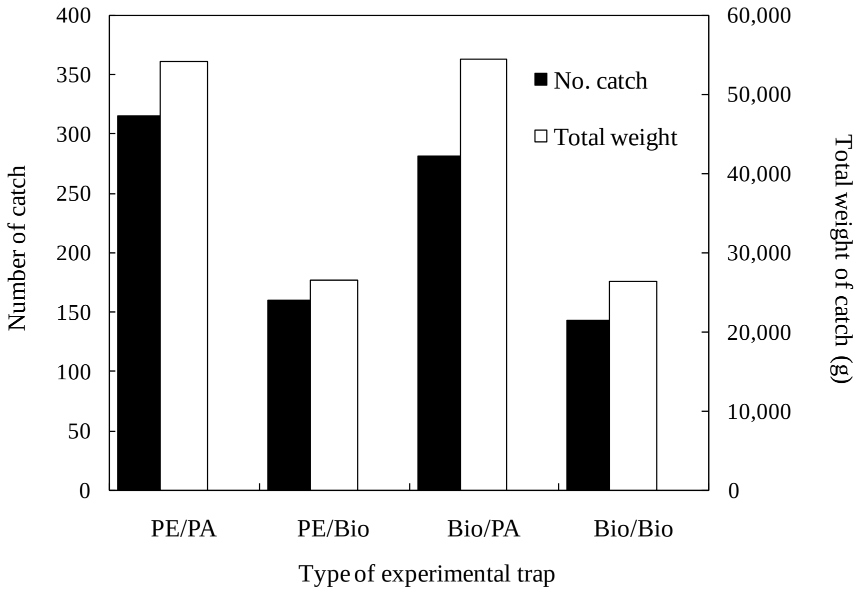

Figure 7. Comparison of *Octopus minor* catches using various experimental pots.

Table 3. Size composition of *Octopus minor* catch using various net pots

Weight class (g)	Material of the pot netting[1]				Total
	PE/PA	PE/Bio	Bio/PA	Bio/Bio	
<40	0	2	0	0	2
41–65	0	1	0	1	2
66–90	8	7	4	1	20
91–115	15	12	12	9	48
116–140	26	13	16	16	71
141–165	15	9	18	14	56
166–190	20	7	27	14	68
191–215	9	5	16	10	40
216–240	12	2	17	2	33
241–265	7	1	3	3	14
266–290	4	2	7	0	13
291–315	1	0	7	1	9
316–340	3	0	4	1	8
341–365	0	0	1	0	1
366–390	0	0	2	1	3
391–415	0	0	1	0	1
416–440	0	0	0	0	0
441–465	0	0	2	0	2
Total number of individuals	120	61	137	73	391
Weight (g)	17,269	8436	26,728	11,914	64,347

[1]PE: Poly ester; PA: Poly amide; Bio: Polybutylene succinate and polybutylene adipate-co-terephthalate

Moreover, there was a significant difference in the results of the *t*-test in terms of catch weight in the two pots (*t*-test, P=0.001, <0.05). On the other hand, the number of individuals caught in the Bio/PA pot, which is biodegradable in the body only, was about 1.14 times higher than that of the commercial pots. Assuming that the test results follow a normal distribution (Kolmogorov–Smirnov test, P=0.2, >0.05), there was a significant difference in the 95% confidence interval as a result of the *t*-test in terms of number of individuals caught in the two experimental pots (*t*-test, P=0.582, >0.05), although no significant difference was observed by weight (*t*-test, P=0.984, >0.05). The fishing performance was the same in terms of catch weight.

The CPUE in terms of number and weight of the catch per pot is presented in Table 4. The CPUE of the PE/PA pot in terms of number and weight of catch was 0.16 individuals/pot and 27.17 g/pot, respectively, whereas that of the PE/Bio pots was 0.08 individuals per pot and 13.27 g/pot, respectively. The results showed a significant difference based on the *t*-test (P=0.0001, <0.05), and the number of catch was greater in the control pot. The *t*-test showed a significant difference in the CPUE weight (*t*-test, P=0.001, <0.05). The existing PA material was thus superior in performance to the biodegradable materials, allowing more *Octopus minor* individuals to enter the pot based on the funnel material. Conversely, the significant difference (*t*-test, P=0.001, <0.05) in the CPUE number and weight between the PE/PA and Bio/PA pots may be attributable to the composition of the net funnel.

Discussion

Most of the recent environmental pollutants occurring at sea are caused by various non-degradable plastic fishing gear such as gill nets and net pots. These materials can also harm spawning grounds and habitats of marine organisms. Furthermore, these fishing materials are responsible for ghost fishing, which may lead to major losses in fishery resources (Matsuoka *et al.*, 2005).

Net pots used in catching *Octopus minor* thriving in the southern coast of Korea have a longer soaking period than other fishing operations; these gears are cast immediately after hauling and thus, they are considered as a fixed type of fishing gear. This type of fishing operation is associated with a high probability of loss, especially during inclement weather, which is also associated with an extended soaking period. In addition, most fishing boats concentrate on the main fishing ground for operation, thus increasing the risk of tangling numerous fishing gears.

Biodegradable net pots have been developed to reduce the incidence of ghost fishing due to lost or abandoned net pots and to protect the marine environment.

Octopus minor usually thrive in the bottom of the sea, which generally consist of mud flats or the mixture of sand and mud; these organisms feed on crustaceans, using their well-developed vision (Cohre, 1973), sense of smell and touch (Well, 1963), and hiding abilities (Chang and Kim, 2003). *Octopus minor* is a predator with developed tentacles, which

Table 4. CPUE of each experimental pot

Pot type	PE/PA					PE/Bio					Bio/PA					Bio/Bio				
Trial	No. of pot	No. of catch	Weight(g)	CPUE (individual/pot)	CPUE (g/pot)	No. of pot	No. of catch	Weight(g)	CPUE (individual/pot)	CPUE (g/pot)	No. of pot	No. of catch	Weight (g)	CPUE (individual/pot)	CPUE (g/pot)	No. of pot	No. of catch	Weight(g)	CPUE (individual/pot)	CPUE (g/pot)
1	98	19	2,620	0.19	26.73	100	7	840	0.07	8.40	98	6	1,100	0.06	11.22	99	1	180	0.01	1.82
2	100	6	750	0.06	7.50	100	10	1260	0.10	12.60	100	7	1,160	0.07	11.60	100	4	440	0.04	4.40
3	100	8	1,350	0.08	13.50	100	6	540	0.06	5.40	100	13	2,450	0.13	24.50	99	6	680	0.06	6.87
4	100	19	3,100	0.19	31.00	100	6	1,400	0.06	14.00	100	13	2,500	0.13	25.00	100	5	1,055	0.05	10.55
5	100	14	3,210	0.14	32.10	100	9	1,740	0.09	17.40	100	4	745	0.04	7.45	99	5	1,080	0.05	10.91
6	100	18	3,380	0.18	33.80	100	8	1,710	0.08	17.10	100	9	1,780	0.09	17.80	100	1	265	0.01	2.65
7	100	16	4,410	0.16	44.10	100	8	1,520	0.08	15.20	100	9	1,630	0.09	16.30	100	1	430	0.01	4.30
8	100	18	4,505	0.18	45.05	99	11	3,080	0.11	31.11	100	15	3,860	0.15	38.60	100	16	3,570	0.16	35.70
9	100	31	5,980	0.31	59.80	100	4	700	0.04	7.00	100	15	3,050	0.15	30.50	100	13	2,940	0.13	29.40
10	100	14	2,760	0.14	27.60	100	8	1,235	0.08	12.35	100	16	2,470	0.16	24.70	100	2	435	0.02	4.35
11	100	7	1,400	0.07	14.00	100	9	1,750	0.09	17.50	100	28	5,430	0.28	54.30	100	10	2,145	0.10	21.45
12	99	25	3,510	0.25	35.45	100	13	2,300	0.13	23.00	100	10	1,610	0.10	16.10	100	6	1,240	0.06	12.40
13	100	9	754	0.09	7.54	100	1	96	0.01	0.96	100	6	800	0.06	8.00	100	1	186	0.01	1.86
14	100	10	1,194	0.10	11.94	100	9	805	0.09	8.05	100	9	1,466	0.09	14.66	100	2	230	0.02	2.30
15	100	18	2,216	0.18	22.16	100	7	758	0.07	7.58	100	7	1,492	0.07	14.92	100	15	2,002	0.15	20.02
16	100	22	2,984	0.22	29.84	100	10	1,073	0.10	10.73	100	19	2,721	0.19	27.21	100	12	1,815	0.12	18.15
17	100	9	1,319	0.09	13.19	100	3	328	0.03	3.28	100	9	1,219	0.09	12.19	100	5	828	0.05	8.28
18	100	7	1,212	0.07	12.12	100	5	788	0.05	7.88	100	3	616	0.03	6.16	100	8	1,247	0.08	12.47
19	100	18	3,307	0.18	33.07	100	11	1,999	0.11	19.99	100	46	10,413	0.46	104.13	100	15	3,124	0.15	31.24
20	100	27	4,283	0.27	42.83	100	15	2,589	0.15	25.89	100	38	8,001	0.38	80.01	100	11	1,879	0.11	18.79
Total		315	54,244	0.16[1)]	27.17[2)]		160	26,511	0.08[3)]	13.27[4)]		282	54,513	0.14[5)]	27.27[6)]		139	25,771	0.07[7)]	12.90[8)]

[1)-8)], average value

are used to live small crabs; this same mechanism has been adapted in fishing operations. According to Park *et al.* (2006), *Octopus minor* uses its tentacles in prying into the funnel or nets to search for its prey. A similar octopus species goes through the hole of the net pot to hide. Thus, this octopus behavior was adopted, i.e., using pots made from mud or plastic materials to catch octopuses (Fiorito and Gherardi, 1999; Sobrino *et al.*, 2011). In commonly used net pots for *Octopus minor*, the funnel nets are made from soft materials such as PA (nylon) to make it favorable for entry.

The biodegradable netting twine and nets that are currently developed from biodegradable resins are inferior in softness to that of the PA netting twine or nets. Also, the PA netting twine absorbs water and becomes softer, whereas the biodegradable netting twine are impervious to water; minor differences in softness were observed in biodegradable twine subjected to either wet and dry conditions, as shown in Figure 6. Softness is an important element that influences the fishing performance of gill nets and net pots.

This study has shown huge differences in the catches between funnels consisting of biodegradable and PA materials. Because the netting elements such as mesh size, thickness, and type of knot were similar in the two types of net pots, the difference in catches is therefore attributable to the softness of the net. It is therefore important to consider biodegradability and softness of the net material when developing a new type of fishing gear. Biodegradable fishing gear is also more expensive than commercial nets and thus, future research efforts may need the financial assistance of government or other institutional agencies.

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