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# PRELIMINARY REPORT OF SIDE-SETTING EXPERIMENTS IN A LARGE SIZED LONGLINE VESSEL

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Paper prepared by

Kosuke Yokota and Masashi Kiyota

National Research Institute of Far Seas Fisheries
5-7-1, Orido, Shimizu, Shizuoka 424-8633, Japan

# Preliminary report of side-setting experiments in a large sized longline vessel

Kosuke YOKOTA and Masashi KIYOTA

National Research Institute of Far Seas Fisheries, Fisheries Research Agency, Japan

5-7-1, Orido, Shimizu-ku, Shizuoka 424-8633, Japan

**Abstract**

Experiments on side-setting methods were conducted in April-May 2006 using a large-sized longline research vessel (total length 54 m, 450 GT) to examine the applicability of side setting to large distant-water-type Japanese longline vessels. Two sets of line setting equipment were installed at the end and side of the stern deck, and the performances of stern setting and side setting were compared. Preliminary analysis of the results indicated satisfactory performance of side setting in practical feasibility and in improvement of sink rates of baited hooks.

## Introduction

It has been reported that side setting (setting longline form the side of a vessel) has high seabirds avoidance performance, deterring seabirds from taking baited hooks by vessel's hull effect. In addition, side setting has potentials to save labor in fishing operation and to improve sinking rate of baited hooks. The previous experiments were conduced in small longline vessels (e.g., Gilman et al., 2003).

We conducted repeated comparative experiments (side vs. stern setting) in the western North Pacific to examine if side-setting method is applicable to large distant-water-type Japanese longline vessels. In the present paper, we report preliminary results of the experiments chiefly on sinking rate of baited hooks and practical feasibility.

## Materials and Methods

### General methods for experiments

Experiments were conducted using a large-sized longline research vessel (*R*/*V* Kurosaki; total length 54 m, 450 GT) in the western North Pacific off the coast of Japan in April-May 2006. Two sets of line setting equipment were installed at the end and side of the stern deck. General configurations of conventional (stern) and experimental (side) setting in experiments are shown in Fig. 1. We carried out two types of experiments; 1) to compare sinking rate of baited hooks and bait-taking behavior of seabirds in stern setting with that in side setting, in pair, and 2) to examine practical feasibility of side setting and its effect on reducing incidental catch of seabirds.

The fishing gear configurations followed the usual style of shallow-set longline used by commercial fishing vessels in the study area. Each basket had four hooks and branch lines. Float lines were made of polyester, and branch lines were made of polyester and polyamide; float lines were 10 m in length, and branch lines had a total length of 18.5 m. We used 2.0 m wire and nylon monofilament leaders in paired experiment of sinking rate of baited hook and bait-taking behavior of seabirds, and used only nylon monofilament ones in experiment of seabirds avoidance effect and practical feasibility. The experiment used conventional 3.8-*sun* tuna hooks, and mackerel (*Scomber japonicus*) and Japanese common squid (*Todarodes pacificus*) bait. In paired experiment, we used only mackerel bait. The in-water weight of mackerel bait was 7.8 ± 1.99 gram weight (gw), and those of branch line (including leader and hook) with nylon monofilament leader and wire leader were about 92 gw and 109 gw, respectively.

Vessel speed during line settings were around 9 knots. Branch lines were thrown into the sea by hand (Fig. 2). In side setting, the baited hooks took water at about 13.8 m ahead of the stern (Fig. 3). Transit time of baited hooks from the launch point to 0 m astern (*a*-*c*; Fig. 3) was about 3 sec.

**1) Paired comparison of side and stern setting**

To compare sinking rates of baited hooks and bait-taking behavior of seabirds in side setting with those in stern setting, we conducted paired experiments of two setting methods, repeating side and stern setting in series. We used thirty baskets in a setting. Each setting took about 15 min and the line was hauled after soaking time of 60 min. A total of 14 line settings (7 pairs) were carried out.

In one basket having nylon monofilament leaders and another one having wire ones, we attached Miniature depth loggers (diameter 18 mm, length 93 mm, limit of resolution 1.0 cm) (Alec electronics, Kobe, Japan) at every four hooks. The in-water weight of loggers was adjusted to zero gw, and the loggers were attached to the tips of hooks and implanted into the abdomens of mackerel bait. Measurement intervals were set at 1 s.

We compared differences in the average sinking speeds of baited hooks from 0 to 10 m between side and stern setting applying repeated paired-comparison by Wilcoxon signed-ranks test (i.e., trial no. 1 vs. no. 2, no. 3 vs. no. 4… and no. 13 vs. no. 14).

We settled 10-min observation session in the middle of each line setting and recorded the species composition, maximum number, and frequency of bait-taking behavior of seabirds during the observation session. We conducted paired-comparison (sign test) of the per-capita frequency of bait-taking behavior of seabirds between side and stern settings.

**2) Test of seabird avoidance effect and practical feasibility**

To examine practical feasibility and seabirds avoidance effect of side setting, we conducted 22 longline operations alternating side and stern setting daily. We used 225 baskets and 900 hooks for each operation. We set 10-min observation sessions per 30 baskets and recorded the species composition, maximum number, and frequency of bait-taking behavior of seabirds during the observation session. Mean per-capita frequency of bait-taking behavior of seabirds was calculated for each operation, and the difference between side-setting and stern-setting was compared using

Man-Whitney U-test. The longline was hauled after a soaking time of about 11 h. During hauling, the species and number of animals caught were recorded.

## Results and Discussion

### 1) Paired comparison of side and stern setting

Example of variations in sinking depth of the hooks against elapsed time was shown in Fig. 4 (date: 4/15/2006, trial 1~4, nylon monofilament leader). In this day's experiments, the elapsed times of hooks reaching 10 m in depth were 41 sec in side setting, and 46 and 48 sec in stern setting. In side setting, at the 0 m astern, hooks sank at 0.73 m (trial 1) and 0.67 m (trial 3) in depth.

Average sinking speeds of the hooks in depth from 0 to 10 m were shown in Table 1. On paired comparisons in same day settings, the average sinking speeds of baited hooks for side setting were 0.030 - 0.068 m/s and 0.017 - 0.130 m/s faster than those for stern setting in nylon monofilament and wire leader, respectively. The sinking speeds of baited hooks in side setting were significantly faster than those in stern setting for either leader material (Wilcoxon signed-ranks test, nylon monofilament leader: $P = 0.02$; wire leader: $P = 0.02$).

These results suggest that sinking rate was improved in side setting, compared to that in stern setting, even though the difference was not very large. A likely explanation is that force direction of water current against branch line and baited hook differ between in side and in stern setting (i.e., baited hooks and branch lines were thrown forward in side setting, and in contrast sideward in stern setting.; Fig. 1), and hence in side setting branch lines and baited hooks are more subjected to sinking forces. Another possibility is that difference in the effect of propeller turbulence, and in side setting, baited hooks might avoid propeller turbulence (e.g., Sakai et al., 2001).

After considering line-setting position located forward in side setting compared to stern setting, the side-setting method improved the substantial reach depth of baited hooks. Variations in average sinking depth of the hooks to 10 m against the distance from stern are shown in Fig. 5. When hooks reached at 10 m in average depth, the distance from stern in side and stern setting were 176 m and 236 m, respectively for nylon monofilament leader, and 176 m and 227 m, respectively for wire leader. If the line setting position is located more forward than that in this experiment, side setting method is expected to further improve the substantial reach depth of baited hooks.

Because this experiment was conducted in the coastal water, gulls (*Larus argentatus, L. schistisagus,* and *L. crassirostris*) were dominant seabirds following the vessel during line setting. The per-capita frequency of bait-taking behavior of gulls were significantly lower in side-setting than in stern setting (sign test, $P$ = 0.03). One herring gull was hooked incidentally during stern setting.

**2) Seabird avoidance effect and practical feasibility**

Laysan albatross (*Diomedea immutabilis*) and black-footed albatross (*D. nigripes*) were major seabird species that followed the vessel during line setting. The number of albatrosses varied greatly among the experimental day (Laysan albatross 0-80, black footed albatross 0-10; Table 2). Mean per-capita frequencies of bait-taking behavior for side and stern setting were 0.11 and 0.11 for Laysan albatross and 0.07 and 0.14 for black-footed albatross, respectively. There were no significant differences between side and stern setting in both species (U-test, $P$ = 1.00), probably because of large fluctuation between experimental days and of small sample size.

All the bait-taking behavior of seabirds occurred astern the vessel irrespective of setting methods. Within the zone of baited hooks passing along vessel’s hull (*a*-*c*; Fig 3) in side setting, no seabirds could take baited hooks.

Total numbers of Laysan albatross caught were 2 in side and 17 in stern setting. Those of black-footed albatross were 0 in side and 2 in stern setting. Although the catch rates were lower in side setting, number of birds and their feeding activity varied greatly between experimental days so that conditions were not identical between side and stern setting. For example, on June 1, large number of Laysan albatross followed the vessel and 15 were caught incidentally (Table 2). Hence, we could not draw conclusion for the difference in catch rates of seabirds in side setting and stern setting.

We had no special trouble with fishing operations in side setting. Main and branch lines were not fouled in the propeller during side setting, even when the vessel went astern several times to untangle main line. The works of fishing operation in the side-setting method were hardly different from those in conventional setting, and we can not find the particular advantage in side setting for the works. By contraries, the disadvantage, small work space was found in this side-setting method.

In the side-setting method we conducted, the improved sinking rate would be insufficiently effective as mitigation measure to reduce incidental catch of seabirds. Although we did not use other seabird avoidance methods in our experiments, the side-setting method is expected to be more effective in avoiding seabirds if it is coupled with bird curtain or weighted branch line.

Results of this study showed that side setting taken advantage of the effect of hull in deterring seabirds and improved sinking rate of baited hooks. The effectiveness would be enhanced if the line is set further ahead from the front deck. Side setting from the front deck would also have an operational advantage in improving work space and efficiency (i.e., both line setting and hauling are carried out on same front deck). We plan to conduct side setting from the front deck in future experiment (Fig. 6).

**References**

Gilman, E., Brothers, N., Kobayashi, D. R., Martin, S., Cook, J., Ray, J., Ching, G., Woods, B. 2003. Performance assessment of underwater setting chutes, side setting, and blue-dyed bait to minimize seabird mortality in Hawaii longline tuna and swordfish fisheries. Final report. Western Pacific Regional Fishery Management Council. Honolulu, Hawaii, USA. 42pp.

Sakai, H., Hu, F., Arimoto, T. 2001. Basic study on prevention of incidental catch of seabirds in tuna longline. CCSBT-ERS/0111/62. 17pp.

Table 1. The average sinking speed $\overline{V}$ (m/s) of the hooks in depth form 0 to 10 m.

| Date | No. of trial | Setting style | Leader material | | | |
|---|---|---|---|---|---|---|
| | | | Nylon monofilament | | Steel wire | |
| | | | $\overline{V}$ (m/s) | S.E. | $\overline{V}$ (m/s) | S.E. |
| 4/15/06 | 1 | Side | 0.249 | 0.0039 | 0.271 | 0.0116 |
| | 2 | Stern | 0.218 | 0.0149 | 0.255 | 0.0113 |
| | 3 | Side | 0.251 | 0.0130 | 0.260 | 0.0169 |
| | 4 | Stern | 0.211 | 0.0043 | 0.235 | 0.0175 |
| 4/17/06 | 5 | Side | 0.264 | 0.0134 | 0.298 | 0.0292 |
| | 6 | Stern | 0.195 | 0.0203 | 0.167 | 0.0101 |
| | 7 | Side | 0.226 | 0.0214 | 0.240 | 0.0115 |
| | 8 | Stern | 0.181 | 0.0101 | 0.219 | 0.0131 |
| 4/18/06 | 9 | Side | 0.248 | 0.0173 | 0.213 | 0.0192 |
| | 10 | Stern | 0.198 | 0.0066 | 0.169 | 0.0065 |
| | 11 | Side | 0.221 | 0.0140 | 0.220 | 0.0052 |
| | 12 | Stern | 0.177 | 0.0165 | 0.193 | 0.0163 |
| 4/19/06 | 13 | Side | 0.268 | 0.0216 | 0.245 | 0.0074 |
| | 14 | Stern | 0.238 | 0.0217 | 0.226 | 0.0096 |

Table 2. Maximum appearance number of albatrosses when line setting and catch number for each operation.

| Date of line setting | Setting style | Maximum appearance | | Catch | |
|---|---|---|---|---|---|
| | | Laysan albatross | Black-footed albatross | Laysan albatross | Black-footed albatross |
| 4/23/06 | Side | 8 | 1 | 1 | 0 |
| 4/25/06 | Stern | 8 | 1 | 1 | 0 |
| 4/26/06 | Side | 25 | 1 | 0 | 0 |
| 5/4/06 | Stern | 7 | 8 | 1 | 0 |
| 5/5/06 | Side | 13 | 6 | 0 | 0 |
| 5/6/06 | Stern | 1 | 10 | 0 | 1 |
| 5/7/06 | Side | 0 | 8 | 0 | 0 |
| 5/9/06 | Stern | 0 | 1 | 0 | 0 |
| 5/10/06 | Side | 0 | 3 | 0 | 0 |
| 5/11/06 | Stern | 0 | 0 | 0 | 0 |
| 5/12/06 | Side | 0 | 0 | 0 | 0 |
| 5/14/06 | Stern | 0 | 1 | 0 | 0 |
| 5/15/06 | Side | 0 | 6 | 0 | 0 |
| 5/16/06 | Stern | 0 | 3 | 0 | 0 |
| 5/17/06 | Side | 0 | 2 | 0 | 0 |
| 5/19/06 | Stern | 0 | 0 | 0 | 0 |
| 5/22/06 | Side | 1 | 0 | 0 | 0 |
| 5/24/06 | Stern | 2 | 1 | 0 | 0 |
| 5/25/06 | Side | 2 | 6 | 0 | 0 |
| 5/30/06 | Stern | 2 | 1 | 0 | 0 |
| 5/31/06 | Side | 25 | 0 | 1 | 0 |
| 6/1/06 | Stern | 80 | 5 | 15 | 1 |

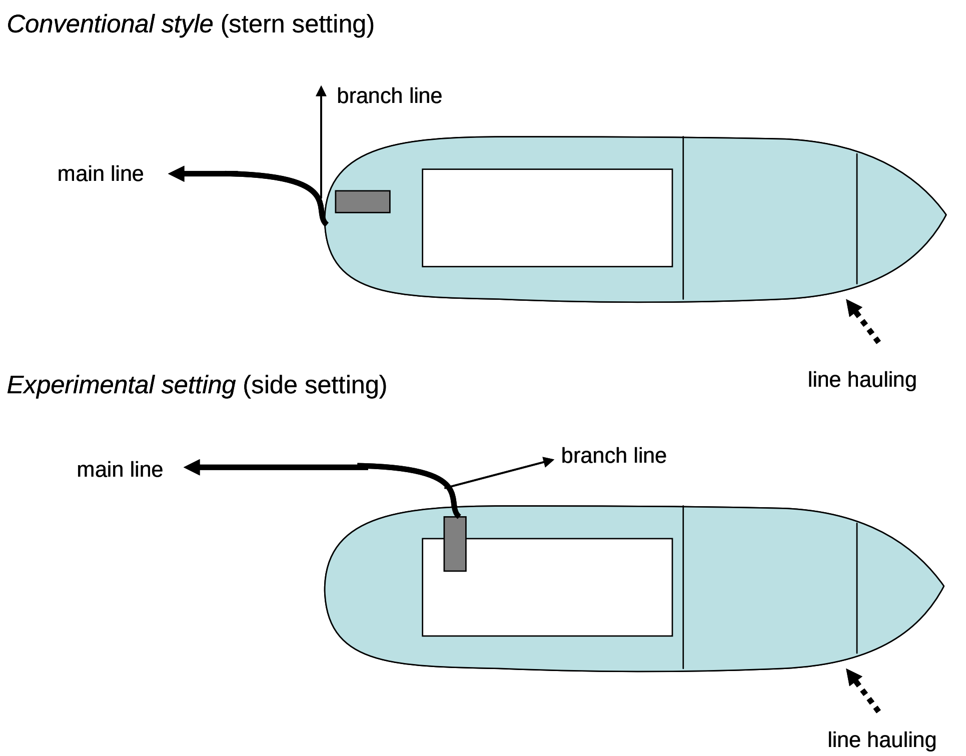



Fig. 1. General configurations of conventional (stern) and experimental (side) setting in this experiments.

Fig. 2. Casting hooked bait and branch line in side setting.

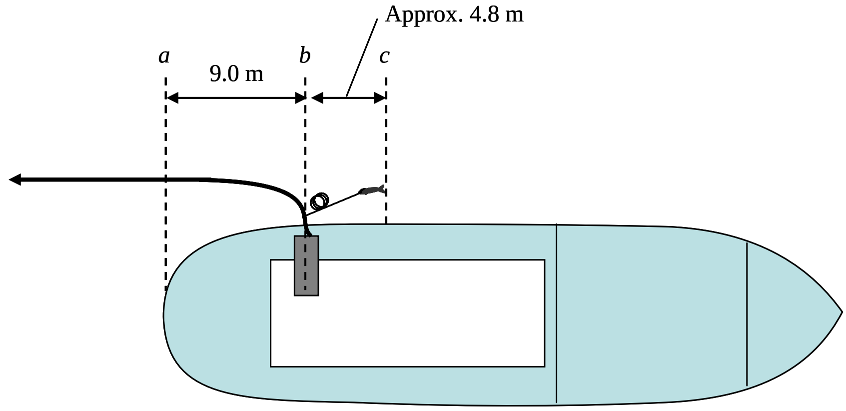



Fig. 3. Distance from the line shooting machine to stern (*a*-*b*), and to the launch point of baited hooks (*b*-*c*) in side setting.

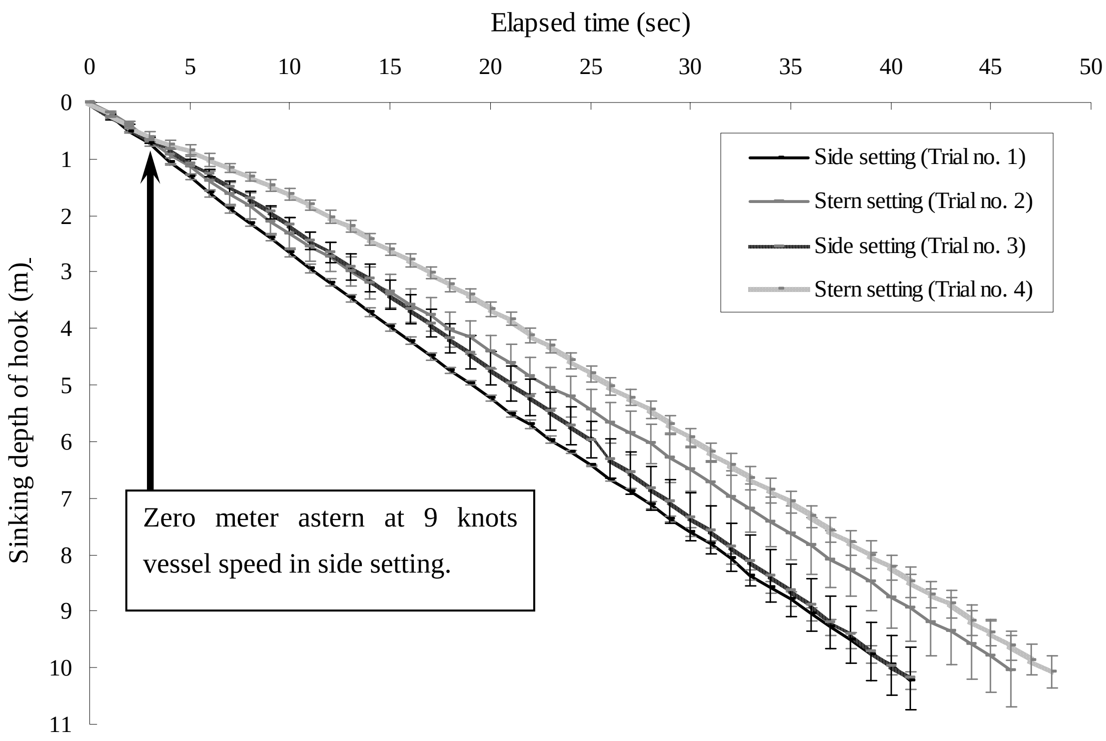
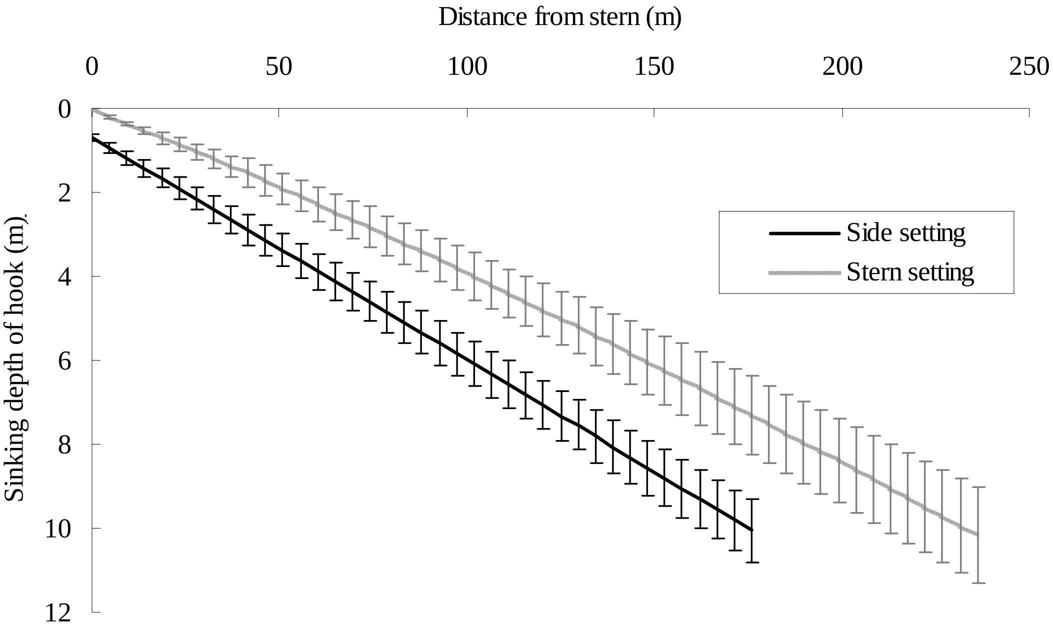



Fig. 4. Sinking depth of baited hooks in side and stern setting (date: 4/15/06; trial no. 1~4). Vertical bars denote standard error.

a) Nylon monofilament leader




b) Wire leader

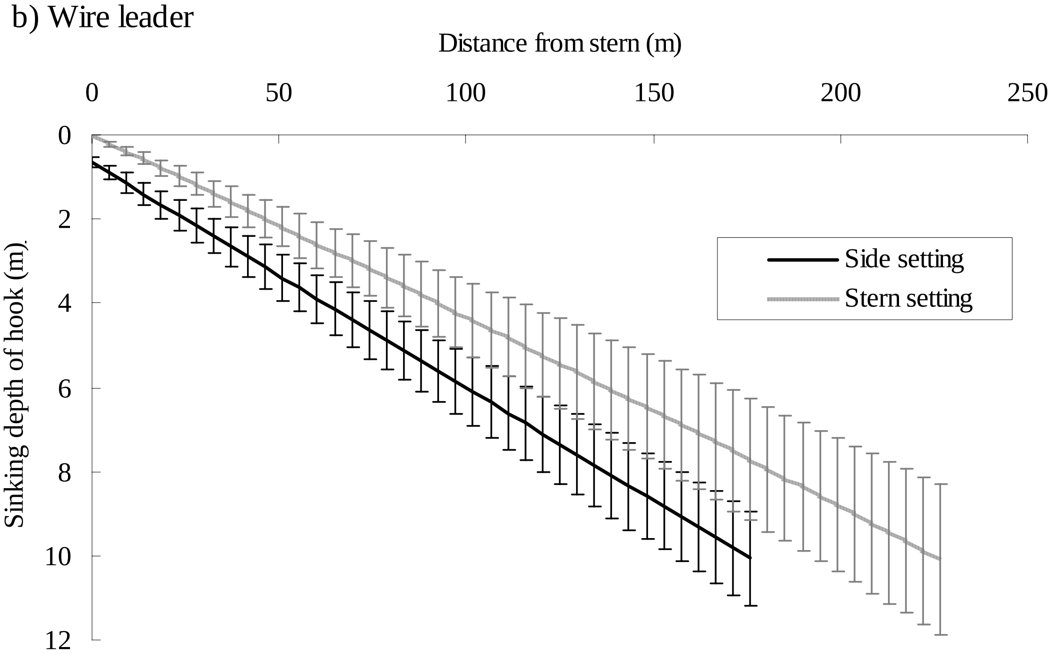



Fig. 5. Average sinking depth of baited hooks against the distance from stern in side and stern setting. Vertical bars indicate standard deviations.

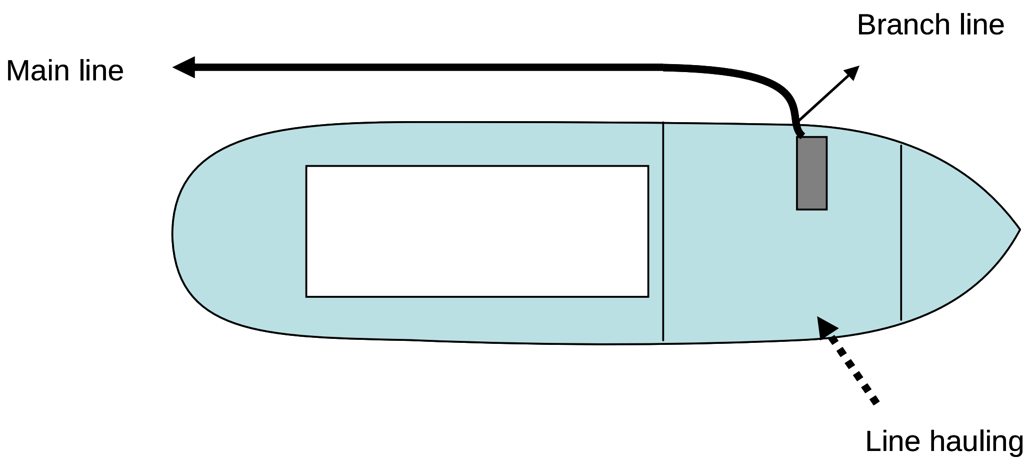



Fig. 6. Proposal of side-setting method in future experiments.