# PRELIMINARY STUDY TO PREVENT INCIDENTAL CAPTURE OF SEA TURTLES BY POUND NET

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## ABSTRACT

To mitigate incidental catch of sea turtles by pound net fishery, we tested the efficiency of the specially designed pocket nets to release turtles selectively. The experiments were carried out using a pound net in operation in a lagoon of Ishigaki Island, southernmost Japan. Immature green turtles, *Chelonia mydas*, were put into the pocket net and their behaviors were captured with underwater video. The turtles showed back and forth motion in the pocket net between two funnels or between the funnel and the cod-end. An escape hatch with a flap was equipped above the base of the funnels on the pocket net. Three designs of the escape hatch were examined. Using these gears, unintended capture of sea turtles by pound net is expected to reduce by about 60 %.

## INTRODUCTION

It is thought that incidental capture of sea turtles by commercial fisheries is one of the threats that causes decline of some local populations of sea turtles (Lutcavage, et al., 1996; Hillestad, et al., 1995). To mitigate bycatch of sea turtles by fisheries, various kinds of effort have been carried out. Turtle excluder devices (TEDs) have been developed for shrimp trawl net fisheries operated in the Caribbean Sea and in the ASEAN region (Oravetz, 2000; Epperly, 2003). It is, however, possible that pound nets provided pockets with funnels still cause turtles to die by drowning when they are incidentally captured. In some coastal regions, pound net is thought to be a major cause of death of turtles (Lutcavage and Musick, 1985). To mitigate bycatch of sea turtles by pound net fisheries, we tested specially designed pocket nets to release turtles automatically and selectively.

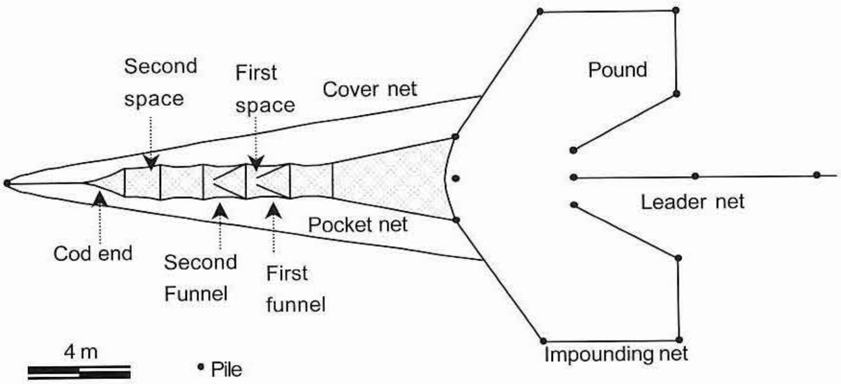


*Figure 1. Structure of the pound net used in the experiment. The lattice pattern indicates the conic pocket net underwater. The first space is between the first and the second funnels. The second space is between the second funnel and the cod end.*

## MATERIALS AND METHODS

Pound net operated in Ishigaki Island, southern Japan, is settled in the shallow lagoon. It is composed of a leader net (about 100 m in length), a pound of about 5 m by 10 m, and one pocket providing two funnels (Figure 1). The length of the pocket net is about 10 m and its maximum diameter is 1.3 m. The mouth of the funnel is pulled with ropes at its four corners, so that it is square shaped. The mouth of the first funnel is 25 cm square, and that of the second funnel is 20 cm square.

The escape hatch was designed to open if the turtle pushed the flap with its head (Figure 2). A square hole fringed with PVC pipe or rope was made above the base of each funnel. A flap was attached to each hole, hinging at the cod-end side of the hole. Unless turtles use the hatch, the flap was kept closed with stopper ropes during the operation. Three models of the escape hatch were examined. Their designs and materials are summarized in Table 1.

Wild immature green turtles, *Chelonia mydas*, were obtained from fishermen. Their straight standard carapace lengths were 41.5 - 51.7 cm. Behavior of turtles was observed in the pocket net of the pound net operated in the lagoon off Kabira village, Ishigaki Island. The turtles were put into the first space of the pocket net through the first funnel and their behaviors were captured on videotape by scuba divers. Voluntary submergence intervals of juvenile C. *mydas* were less than 33min (Brill, et al., 1995) and the similer results were reported for *Eretmochelys imbricata* and *Caretta caretta* (van Dam and Diez, 1997; Lutcavage and Lutz, 1991). Therefore, the turtles used in the experiments were rescued within 10 minutes. Although each turtle was used in the experiment for a few replications, no trace of learning effect was observed during the experiments. They were tagged and released after the experiments.

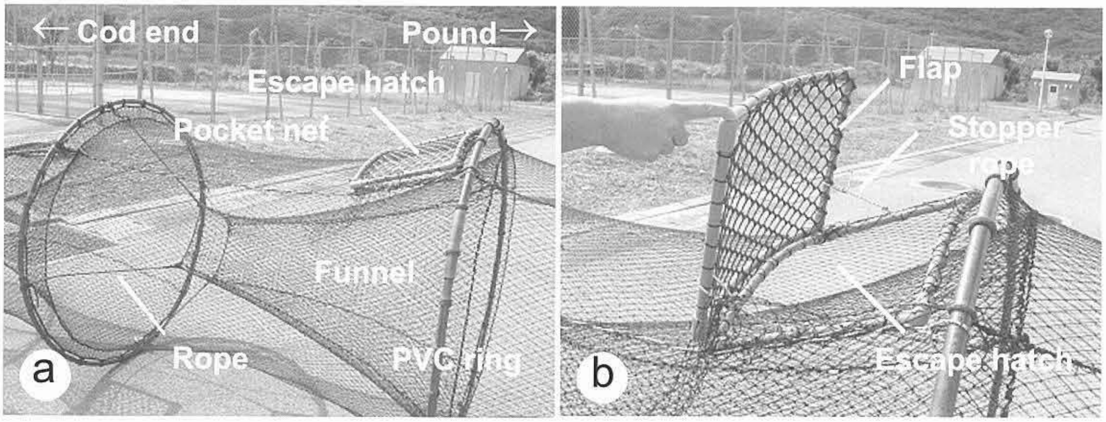


*Figure 2. The escape hatch (Model-1). a: closed. b: opened.*

**Table 1. Three designs of the escape hatch.**

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Size | 44cm x 33cm | 50cm x 40cm | 50cm x 40cm |
| Hatch | PVC pipe, PV13 | Rope, 6mm in diameter | Rope, 6mm in diameter |
| Flap frame | PVC pipe, PV13 | Stainless steel bar (6mm) | Stainless-steel bar (3mm) |
| Flap body | Netron net, Z-1 | Pylen net | Nylon net |
| Note | PVC pipe of the flap frame was filled with sand. | The upper side of the rings were connected together with ropes. | The upper side of the rings were connected together with ropes. |

## RESULTS AND DISCUSSION

Figure 3 shows swimming paths of the turtles in the pocket net. The 78% of examined turtles went through the second funnel into the second space and the 22% remained in the first space. In the first space, turtles mainly wandered about above the upper side of the base of the first funnel, and sometimes showed back-and-forth motions between the first and the second funnels. They were sometimes caught on the ropes pulling the mouth of the funnel. In some cases, they stayed without motion for a few minutes on some certain points of the pocket net, such as the inner surface of the funnel. In the second space, turtles moved backward and forward between the upper side of the second funnel and the cod-end at the beginnings. Then after a while, up-and-down motions were added to the back-and-forth motion. Turtles seemed to try to reach the water surface for breathing at that time. In the cod-end or around the funnels, tracks of turtles tend to move into the upper half space, because turtles, facing the net, stopped and raised its head. Judging from the frequency of the positions in the pocket net that the turtles bump its head against, the upper side of the cod-end seemed to be the most effective site to make escape hatch for confined turtles. However, fishes also showed a tendency to school within the cod-end or below the base of the funnels. Considering all these factors together, we made the escape hatch above the base of the funnel.

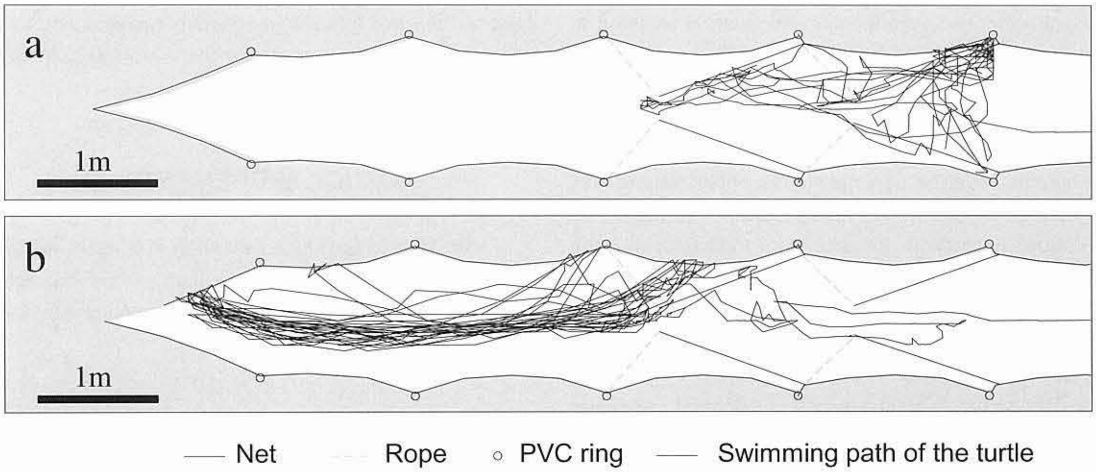


*Figure 3. Lateral view of swimming path of the turtle in the pocket net. Black solid line indicates track of the head of the turtle. Solid gray area is seawater outside of the pocket. Gray solid line, gray broken line, and open circle indicate, net, rope, and cross section of PVC ring, respectively. a; Typical movement in the first space. b; Typical movement in the second space.*

The success rates of escaping through the three models of the escape hatch are summarized in Table 2. Turtles could not escape through the model-1 made of PVC pipes and plastic net (netron net). In the model-1, PVC pipe of the flap frame was filled with sand to make the flap heavy to resist water turbulence. However, the model-1 was so heavy that the net tended to sag. Since cutting the net to make the hatches broke the tension balance of the net between the rings of the pocket, the pocket lost its conic shape. These factors caused the space narrower between the hatch and the funnel, resulting in the turtles kept away from the hatch. Therefore, in the model-2 and the model-3, the rings of the pocket were dragged together with ropes at both sides of the hatch, so that the upper side of the net did not sag. Changing the frame materials from PVC pipe to stainless steel bar saved the weight of the flap. Also, the plastic net of the flap was substituted for the fishing net to make the flap lighter. These improvements contributed to keep the cylindrical shape of the pocket net and the wide space above the funnel. The difference between the model-2 and the model-3 was the diameter of the stainless steel bar framing the flap. Using the model-2 and the model-3, about 60% of turtles migrated in the pocket escaped through the hatch. These results suggest that the escape hatches are effective to release turtles from the pound net.

**Table 2. Success rate of the escape hatch to release turtles.**

| | Model 1 | Model 2 | Model 3 |
|---|---|---|---|
| Success rate (Success/Total) | 0 / 7 | 2 / 3 | 5 / 8 |
| Time to escape | - | 211 x 40 sec | 280 x 147 sec |

Although the escape hatch is expected to prevent unintentional catch of turtles, it must be examined whether it has the same effect during the operation of the fishery. In the case of TEDs for shrimp trawling net, confined turtles may be excluded by passive manner to some extent using the dragging power of the fishing boat. However, the apparatus to exclude turtles from the pound nets requires turtles to find and to go out through the hatch by themselves. In this study, about 60% of the turtle could escape from the pocket using the model-2 and the model-3. Further investigation is required to improve the design and the position of the escape hatch.

When the escape hatches are applied to the pound nets, additional economic burden and labor supply of the fishermen must be minimized. To obtain fishermen's agreement to use these types of gears, it is necessary to show them clear research data indicating that the hatch does not reduce the catch amount. Although no fish was observed escaping through the hatch during the experiments, additional researches to evaluate the change of the catch amounts are required. If the use of the escape hatches causes loss of catches to a greater or a lesser extent, the compensation for the decrease should be considered. On the contrary, if the existence of turtles in the pocket disturbs fishes to migrate into the cod-end, the use of the hatch will increase the catch amount. Fishermen have been complaining that turtles in the pocket net break the fishing gears. If their complaint is true, it will be helpful for fishermen to decrease unintentional catch of turtles. However, the escape hatch should not disturb the fishery operation or additional labors. Therefore, the pocket net with escape hatch must be designed for easy treatment of turtles during the operation. The cost to make the hatch should be financially supported.

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