The effects of bar spacing and orientation of Nordmøre devices on the stability of the trawl cod-end

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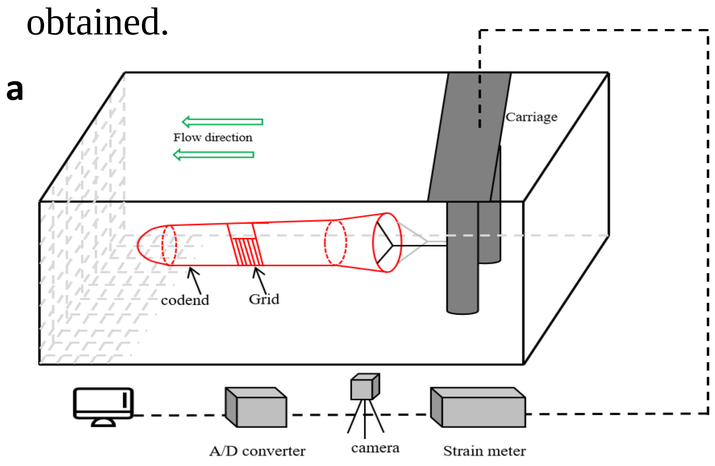
Introduction

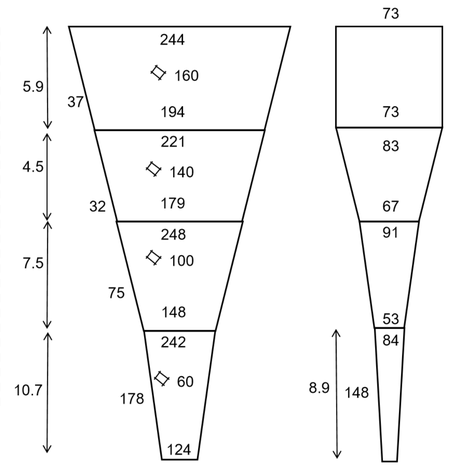
- To reduce bycatch and improve the selectivity of trawl fishing, grid bycatch reduction devices have been widely applied in bottom trawl fisheries.
- Many studies have only focused on the selectivity effects of BRD and hydrodynamic changes under steady-state conditions, without investigating the dynamic hydrodynamic changes of the cod-end with different BRD parameters.
- The Nordmøre grid is a widely adopted Bycatch Reduction Device (BRD) utilized in various shrimp trawl fisheries to minimize bycatch. Variations in bar spacing and orientation of the grid both influence the hydrodynamic acting on the cod-end system and significantly affect its overall stability.

Materials and Methods

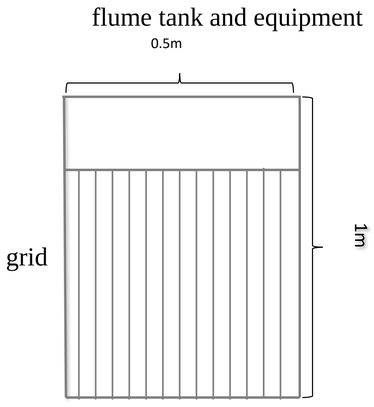
- This study employs flume tank model experiments to investigate the effects of different bar spacings (15 mm, 25 mm, 35 mm, 45 mm) and inclination angles (30°, 45°, 60°) on drag and shape of the cod-end system.
- The Fast Fourier Transform (FFT) was employed to analyze the frequency spectrum of drag fluctuations in the cod-end, revealing the characteristics of cod-end drag oscillations.
- Utilizing the position of the experimental equipment and employing characteristic length as reference scale, the spatial coordinates and shape of the cod-end were obtained.

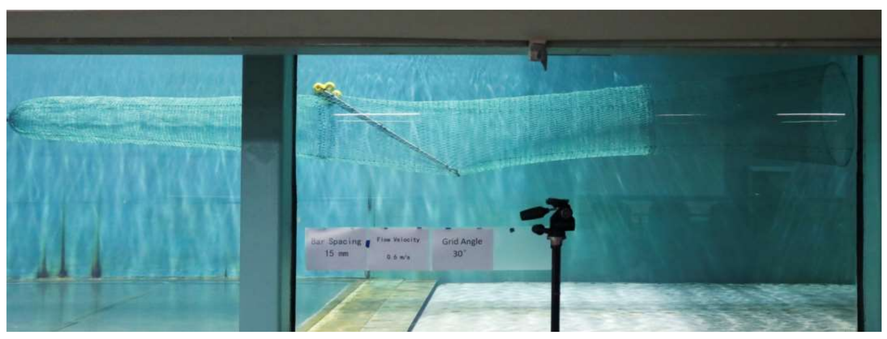


flume tank and equipment



Full-scale cod-end





Side view of cod-end

Results

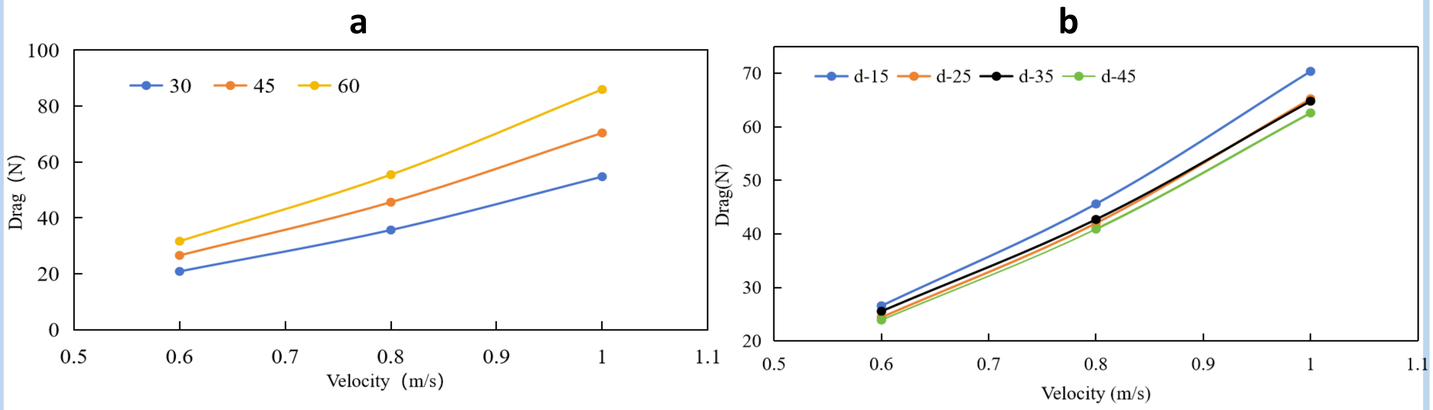


Fig.1 a) Variation of cod-end drag with flow velocity at different inclination angles. b) Variation of cod-end drag with flow velocity at different grid bar spacings.

The drag on the cod-end increases with both the inclination angle of the grid and the flow velocity, while it decreases with larger bar spacing. Specifically, when the grid's inclination angle is 60°, the average drag on the cod-end is 60% greater than at 30° and 20% greater than at 45°.

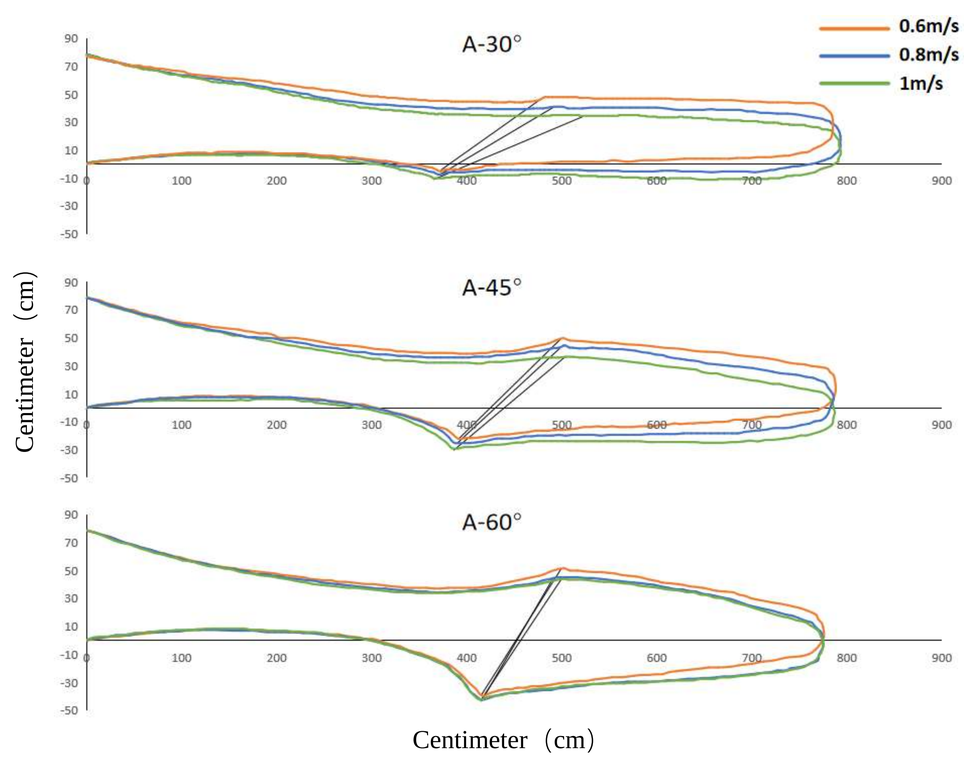


Fig.2 The shape of the cod-end with flow velocity at different inclination angles.

As the inclination angle of the grid increases, the expansion effect on the contour shape of the cod-end becomes more pronounced, resulting in the vertical center point of the cod-end being positioned lower. As the flow velocity increases, the overall shape of the cod-end tends to contract.

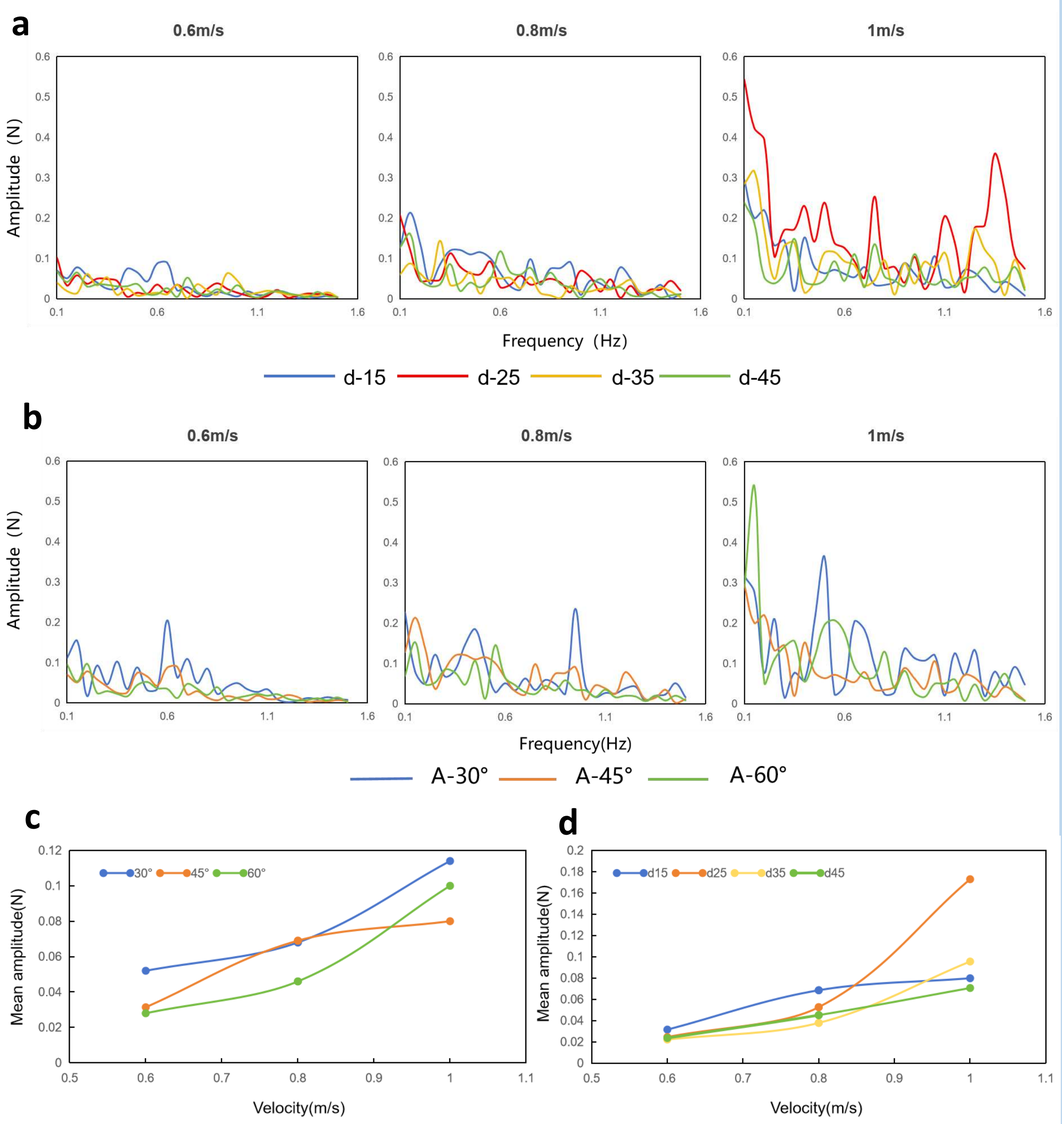


Fig.3 a) Drag amplitude of cod-end structure at different bar spacings. b) Drag amplitude of cod-end structure at different inclination angles. c) Variation of average drag amplitude of the cod-end structure with different Inclination Angles. d) Variation of average drag amplitude of the cod-end structure with different grid bar spacings.

- Cod-end drag shows a noticeable degree of fluctuation, which becomes more pronounced with increasing flow velocity. At grid angle of 30°, the drag oscillation is most significant, while at 45°, this effect is weaker. The average amplitude of drag oscillation at 30° is 30% greater compared to that at 45°.
- Bar spacing has no significant effect on the fluctuation of drag oscillation.

Conclusion

- The drag oscillation effect of the cod-end is most significant at 30°, with a weaker effect observed at 45°. This study indicates that the cod-end system exhibits greater stability at 45°.
- The cod-end equipped with grid BRD expands at the fitting position, facilitating reduction in internal pressure. This enhancement improves the outflow of flow and decreases the high-pressure area in front of the accumulated catch, thereby increasing the escape opportunities for fish of specific sizes.