Evaluation of the Shelter Function of Bikuni Fishing Port from High Waves Based on Interval Camera Observations of Fish Behavior

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Understanding where fish avoid physical disturbance under high-wave and flood conditions is of considerable interest not only to anglers but also to researchers. Coastal structures such as fishing ports, in addition to their primary function of ensuring the safe landing of catches, are increasingly recognized as providing secondary ecological functions, including shelter function from high waves for marine organisms. In Hokkaido, Japan—an area of high importance for fisheries production—there is a great need to enhance such protective functions. However, studies investigating the mechanisms underlying shelter function from high waves in cold-water regions remain limited. In particular, field-based evidence linking wave height to fish behavior under high-wave conditions and quantitative assessments of harbor shelter function from high waves remain scarce. Previous investigations at Suttsu Fishing Port in southwestern Hokkaido, combining interval camera observations at the harbor entrance, biotelemetry surveys inside and outside the port, wave observations, and wave-field analyses, demonstrated that (1) fish abundance and occurrence rates decreased with increasing significant wave height, indicating that fish behavior is influenced by high-wave conditions (Kajihara et al., 2021), and (2) even under high-wave conditions, wave height remained lower in the inner harbor than at the entrance, and black rockfish (*Sebastes schlegelii*) moved into the harbor, suggesting that calm inner-port areas function as shelters from high waves (presented at JpGU 2023).

To further expand these findings, this study focused on Bikuni Fishing Port in western Hokkaido, located adjacent to a river. Interval camera observations were conducted to examine fish behavior under high-wave conditions, together with measurements of current velocity and significant wave height. The relationship between fish behavior and hydrodynamic conditions was analyzed, and the results were compared with those from the non-estuarine Suttsu Fishing Port to clarify the characteristics of fish assemblages at Bikuni and to evaluate the harbor’ s shelter function from high waves.

During effective daytime observation periods with sufficient water clarity, significant wave height reached a maximum of 3.8 m outside the port (St.B), whereas it remained below 0.3 m at the central inner-port station (St.A). Current velocity measured on foot protection blocks at St.7 near the harbor entrance remained below 9 cm/s. Approximately one year of interval camera observations at St.7 revealed fewer fish taxonomic groups than those recorded at Suttsu Fishing Port, where additional methods including diving surveys and net sampling were employed. Nevertheless, some taxa not observed at Suttsu were detected at Bikuni, and the number of observed taxa increased from June to November. No clear relationships were detected between fish abundance or occurrence rates and significant wave height at St.A or St.B, nor with current velocity at St.7. In contrast, at Suttsu Fishing Port, fish occurrence rates began to decline when significant wave height exceeded 0.2 m, and no fish were observed when wave height exceeded 0.8 m. Similarly, fish occurrence decreased when calculated current velocity exceeded 5 cm/s and disappeared above 20 cm/s. The absence of relationships between fish abundance or occurrence rates and hydrodynamic variables at Bikuni is likely attributable to the fact that wave heights and current velocities did not reach levels sufficient to influence fish behavior under high-wave conditions, as observed at Suttsu.

These results suggest that fish are able to remain active within calm harbor environments even when

high-wave conditions prevail outside the port. The present findings provide further evidence supporting the role of sheltered fishing ports as effective shelters from high waves in cold-water regions.

Keywords: Fishing port, Fish behavior, Shelter function from high waves, Time-lapse photography

