Forage Fish Distribution at Pier Edges in the Hudson River

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Introduction

- The majority of the Hudson River estuary shoreline has been anthropogenically modified with the potential to affect fish distribution.
- Potential responses include use of pier-edge habitats as refuges and use of pilings as current baffles. Responses to these variables may be confounded by differing light levels.
- We investigated forage fish distribution in response to piers and pilings. Newly developed Dual-frequency Identification Sonar (DIDSON) allows observation under piers or relict pile fields independent of light or water clarity.

Methods

Dual-frequency Identification Sonar (DIDSON)

- DIDSON (Sound Metrics Corp., Lake Forest Park, WA, www.soundmetrics.com) produces video-quality echograms.
- This is a non-invasive sampling technique that permits the observation of pelagic and benthic habitats.

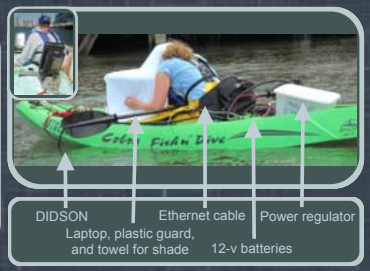
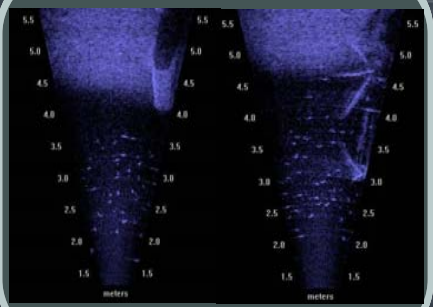


Fig. 1

Above: The electronic set-up allows for real-time viewing and adjustment of the DIDSON.

Inset: The DIDSON is bolted to the underside of a kayak and can be transported on a small skiff.

DIDSON Echogram Analysis



- Individual fish were measured to the nearest cm using DIDSON image software.
- Size range and school abundance were sub-sampled using a grid superimposed on the echogram.

Fig. 2

Schools of forage fish cluster around underwater structures.

Fig. 3

Above: Pier 40 was one of several piers included in this study.

Right: The lower Hudson River has been intensely developed; much of the area's natural habitat has been eliminated.

Bottom left: Tidal conditions can hinder navigability underneath piers.

Bottom right: Pilings without cover, or relict pile fields, are not subject to light limitations.

Study Site

- We sampled along the eastern shore of the Hudson River in three habitats: under-pier, pier-edge, and relict pile field.
- Transects were performed on north and south sides of structures at day and at night. Each transect was 5-7 minutes. The paddler kept an audio record of piling counts and location for later analysis.

Fig. 4

Left: The pier shadow represents the beginning of the shaded refuge zone.

Right: The maneuverability of the kayak allows the paddler intimate access to pilings.

Results

- More forage fish schools (e.g., Atlantic silversides, bay anchovies) were observed at night than at day (single-factor ANOVA, df=1, p=.0001, α=0.05, Chart 1).
- Schools occurred most often in pier-edge habitats (single-factor ANOVA, df=2, p<.0001, α=0.05, Chart 2).
- There was a significant (p=.0005) interaction among school distribution on the north and south sides of piers and relict pile fields and in the types of habitats (2-factor mixed model ANOVA, df=2, α=0.05).
- There was a significant (p<.0001) interaction among all variables: time of day, type of habitat, and north and south structure side (3-factor mixed model ANOVA, df=1, α=0.05).

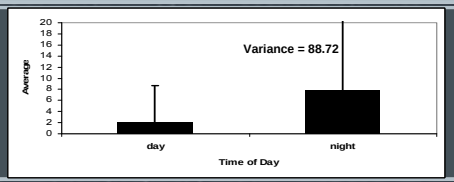


Chart 1

More schools were observed and school variance was higher in low light levels.

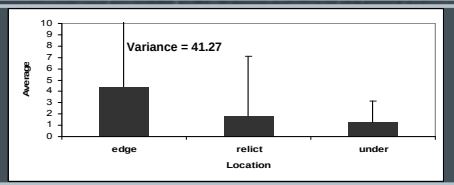


Chart 2

Most schools were observed and school variance was highest in pier-edge habitats.

Conclusions

- Light levels and type of habitat affect the positioning of forage fish schools around structures. Schools were most frequently observed at night and in pier-edge habitats. More observation and analysis is necessary to investigate school distribution as a function of orientation to structure.
- Future studies should be conducted on a seasonal basis, as current baffles may be most important in winter conditions.
- Differing flow regimes may also be considered as a factor.

References available upon request.

Acknowledgements:

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