Responses of demersal fish and invertebrates to Block Island Wind Farm

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Demersal Trawl Survey

- Conducted on commercial trawler from Pt. Judith
- Otter trawl consistent with other regional studies
- 20 minute tows, once a month
- Three Study Blocks
  - Reference South – 2 tows
  - Reference East – 2 tows
  - Area of Potential Effect – 2 tows
- Seven Years of Surveys
  - 2 years before construction
  - 2 years during construction
  - 3 years after construction
Block Island Wind Farm Trawl Survey Sampling
October 2012 – September 2019

• 497 tows (using regional sampling protocol)
• > 750,000 fish and invertebrates collected
• Nine species account for 90% of all individuals
• Numerical dominants:
  Butterfish
  Little skate
  Scup
  Winter skate
  Longfin squid
Block Island Wind Farm Trawl Survey Sampling
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Statistical Power
Minimum effects sizes of approximately 40% to 63% for the fish species evaluated (black sea bass, little skate, summer flounder, windowpane, winter flounder and winter skate)
Examined Multiple Metrics

- Fish/invertebrate abundances
- Size distributions
- Fish condition
- Flounder and hake dietary habits
- Prey accumulation curves
Spatial and Temporal Variation in Abundances

Winter skate

Atlantic herring

Spiny dogfish
Fish Catch Model – Results
Black sea bass – Baseline vs Operation

![Graph showing the comparison of Black sea bass catch per unit effort (CPUE) between baseline and operation. The graph indicates a higher CPUE in the baseline compared to operation.]

- **Baseline**
- **Operation**
Fish Catch Model – Results
Windowpane – Baseline vs Operation

![Bar chart showing average CPUE for different categories (APE, REFE, REFS) for Baseline and Operation.]
Regional Context of Study Results
Fish Condition Index – Baseline vs Operation

Condition index values = residuals from a log(Weight)-log(Length) regression

- All species showed highly significant ($p << 0.001$) decreases in condition values from Baseline to Operation (averaged across areas)

- Silver hake condition increased at APE, decreased at reference (interaction $p = 0.016$).
Fish Diet

Winter flounder
Summer flounder
Silver hake
Red hake
Spotted hake
Atlantic cod
Black sea bass (Year 7)
Diet Composition

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<th>n = 98</th>
<th>110*</th>
<th>168</th>
<th>624</th>
<th>392</th>
<th>435</th>
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<td>Atlantic cod</td>
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<td>Winter flounder</td>
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- Worm - nemertean
- Worm - annelid
- Unknown
- Tunicate
- Squid
- Sponge
- Sea anemone
- Plant
- Other crustacea
- Nudibranch
- Isopod
- Hydroid
- Gastropod
- Fish
- Echinoderm
- Decapod
- Cnidaria
- Bryozoan
- Bivalve
- Amphipod
Stomach Content Analysis
Prey Accumulation Curves

Winter flounder (fall and spring)

- Baseline APE
- Baseline REFE
- Baseline REFS
- Operation APE
- Operation REFE
- Operation REFS

Number of unique prey items

Number of stomachs
Lessons Learned

• Study design should balance fishing community interests and science interests. Consider adaptive monitoring to address fishing community concerns where possible.

• If possible, conduct power analysis to determine if ecologically meaningful differences can be detected.

• Fish abundances (CPUE) are highly variable for some species, and therefore can yield low statistical power. At BIWF, a 40% to 63% difference in catch rates between reference sites was the minimum effect size averaged over the taxa examined.

• Comparing results to regional surveys is useful for interpreting trends.
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