The Pulse Beam Trawl in the North Sea Brown Shrimp Fishery—
does it pay off?

Jörg Berkenhagen    Daniel Stepputtis    Petr Zajicek
Thünen-Institute of Sea Fisheries – Thünen-Institute of Baltic Sea Fisheries
The problems

Brown shrimp fishery – beam trawls
- Bycatch
- Seabed impact
- Towing resistance -> high fuel consumption
A potential solution

Pulse trawl:
- Electric pulse stimulates shrimp to jump
- Straight ground rope
- Less bobbins

Less bycatch
Less seabed impact
Constant or more shrimp catch
Reduced towing resistance -> reduced fuel consumption
Promising results from Belgium and The Netherlands
The current situation

Pulse beam trawling is in general forbidden; licences only for test fishing (5% of beam trawler fleet)

Almost all licences issued to flatfish beam trawlers, and almost no flatfish beam trawler without pulse technology is left (NL).
<table>
<thead>
<tr>
<th>Cost</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Investment: interest and depreciation</td>
<td>Less fuel cost</td>
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<td>Additional repair cost</td>
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</table>
Experimental setup

Beam Trawler „Marlies“
1973
17.2 m, 221 kW
Refurbished – „modern“

− Sampling over 13 months (self-sampling and scientific sampling)
− 522 hauls, ~ 1000 h towing
− Shrimp and bycatch quantities and composition measured
− One standard, one pulse gear

− USEFUL FUEL CONSUMPTION MEASUREMENT NOT POSSIBLE
## Cost of equipment

<table>
<thead>
<tr>
<th>Year</th>
<th>Residual value</th>
<th>Depreciation (10% linear)</th>
<th>Interest expense (rate = 5%)</th>
<th>Maintenance</th>
<th>Annual total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>75000</td>
<td>7500</td>
<td>3750</td>
<td>3500</td>
<td>14750</td>
</tr>
<tr>
<td>2</td>
<td>67500</td>
<td>7500</td>
<td>3375</td>
<td>3850</td>
<td>14725</td>
</tr>
<tr>
<td>3</td>
<td>60000</td>
<td>7500</td>
<td>3000</td>
<td>4235</td>
<td>14735</td>
</tr>
<tr>
<td>4</td>
<td>52500</td>
<td>7500</td>
<td>2625</td>
<td>4659</td>
<td>14784</td>
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<tr>
<td>5</td>
<td>45000</td>
<td>7500</td>
<td>2250</td>
<td>5125</td>
<td>14875</td>
</tr>
<tr>
<td>6</td>
<td>37500</td>
<td>7500</td>
<td>1875</td>
<td>5638</td>
<td>15013</td>
</tr>
<tr>
<td>7</td>
<td>30000</td>
<td>7500</td>
<td>1500</td>
<td>6202</td>
<td>15202</td>
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<tr>
<td>8</td>
<td>22500</td>
<td>7500</td>
<td>1125</td>
<td>6822</td>
<td>15447</td>
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<tr>
<td>9</td>
<td>15000</td>
<td>7500</td>
<td>750</td>
<td>7504</td>
<td>15754</td>
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<tr>
<td>10</td>
<td>7500</td>
<td>7500</td>
<td>375</td>
<td>8254</td>
<td>16129</td>
</tr>
</tbody>
</table>
Towing resistance

Rudder gauge

Towing resistance measurement:
- 14%!
Fuel consumption did not decrease -> uneven towing resistance required countersteering

After the project the skipper continued with two pulse beams:

According to his observation fuel savings of 10%
Catch and revenue

**Catch, revenue ratios**

- **kg**
  - Standard: 48.3%
  - Pulse: 51.7%
- **€**
  - Standard: 48.1%
  - Pulse: 51.9%

**Surplus catch, revenue**

- **kg**
  - PULSE: 7.0%
- **€**
  - PULSE: 8.1%
Partition of marketable shrimp catch (mass)
## Overview revenue and expense

<table>
<thead>
<tr>
<th>Cost for Equipment</th>
<th>Low</th>
<th>Medium</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12,000€</td>
<td>15,000€</td>
<td>20,000€</td>
</tr>
</tbody>
</table>

**Fuel savings ~10%:**
Typical annual consumption 50,000 – 120,000 l

<table>
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<tr>
<th>Savings</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Savings at 30T€</td>
<td>3,000€</td>
<td></td>
</tr>
<tr>
<td>Savings at 100T€</td>
<td>10,000€</td>
<td></td>
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5% additional profit margin from **catch surplus**
(8% revenue minus 30% variable costs)

<table>
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<tr>
<th>Typical annual revenue</th>
<th>100,000 – 400,000€</th>
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<tbody>
<tr>
<td>Additional profit margin (at 100T€ - low)</td>
<td>5,000€</td>
</tr>
<tr>
<td>Additional profit margin (at 400T€ - high)</td>
<td>20,000€</td>
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Scenarios

The graph illustrates the profit increase in T€ (without "pulse" expenses) in relation to the annual revenue in T€. It shows three scenarios:

- **No fuel savings** (gray line)
- **30 T€ fuel/year** (orange line)
- **100 T€ fuel/year** (purple line)

As the annual revenue increases, the profit increase also increases, but at different rates for each scenario. For instance, with no fuel savings, the profit increase is relatively flat, whereas with 30 T€ fuel/year or 100 T€ fuel/year, the profit increase is more pronounced as revenue increases.
External effects

Decreased towing resistance

Less bycatch (-9%)

- Less seabed impact
- Lower impact on ecology
- Maybe facilitating MSC certification
- Maybe less spatial restrictions

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J. Berkenhagen, D. Stepputtis, P. Zajíček
EAFE, Salerno
Feedback from fishermen

- Concerns about increasing catches:
  "Don’t want to catch more, don’t want to catch less”
  (more would be detrimental for prices, less would cut their income)

- Uncertainty keeps them away from investing

- 2 German fishermen have invested in pulse technique for shrimp beam trawling (however, licences are limited) → fishing with traditional ground rope!
Outlook

– Pulse beam trawling for shrimp is a promising technique:
  ✓ pays off under certain circumstances
  ✓ potential positive environmental effects

– Clear regulations necessary to avoid misuse
  (electric field, ground rope)

– Manifold options for improvement, esp. ground rope
  (wheels!)
THANKS!
Verteilung der Erlöse und kg

- Jun2013
- Jul2013
- Aug2013
- Sep2013
- Okt2013
- Nov2013
- Dez2013
- Jan2014
- Feb2014
- Mrz2014
- Apr2014
- Mai2014
- Jun2014

€
kg
## Cost and benefit

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