The Assessment of *Nephrops* Stocks in the Irish Sea

Dr Richard Briggs
Probably not *Nephrops*
Overview

1. Biology and Fishery
2. Stock Assessment
3. UWTV Method
4. The 2010 Assessment
5. ICES Advice (International Council for the Exploration of the Sea)
6. Conclusions
1. Biology

*Nephrops* in NOT a fish!!

- Phylum: Arthropoda
- Class: Crustacea
- Order: Decapoda
- Super Family: Nephropsidea

**Dublin Bay prawn**

(*Nephrops norvegicus*)

**Cod**

(*Gadus morhua*)
Characteristics

- Hard exoskeleton which is periodically shed (ecdysis) and growth is discernable (the only time). No hard structures with growth rings.
- Kidney shaped eye (from the Greek *nephros* = kidney and *op* = eye).
- Live within burrows in seabed sediment which they build.
- Females remain in burrows whilst incubating eggs (9 months).
- Planktonic larval stage.
- Juveniles (0-group) remaining burrowed for at their 1st year.
Life Cycle

I. Planktonic Stages
2-3 Weeks

II. III. IV.

SEA BED

OVIGEROUS FEMALES
9 months

ADULT
The Fishery

Captured by otter trawls (single or multiple) or by creels
Northern Ireland Marine Fisheries

Value of top 15 species in 2009

Value of all species = £21.5 millions
2. Stock Assessment

Functional Units as defined by ICES
### Irish Sea Nephrops TAC: Sub-Area VII

#### Sub Area VII

<table>
<thead>
<tr>
<th>MA</th>
<th>FU</th>
</tr>
</thead>
<tbody>
<tr>
<td>J</td>
<td>14 15</td>
</tr>
<tr>
<td>L</td>
<td>16 17 18 19</td>
</tr>
<tr>
<td>M</td>
<td>20 21 22</td>
</tr>
</tbody>
</table>

Western Irish Sea = FU15

![Map of Irish Sea Sub-Area VII](image-url)

The map shows the sub-areas and their corresponding months:
- **January (J)**: Sub-Area VII consists of sub-areas 14 and 15.
- **February (L)**: Sub-Area VII consists of sub-areas 16, 17, 18, and 19.
- **March (M)**: Sub-Area VII consists of sub-areas 20, 21, and 22.

The coordinates for each sub-area are as follows:
- **Sub-Area VII**: 48.00 to 55.00 latitude, -19.00 to 1.00 longitude.
Assessment Methods

(1) Catch Data
   a) Length Cohort analysis
   b) Size compositions sliced to ages, VPA and XSA models used similar to Fin-fish methods (used until 2005).

(2) Larval Production
   Using fecundity data to back calculate the number of females required to produce the amount of larvae observed in surveys. Labour intensive and costly. Done as a one off.

(3) Camera Surveys*
   Underwater video used to count Nephrops burrow clusters
   *Adopted by ICES since 2005
3. UWTV Method

- Adults inhabit burrows in offshore sediment from which they only emerge to feed and to mate.

- Research in Scotland suggests that one adult Nephrops occupies a single burrow cluster and unoccupied burrows are quickly filled by sediment.

- By counting burrow clusters over a known area it is possible to provide a fishery independent index of Nephrops abundance and to map the Nephrops grounds.
Nephrops burrows
Polyester resin pours underwater rather like treacle in air and when mixed with catalyst cures to produce high quality casts of burrows like this burrow of Nephrops norvegicus (Scale bar 20cm)
The Ships

AFBI have performed collaborative UWTV *Nephrops* surveys with the Irish Marine Institute since 2003. Now 7 years data

*RV Corystes*

*RV Celtic Voyager*
The AFBI camera sledge

Camera Surveys
(AFBI/Marine Institute initiative but now includes CEFAS to cover eastern Irish Sea stocks (FU14))

Deploying the camera
The Stations

- 3.5km apart
- Camera towed for 10 mins at each station
Eastern Irish Sea (FU14) Stations

UWTV survey extended since 2007 and used for the assessment in 2010

Joint survey with CEFAS/AFBI and Marine Institute
4. The 2010 Assessment

Western Irish Sea (FU15)
Contour plots of burrow densities using geostatistics (2003 – 2009)
Burrow densities from different areas

Clusters m$^{-2}$

- Farn Deeps: 0.45
- Fladen: 0.29
- Moray Firth: 0.29
- North Minch: 0.49
- Clyde: 0.69
- Sound of Jura: 1.21
- W. Irish Sea: 1.47
- Arun Grounds: 0.84
- Galway Bay: 1.6
Summary of data analysis

Landings

Size distribution

Mean Nephrops weight in

Predicted Landings

Catch Data Growth and Maturity Parameters

Catch Option Table

Harvest Rates from Model

Bias Adjusted Burrow Count
### Bias estimates introduced by ICES Benchmark Assessment 2009

<table>
<thead>
<tr>
<th>FU</th>
<th>Area</th>
<th>Edge Effect</th>
<th>Detection Rate</th>
<th>Species Identification</th>
<th>Burrow Occupancy</th>
<th>Cumulative bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>Farn Deeps</td>
<td>1.30</td>
<td>0.85</td>
<td>1.05</td>
<td>1</td>
<td>1.20</td>
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<tr>
<td>7</td>
<td>Fladen</td>
<td>1.45</td>
<td>0.90</td>
<td>1.00</td>
<td>1</td>
<td>1.35</td>
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<tr>
<td>8</td>
<td>Firth of Forth</td>
<td>1.23</td>
<td>0.90</td>
<td>1.05</td>
<td>1</td>
<td>1.18</td>
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<tr>
<td>9</td>
<td>Moray Firth</td>
<td>1.31</td>
<td>0.90</td>
<td>1.00</td>
<td>1</td>
<td>1.21</td>
</tr>
<tr>
<td>11</td>
<td>North Minch</td>
<td>1.38</td>
<td>0.85</td>
<td>1.10</td>
<td>1</td>
<td>1.33</td>
</tr>
<tr>
<td>12</td>
<td>South Minch</td>
<td>1.37</td>
<td>0.85</td>
<td>1.10</td>
<td>1</td>
<td>1.32</td>
</tr>
<tr>
<td>13</td>
<td>Clyde</td>
<td>1.19</td>
<td>0.75</td>
<td>1.25</td>
<td>1</td>
<td>1.19</td>
</tr>
<tr>
<td>15</td>
<td>Irish Sea West</td>
<td>1.24</td>
<td>0.75</td>
<td>1.15</td>
<td>1</td>
<td>1.14</td>
</tr>
<tr>
<td>17</td>
<td>Aran</td>
<td>1.35</td>
<td>0.90</td>
<td>1.05</td>
<td>1</td>
<td>1.30</td>
</tr>
</tbody>
</table>

**Bias Adjusted Count = Count X Bias**
# Catch Option Table

<table>
<thead>
<tr>
<th>Rationale</th>
<th>Harvest ratio</th>
<th>Landings 2011 (tonnes)</th>
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</thead>
<tbody>
<tr>
<td>MSY framework</td>
<td>17.10%</td>
<td>8,724</td>
</tr>
<tr>
<td>MSY transition</td>
<td>17.80%</td>
<td>9,104</td>
</tr>
<tr>
<td>F2009</td>
<td>18.00%</td>
<td>9,199</td>
</tr>
<tr>
<td>F0.1 (combined)</td>
<td>11.00%</td>
<td>5,612</td>
</tr>
<tr>
<td>F35% (combined)</td>
<td>13.40%</td>
<td>6,832</td>
</tr>
<tr>
<td>Fmax (combined)</td>
<td>17.10%</td>
<td>8,724</td>
</tr>
</tbody>
</table>
Maximum Sustainable Yield (MSY): now forming ICES advice basis. Not possible to estimate directly for *Nephrops* as no age or SSB data. MSY proxy therefore established.
Evidence for Harvest Rate at Fmax as Proxy for MSY

Commercial Fishery Data: ie fished sustainably for many years above Fmax

- **Landings - International**
  - International Landings
  - UK - All gears
  - Rep. of Ireland - All gears

- **Effort - Different fleets**
  - UK Northern Ireland Nephrops trawlers
  - Rep. of Ireland

- **LPUE - Different fleets**
  - Rep. of Ireland - LPUE
  - UK Northern Ireland - LPUE

- **Mean sizes - Different fleets**
  - ROI - Catch - Males
  - ROI - Catch - Females
  - UK NI - Catch - Mal
  - UK NI - Catch - Fem
Trawl Survey Data

Figure 1: Western Irish Sea Nephrops stations
**Trawl Surveys: catch rates**

![Graph showing catch rates over time for August and April](image-url)

Key:
- **August**: Light grey bars
- **April**: Dark grey bars
- **Aug mean**: Light grey dashed line
- **Apr mean**: Dark grey dashed line

**Axes:***
- **Y-axis**: Kg per nm
- **X-axis**: Years from 1994 to 2009

The graph illustrates the catch rates in Kg per nm for August and April over the years 1994 to 2009. The Aug mean and Apr mean are represented by dashed lines for comparison.
Mean carapace length from Q3 surveys
(error bars = SD)

Mean percentage females in August
(error bars = SD)
Trawl survey data scaled to UWTV survey abundance index

5 year mean = $B_{\text{trigger}}$
Other Data

- Examination of historical data from 1960s when the fishery was in its infancy shows little change in size composition of catches

- Larval production studies have shown that in 1995 $440 \times 10^9$ *Nephrops* larvae were produced suggesting high recruitment potential

- The Irish Sea Gyre (whirlpool effect) retains both larvae and sediment enhancing recruitment success
5. ICES Advice

Benchmark Workshops
(2009 for Nephrops)
Data compilation
+ External review

Stock annex

Expert Groups

Review Group

1st draft of advice

Advice Drafting Groups

STEC and EU

Final Advice

ACOM web conference

ACOM (2009 for Nephrops)
6. Conclusions

- Since 2005 *Nephrops* stock assessment based on UWTV surveys.

- The 2010 assessment of W. Irish Sea (FU15) stocks advises
  Landings at F_{max} as an MSY proxy ie near to 2009 tonnage.

- Management should be at Functional Unit level as components of the
  TAC area (VIIa) have different states of exploitation eg FU 17
  (Porcupine Bank) are over fished and the advice is zero catch.
  This drags the TAC downwards.
CEFAS - AFBI – MI
(Jon Elson, Richard Briggs, Colm Lordan)

----- The End ----