Summary of the west coast rock lobster recreational fishery estimates

S.J. Johnston

MARAM
Department of Mathematics and Applied Mathematics
University of Cape Town
Rondebosch

The telephone surveys during this period were conducted by Decision Surveys International. Note no surveys were conducted in the 1995/96 and 1999/2000 seasons. Each season was broken into two-week survey stages. The number of stages, number of interviews per stage, and total number of interviews is as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of stages</th>
<th>Number of interviews per stage</th>
<th>Total number of interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991/92</td>
<td>7</td>
<td>100</td>
<td>700</td>
</tr>
<tr>
<td>1992/93</td>
<td>17</td>
<td>70</td>
<td>1190</td>
</tr>
<tr>
<td>1993/94</td>
<td>14</td>
<td>70</td>
<td>980</td>
</tr>
<tr>
<td>1994/95</td>
<td>10</td>
<td>70</td>
<td>700</td>
</tr>
<tr>
<td>1996/97</td>
<td>12</td>
<td>70</td>
<td>840</td>
</tr>
<tr>
<td>1997/98</td>
<td>12</td>
<td>90</td>
<td>1080</td>
</tr>
<tr>
<td>1998/99</td>
<td>11</td>
<td>100</td>
<td>1100</td>
</tr>
<tr>
<td>2000/01</td>
<td>10</td>
<td>100</td>
<td>1000</td>
</tr>
</tbody>
</table>

Calculation of total recreational catch

Total volume per stage = number of permits sold x ave # lobster removed per person per fortnight

Thus,

Total volume per stage = (# permits x total # lobsters removed by interviewees for that stage)/# of interviewees in the sample for that stage

The total catch is then simple the addition of the catches over all the stages.

Estimate of variance associated with the total recreational catch estimate
The total recreational catch estimate is provided with the 95% confidence level (see Table 1). The method used to provide this CI is not provided.

Period 2001/02
This telephone survey as conducted by Lara Atkinson of Anchor Environmental Consultants CC, Department of Zoology, UCT.

The season was broken down into six interview stages. A total of 1500 interviews were conducted. Stages 2-6 had 184 interviews conducted, and 580 interviews were conducted for stage 1.
Calculation of total recreational catch

Total volume per stage = (Adjusted number of permits sold x Total # of rock lobster removed for that stage)/# of interviewees sampled for that stage

where adjusted number of permits sold takes into the account that some for the fact that some permit holders may have purchased their permit at the start of the stage and had more time available to fish. The method employed was as follows:

Stage 1:
Dates for interviews 31 Jan-10 Feb; interview relating to period 22 Nov-31 Jan

\[
\frac{3}{4} \text{ Permit sales for Oct (280) + Nov (20 829 )} = 21109
\]

\[
+ \frac{1}{4} \# \text{permits sales for Dec (24 941)} = 18705.75
\]

\[
+ \frac{1}{4} \# \text{permits sales for Jan (5190)} = 1297.5
\]

Stage 1 adjusted permits sold = 41112.25

Stage 2:
Dates for interviews 11 Feb-13 Feb; interview relating to period 2-3 Feb and 9-10 Feb

Total permits sold during Stage 1 = 50283

\[
+ \frac{1}{2} \text{ difference of permits sold between Stage 2 and Stage 1 (50960-50283)/2} = 338.5
\]

Stage two adjusted permits sold = 50621.5

Figures for the other stages were adjusted in a similar manner.

Estimate of variance associated with the total recreational catch estimate

The total recreational catch estimate is provided with the 95% confidence level (see Table 1). The method used to provide this CI is not provided.

**Period 2003/04 – 2007/08**

For the period covering the 2003/04 – 2007/08 seasons, a telephonic survey was carried out by Enviro-Fish Africa (Pty) Ltd. The method used to estimate the recreational catch for each season is as follows.

The recreational catch season was broken up into two-week periods (there would thus be between 7-11 survey periods each season, depending on the season length). About 150 phone interviews were conducted for each sample period. The total number of interviews each season is:

- 2003/04 = 1502
- 2004/05 = 1054
- 2005/06 = 1644
- 2006/07 = 1498
- 2007/08 = 1336
During an interview, the person was asked about their lobster fishing in the previous two-week period. The person was asked how many days they fished, and the total number of lobsters caught during this period. Other questions were also asked e.g. from what area did most lobsters come from.

**Calculation of total recreational catch**

\[ C_{\text{rec}} = \text{cpue} \times E_{\text{total}} \]  

(1)

where

- \( C_{\text{rec}} \) is the total recreational catch in numbers
- \( \text{cpue} \) is mean CPUE (lobsters/fisher-day) over all four areal zones
- \( E_{\text{total}} \) is the total effort (fisher-days)

\( C_{\text{rec}} \) in numbers is converted to \( C_{\text{rec}} \) in kgs by multiplying numbers by 0.345kg.

**Estimation of CPUE**

Each person was asked how many lobsters they caught in the season (\( C \)) and how many fisher-days they used (\( E \)). A \( \text{cpue} \) for each person was then calculated as follows:

\[ \text{cpue} = \frac{C}{E} \]  

(2)

These \( \text{cpue} \) values were averaged for each of four Zones (Zones A, B, C and D). A mean value across all four zones was then used in equation (1).

**Estimation of fishing effort \( E_{\text{total}} \)**

The estimation of fishing effort takes into account the increase in effort that occurs throughout the season – as recreational licences are sold throughout the fishing season, the number of fishers entering the fishery will increase as the season progresses. As such, the fishing effort is calculated individually for each sample period using the following equation:

\[ E_i = \left( \frac{e}{fs} \right) P \]  

(3)

where

- \( E_i \) is the effort (in days) during survey period \( i \),
- \( e \) is the effort recorded by the interviewees during the sample period (in days),
- \( fs \) is the number of fishers interviewed during the survey period, and
- \( P \) is the number of permits that have been issued at that point in the season.

\( P \) is calculated as:

\[ P = p_i + \left( \frac{i}{d_1} \right) x d_i \]  

(4)

where

- \( p_i \) is the number of permits that have previously been issued during the season,
- \( i \) is the number of permits issued in the month,
is the days in the month, and

is the number of days that are within the survey period.

Total fishing effort is then calculated as:

\[
E_{\text{total}} = \sum_{i} E_{i}
\]

where

\(E_{\text{total}}\) is the total seasonal fishing effort, and

\(E_{i}\) is the fishing effort during the two weekly sampling periods.

Estimate of variance associated with the total recreational catch estimate

For each season, the analysts provide the mean for all respondents from the final sample period of how many lobsters they had caught over the whole season. The SD of this figure is provided for the last two seasons only, where for both seasons the number of interviews in the last stage was 149.

<table>
<thead>
<tr>
<th>Season</th>
<th>Mean</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003/04</td>
<td>11.54</td>
<td>23.8</td>
</tr>
<tr>
<td>2004/05</td>
<td>12.04</td>
<td>23.8</td>
</tr>
<tr>
<td>2005/06</td>
<td>9.8</td>
<td>23.8</td>
</tr>
<tr>
<td>2006/07</td>
<td>28 ± 23.8</td>
<td></td>
</tr>
<tr>
<td>2007/08</td>
<td>20.1 ± 15.5</td>
<td></td>
</tr>
</tbody>
</table>

Obtaining a standard error of the mean based on the number of interviews for the last two seasons suggests CVs for the total takes per respondent and hence the estimate of total recreational catch to be:

<table>
<thead>
<tr>
<th>Season</th>
<th>CV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2006/07</td>
<td>0.104</td>
</tr>
<tr>
<td>2007/08</td>
<td>0.094</td>
</tr>
</tbody>
</table>

Summary Plots

Figures 1-3 provide plots of the number of permits sold in relation to the season length, and total recreational catches estimates in relation to permit sales and season length. There are no obvious trends in any of these plots.

Discussion

A key component of results from these surveys is the precision with which the total take is estimated.

For the earlier period of surveys this averages 7.5%, but no explanation of the method used is given in the reports. For the last two surveys this average is similar at 9.9%. What however concerns is that the earlier analyses apparently use all the data for this computation whereas the later use only data from the last set of interviews based on a much smaller sample. Why then are the CVs so similar?
Table 1: Summary of recreational catch estimates. Values in square parentheses show the 95% CI where available; the associated CV is given in round parentheses.

<table>
<thead>
<tr>
<th>Season</th>
<th>Analyst</th>
<th>Total Catch estimate (kgs)</th>
<th>Total Catch estimate (#s)</th>
<th>Mean cpue (lobsters/fisher/day)</th>
<th>$E_{net}$ (fisher days)</th>
<th>Total number of fishing days</th>
<th>Total number of permits sold</th>
</tr>
</thead>
<tbody>
<tr>
<td>1991/92</td>
<td>DSI</td>
<td>159 229/205 931</td>
<td>419 286/541 923</td>
<td>419 286/541 923</td>
<td>5 months</td>
<td>(150 days)</td>
<td>44 469</td>
</tr>
<tr>
<td>1992/93</td>
<td>DSI</td>
<td>469 257 (0.098)</td>
<td>[379 550; 558 964]</td>
<td>1360 166 (0.098)</td>
<td>8 months</td>
<td>(240 days)</td>
<td>59 202</td>
</tr>
<tr>
<td>1993/94</td>
<td>DSI</td>
<td>391 137 (0.058)</td>
<td>[346 436; 435 839]</td>
<td>1133 731 (0.058)</td>
<td>6.5 months</td>
<td>(195 days)</td>
<td>57 590</td>
</tr>
<tr>
<td>1994/95</td>
<td>DSI</td>
<td>336 017 (0.070)</td>
<td>[289 719; 382 316]</td>
<td>973 963 (0.070)</td>
<td>6.5 months</td>
<td>(195 days)</td>
<td>54 160</td>
</tr>
<tr>
<td>1996/97</td>
<td>DSI</td>
<td>495 617 (0.091)</td>
<td>[407 434; 583 800]</td>
<td>1436 571 (0.091)</td>
<td>5.5 months</td>
<td>(165 days)</td>
<td>65 617</td>
</tr>
<tr>
<td>1997/98</td>
<td>DSI</td>
<td>339 560 (0.066)</td>
<td>[295 552; 383 568]</td>
<td>984 233 (0.066)</td>
<td>5.5 months</td>
<td>(165 days)</td>
<td>44 383</td>
</tr>
<tr>
<td>1998/99</td>
<td>DSI</td>
<td>258 264 (0.071)</td>
<td>[222 543; 293 983]</td>
<td>748 591 (0.071)</td>
<td>5.5 months</td>
<td>(165 days)</td>
<td>39 982</td>
</tr>
<tr>
<td>2000/01</td>
<td>DSI</td>
<td>314 169 (0.071)</td>
<td>[270 679; 357 660]</td>
<td>910 636 (0.071)</td>
<td>146</td>
<td></td>
<td>47 063</td>
</tr>
<tr>
<td>2001/02</td>
<td>Anchor</td>
<td>336 964 (0.115)</td>
<td>[261 088; 412 841]</td>
<td>976 708 (0.115)</td>
<td>91</td>
<td></td>
<td>53 704</td>
</tr>
<tr>
<td>2003/04</td>
<td>Enviro</td>
<td>135 053</td>
<td></td>
<td>3.03</td>
<td>129 409</td>
<td>78</td>
<td>55 077*</td>
</tr>
<tr>
<td>2004/05</td>
<td>Enviro</td>
<td>156 408</td>
<td></td>
<td>3.17</td>
<td>143 015</td>
<td>107</td>
<td>28 902</td>
</tr>
<tr>
<td>2005/06</td>
<td>Enviro</td>
<td>275 063</td>
<td></td>
<td>3.07</td>
<td>259 702</td>
<td>99</td>
<td>47 325</td>
</tr>
<tr>
<td>2006/07</td>
<td>Enviro</td>
<td>162 092</td>
<td></td>
<td>3.38</td>
<td>139 004</td>
<td>108</td>
<td>34 245</td>
</tr>
<tr>
<td>2007/08</td>
<td>Enviro</td>
<td>170 676</td>
<td></td>
<td>3.17</td>
<td>156 061</td>
<td>80</td>
<td>42 177</td>
</tr>
</tbody>
</table>

*Estimate based on previous three years – this value seems unlikely however, as it is bigger than all three previous seasons total number of permits sold?
Figure 1: Total # permits sold in relation to the season length.
Figure 2: The recreational catch in relation to # permits sold

**Recreational Catch in relation to # permits sold (since 2003)**
Figure 3: Recreational catch in relation to season length.