The CPR: Antique technology observing today’s oceans

Sonia Batten
In 1927 Alister Hardy took part in the Discovery Expedition and deployed the MK 1 CPR. His intent was:

To carry out ‘meteorology’ of the seas, as a tool for fishermen

To map the ocean distributions of the plankton

To record changes and to explain them
A CPR is a simple mechanical device that filters plankton from seawater.

It is rugged, capable of being deployed at >20 knots.

Commercial ships make an ideal deployment platform (cheap, have regular routes).
The outer body holds an internal changeable cassette that can be towed for 500 nm.
Back in the lab the length of mesh is cut into 10nm sections (a sample).

Plankton have to be examined and identified by eye. Each sample can take one to several hours to process.
>50 years of sampling in the North Atlantic
Effects of climate change, From Beaugrand et al. (2002). Science 296

<table>
<thead>
<tr>
<th>Year Period</th>
<th>Southern</th>
<th>Temperate</th>
<th>Cold-Temperate</th>
<th>Subarctic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960-1983</td>
<td><img src="image1" alt="Image" /></td>
<td><img src="image2" alt="Image" /></td>
<td><img src="image3" alt="Image" /></td>
<td><img src="image4" alt="Image" /></td>
</tr>
<tr>
<td>1984-1987</td>
<td><img src="image5" alt="Image" /></td>
<td><img src="image6" alt="Image" /></td>
<td><img src="image7" alt="Image" /></td>
<td><img src="image8" alt="Image" /></td>
</tr>
<tr>
<td>1988-1991</td>
<td><img src="image9" alt="Image" /></td>
<td><img src="image10" alt="Image" /></td>
<td><img src="image11" alt="Image" /></td>
<td><img src="image12" alt="Image" /></td>
</tr>
<tr>
<td>1992-1995</td>
<td><img src="image13" alt="Image" /></td>
<td><img src="image14" alt="Image" /></td>
<td><img src="image15" alt="Image" /></td>
<td><img src="image16" alt="Image" /></td>
</tr>
<tr>
<td>1996-1999</td>
<td><img src="image17" alt="Image" /></td>
<td><img src="image18" alt="Image" /></td>
<td><img src="image19" alt="Image" /></td>
<td><img src="image20" alt="Image" /></td>
</tr>
</tbody>
</table>

Mean number of species per assemblage indicator.
The North Pacific has not had the same level of historical plankton sampling.
In 2000 a transect was started from Prince William Sound to California. Since 2004, it's from Anchorage (Cook Inlet) to Puget Sound.
And a transect from Vancouver to Japan, supplemented by a seabird/mammal observer and CTD
Ship routes are not exactly the same from month to month so coverage is quite widespread.

All samples so far processed (2000 – 2006):

An additional ~8000 samples archived
>200,000 km of ocean sampled
Time series of biomass in offshore box (sampled 9 times each year, March to October)

Peak biomass is advanced in warm years
Calculated the latitude at which 75% of the subtropical copepod abundance had been reached v. SST at Amphitrite Point

Latitude significantly correlated with spring SST \((p<0.01)\)
Analysis of molecular variance (AMOVA) showed that a significant component of the total genetic variability was explained by differences among patches, e.g. patch 8 was genetically distinct (p <0.05) to all other patches in May/June 2005.

First population DNA study using CPR samples, Kirby et al., 2007

*Neocalanus cristatus*
Similarity in faunal boundaries between low and high trophic levels – June 2002
Now starting to model the pan-Pacific transect data examining trophic interactions:

5 years of:
Net Primary Productivity and Chla (satellite data)
Zooplankton abundance, diversity (CPR data)
Bird abundance, diversity (on board observations)

e.g. in summer, Bird density is significantly correlated with zooplankton abundance

See Mike Henry’s talk for more details and more results
At present, species level data is labour-intensive to produce (therefore expensive and time-consuming). In the future?
Whatever the eventual analysis process one strength of the survey is in having a physical sample:

- novel analyses
- ability to re-analyse
- historical record

Archiving is as important as collection!

Thank You!