Continuous Plankton Recorder Surveys of the Global Oceans

by Sonia D. Batten and Peter H. Burkill

The Continuous Plankton Recorder (CPR) is an instrument designed to be towed behind ships of opportunity and to collect plankton samples along the ship's path. The samples provide broad scale horizontal coverage of larger hard-shelled phytoplankton and more robust mesozooplankton organisms. There are currently five regional CPR surveys around the globe (Fig 1). The longest running survey, operated by the Sir Alister Hardy Foundation for Ocean Science (SAHFOS), has collected samples in the North Sea and North Atlantic in an essentially unchanged fashion since the 1940s. The Gulf of Maine survey has been conducted since 1961 by the U.S. NOAA/National Marine Fisheries Service laboratory in Narragansett, and one in the Southern Ocean has been carried out for 19 years by the Australian Antarctic Division. The North Pacific has a more recent survey; a PICES project managed by SAHFOS is now in its tenth year. The AusCPR survey that began in 2009 will sample the East Australian Current and the ocean between Tasmania and Antarctica.

Each of these surveys has demonstrated their regional value, but the community that runs these surveys now recognises a more holistic requirement. The CPR workshop convened on June 22 at the 2009 GLOBEC Open Science Meeting was intended to address the global issues that now require a global approach. This new scientific focus would bring together these surveys to examine how integration and inter-comparison might enable the global ocean to be better studied. Members from each of the five surveys were present at the workshop and gave presentations covering recent results from these surveys, the lessons learned, as well as a variety of applications and analyses of data.

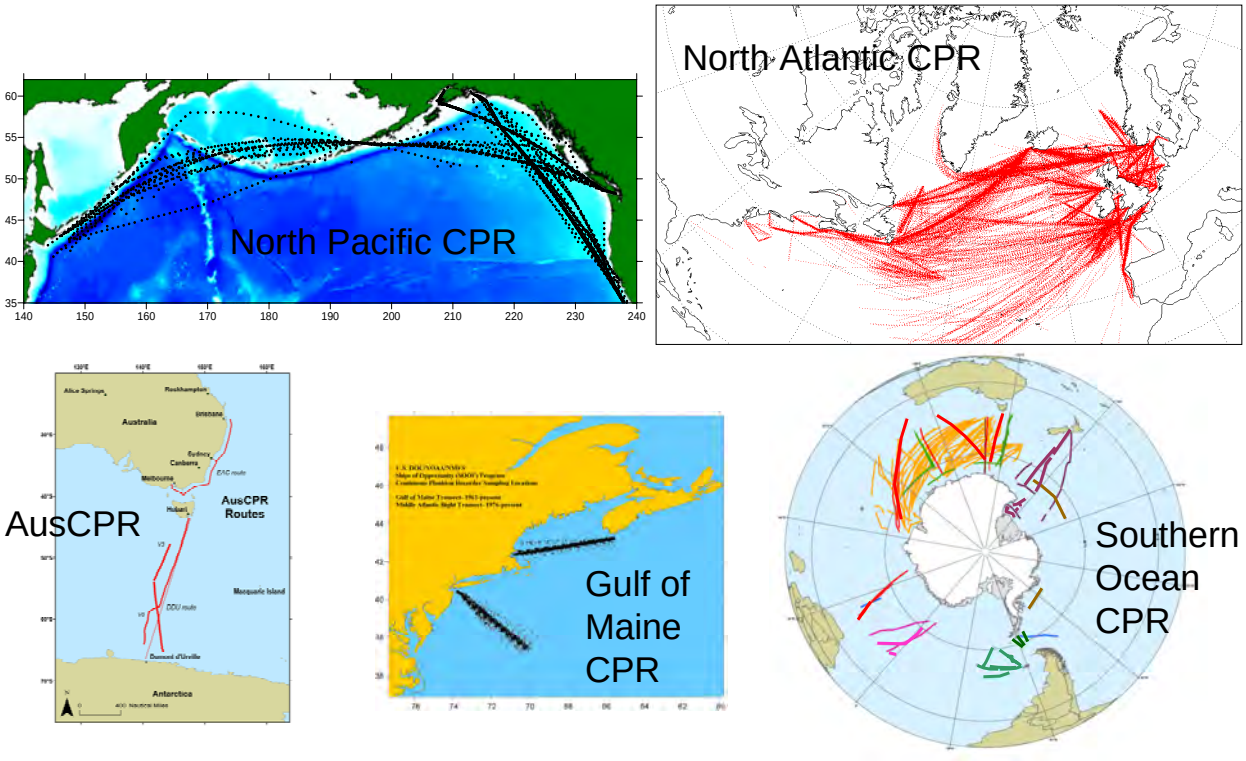

Fig. 1 Images of the five CPR surveys from the workshop presentations showing the extent of global coverage.

The workshop addressed a number of questions: Where to go in the future? What do we need to improve? What are the issues concerning standardisation or inter-calibration of methods? Discussion after the presentations was thorough and wide-ranging. There was a consensus that we need to form a 'commonwealth' of surveys, so that mutual benefit is achieved through pooling our wealth of expertise. This commonwealth would tie the surveys more closely together and enhance the sense of belonging to a community. It would also raise the visibility of the CPR approach and this could facilitate new surveys and the development of associated instrumentation in the future. For the latter costs would be lower because there would be a larger potential market visible to the instrument developer. To this end, it was agreed that a Memorandum of Understanding (MOU) would be drawn up. Although an MOU is not a legally

binding document, it would demonstrate mutual recognition and a commitment to work together to develop a global database, identify who to contact for various issues, suggest a framework for data access and a means of addressing common issues. Establishing a CPR commonwealth Project Office at SAHFOS in Plymouth was raised as a possibility and this will be looked into.

The issue of standardisation and inter-calibration received extensive discussion. It was recognised that while a standard set of methods and approaches was desirable, each survey has made particular modifications or has certain requirements, either from historic reasons or local characteristics. It would not be expected that a survey would change protocols at this point. For example, the Baltic Sea (a CPR survey is in the planning stages) has particularly small zooplankton taxa and uses 200 µm mesh to sample. The use of standard CPR mesh size of 270 µm would under-sample the plankton in this region to an unworkable degree. The Southern Ocean CPR survey counts plankton in 5 nautical mile sections by washing the plankton off the filtering mesh, rather than using a special microscope stage that keeps the plankton on the mesh and viewing 10 nautical mile sections as is the norm in the other surveys. However, many indicators of change, such as phenological shifts or changes in species distributions, are independent of the methods used to generate the data and would not prevent data integration. Wherever possible, however, we recommend that inter-calibration exercises be undertaken to allow conversion factors to be generated.

Molecular techniques are being applied more frequently to CPR material, and the cost is likely to decrease while the abilities of the technique are likely to increase. These would help with taxonomic standardisation and address key issues; *Oithona similis* is considered cosmopolitan in surface waters. How phenotypically and genotypically similar is this species throughout the world? Molecular procedures can be used to facilitate the identification of taxa not easily enumerated by conventional CPR techniques, such as gelatinous plankton and taxa that form harmful algal blooms.

There was recognition that it would be beneficial to have data available more rapidly after sampling. Following normal protocols it takes 12–18 months for full quality controlled data to be available. The Pacific CPR survey processes a portion of the samples within about 3 months, so that some indication of current conditions is possible. Other 'quick and dirty' methods were suggested but each would involve additional processing. Prioritising a proportion of the samples is something that each survey could initiate straight away without adding to the sample processing requirements.

It was agreed that SAHFOS should complete and make available a CPR survey methods handbook, which would include data management. This would greatly help new surveys to get established and provide a valuable resource for existing surveys to maintain consistency in methods.

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