APPENDIX C1: Comments from external reviewer, Lynne Purchase (Renewable Resources Assessment Group, Imperial College London, England), 10/3/05 Working Group meeting

General Comments

The purpose of this workshop was to review data and methodology available for an assessment the *Illex illecebrosus* stock in advance of the future SARC 42 meeting. This document records my observations as an outside observer on the conduct, conclusions drawn and recommendations for future work made from this working group in order to finalise the assessment and supporting data at the next subcommittee stage. Whilst noting that the data from this fishery does not lend itself to the 'standard' squid assessment methodologies, what emerged from presentation and discussion between scientists and representatives of the industry at the working group meeting was a comprehensive, coherent and rigorous synthesis of both commercial and research data in order to summarise and report on current understanding of stock status within a precautionary approach to the fishery.

Specific comments - data characteristics of fishery

Stock distribution, its range, and environmental factors affecting both were clearly defined and presented. The performance pattern within the fishery is a result of the timing and extent of the feeding migration into shelf waters and subsequent spawning migration off the shelf into deeper waters. (A spawning site for the stock was found during the May 2000 survey on the continental shelf.)

The position of the US EEZ stock (NAFO subareas 5 and 6) as a component of a larger management unit encompassing NAFO subareas 3 to 6 was apparent from landings statistics summarised over the history of the fishery since 1963. It was noted that a closure had occurred in the 2004 fishery since the TAC (24,000mt) was reached and that in order to ensure continued sustainability of the stock, adequate spawner escapement from all fishery areas is required.

Length and weight of samples from landings appear to indicate and increasing trend since 2000 when it was noted that animals were smaller and weighed less than in earlier years. It would be beneficial to obtain corresponding information on maturity from these samples in order to ascertain the presence of more than one cohort in the fishery since it is known that recruitment occurs in most months. This could be facilitated either by the training of observers and/or provision of frozen samples to NEFSC for analysis.

Specific comments - assessment models

Assessment of this stock in the context of estimation of absolute stock biomass or fishing mortality rate has not been possible; this is because the DeLury depletion-'no recruitment' type model has proven inappropriate, given observed trends in LPUE within the data from the fisheries. The autumn bottom trawl surveys do not cover the entire habitat range for the stock and so survey indices are not representative, although they do indicate a relative index of spawner escapement. Accordingly, per-recruit models and supporting analyses have and continue

to be developed in order to provide biological reference points in order to minimise recruitment overfishing and to ensure sufficient escapement. Key to this development are egg- and yield-per-recruit models in which non-spawning and spawning natural mortality is accounted for explicitly.

This represents a new approach compared to the assumption of constant natural mortality for animals of all ages adopted in most other cephalopod assessments in which fishing takes place on a spawning population. Whilst the 'trigger' for onset of spawning maturity remains largely unknown, this approach reflects the observation that within semelparous species, such as *Illex*, it is the older individuals that are most likely to become mature, to spawn and then die. Far from being constant, it is much more the case that natural mortality increases over the range of ages at which spawning occurs.

The age-based cohort model developed for estimating spawning mortality (maturation-mortality model) and application of these mortalities within per-recruit models (which are highly sensitive to assumptions about natural mortality) for *Illex illecobrosus* was presented comprehensively with detailed supporting analysis.

Whilst it was noted that this model has also been peer reviewed prior to publication, in the context of testing its overall robustness and general applicability, it is worth underlining the caveat that this model has been developed on the basis of age and maturity data from one survey (May, 2000). Analyses from other squid fisheries indicate that there is often significant intra- and interannual variation in growth and maturation rates. As indicated in the course of the workgroup meeting, the effect of this on the model needs further study and, in this context, it may be worth seeking out data
(*ie.,.*biological data in which age has been recorded in addition to the more usual sex, maturity, length and weight) from other, similar cephalopod fisheries. This would extend testing of this model in a cost-effective and timely manner.

The estimates of non- and spawning mortalities have been used within the 'in-season' model developed to estimate initial abundance and total fishing mortality from real-time data. Again, it appears that the use of growth and age data from the May survey is a major source of uncertainty in this method. It was noted that current simulation analyses of this 'in-season' stock assessment model should be extended to assess its performance and to highlight the need for any additional data.

A better understanding of trends in 'in-season' LPUE are important if LPUE is to be used in future monitoring of the fishery as an indicator of abundance of squid within a given fishing area. It was noted that GLM analysis undertaken to standardise effort data within the model required further development and investigation; problematic in this case was the differing behaviour of the two vessel types in terms of trip duration and attributing landings to specific dates; it is possible that repeating this analysis on a time-scale of two- rather than one week periods as main effects may improve the standardisation process in terms of smoothing the data. It is worth noting that effort data may not be smooth over time.