BRIEF COMMENTS ON THE SIMULATION STUDY MADE BY PROF. BUTTERWORTH ON KRILL FISHING BY AN INDIVIDUAL JAPANESE TRAWLER

T. Ichii and Y. Endo

Abstract

In this paper, three essential questions are raised concerning the simulation study of the Japanese krill fishery carried out by Butterworth (1988). Firstly, the simulation study used krill distribution parameter values based on the FIBEX results, whereas Japanese vessels often operate on layers which are much larger than the swarms detected during FIBEX surveys. Since very little searching time is spent on layers, the utility of searching time data appears doubtful. Secondly, the utility of indices based on the sum of primary and secondary searching times (PST+SST) is also doubtful because SSTs are markedly dependent upon the type of products being produced, and the demand for each product varies substantially from one season to the next. Finally, attention is drawn to the unrealistic behaviour of the simulation model with respect to the values used for the minimum catch rate per overall elapsed time. It is suggested that an improvement in our knowledge of krill distribution is necessary before the routine implementation of searching time data collection is considered.

Résumé

Dans ce document, trois questions essentielles sont soulevées concernant l'étude par simulation de la pêcherie japonaise de krill effectuée par Butterworth (1988). Tout d'abord, l'étude par simulation utilise les valeurs des paramètres de distribution du krill basées sur les résultats FIBEX alors que, souvent, les navires japonais opèrent en couches qui sont beaucoup plus étendues que les essaims détectés pendant les campagnes d'évaluation FIBEX. Vu le temps de recherche très réduit passé sur les couches, l'utilité de données de temps de recherche semble discutable. En second lieu, l'utilité d'indices basés sur la somme des temps de recherche primaire et secondaire (PST+SST) est également douteuse car les SST dépendent nettement du type de produit en cours de production, et la demande pour chaque produit varie considérablement d'une saison sur l'autre. Enfin, le comportement irréaliste du modèle de simulation a été souligné, en ce qui concerne les valeurs utilisées pour le taux minimum de capture par temps total écoulé. Il est recommandé d'approfondir notre connaissance sur la distribution du krill, avant d'établir la collecte régulière des données sur le temps de recherche.

Резюме

Нами были поставленны три существенных вопроса, относящиеся к исследованию крилевого промысла Японии методом математического моделирования, проведенному Батеруортом (1988 г.). Во-первых, при исследовании

методом математического моделирования использовались величины параметров распределения криля, основанные на результатах Программы FIBEX, в то время как японские суда часто ведут промысел в слоях, размер которых намного превышает размер скоплений, обнаруженных в ходе проведения съемок Программы FIBEX. В связи с тем, что поиск при промысле в слоях занимает очень мало времени, полезность данных по времени поиска подвергается сомнению. Во-вторых, мы сомневаемся в полезности показателей, полученных на основе суммы величин времени первичного и вторичного поиска (PST+SST), так как значения SST в значительной мере зависят от вида продукцииж при этом спрос на каждый вид продукции колеблется в значительной степени из сезона в сезон. В заключение, нами было указано на ненадежное поведение модели в отношении минимальной интенсивности лова за общее время промысла. Было предложено расширить знания о распределении криля до начала регулярного сбора данных по времени поиска.

Resumen

En este documento se plantea tres cuestiones esenciales en relación con el estudio simulado japonés de pesca de krill llevado a cabo por Butterworth (1988). Primeramente, el estudio simulado utilizó valores de parámetros de distribución de krill basados en los resultados de FIBEX, mientras los buques japoneses operan a menudo en capas las cuales son mucho más grande que los cardúmenes detectados durante los estudios FIBEX. Debido a que muy poco tiempo de búsqueda se emplea en capas, la utilidad de los datos de tiempo de búsqueda parece dudosa. Segundamente, la utilidad de los índices basados en en la suma de tiempos de búsqueda primarios y secundarios (PST+SST) es también dudosa porque SSTs son notablemente dependientes en el tipo de productos que son producidos y la demanda para cada producto varía substancialmente de una temporada a otra. Finalmente, se llama la atención al comportamiento ilusorio del modelo de simulación con respecto a los valores utilizados para el índice mínimo de capturas por tiempo transcurrido global. Se sugiere que un perfeccionamiento en nuestro conocimiento de la distribución de krill es necesario antes de considerar la ejecución rutinaria de recopilación de datos de tiempo de búsqueda.

Butterworth (1988) made a thorough examination of the usefulness of catch-per-unit-effort (CPUE) data from the Japanese fishery, and suggested that the collection of within-concentration searching times might improve the utility of the data. We commend his efforts in making the simulation as meaningful as possible by using most of the information available at present. His model, however, presents several essential questions and we do not think that CPUEs from the Japanese krill fishery are useful in estimating the change of within-concentration krill abundance even if searching times could be obtained. We present the reasons in the following paragraphs.

(i) As he pointed out, the krill distribution model is based on parameters determined primarily from FIBEX surveys which did not cover the fishing grounds of Japanese trawlers. This causes a major inconsistency in addition to the FISHT problem (in reality, haul times are four to five times greater than in the model). In the peak season, krill usually occur in the form of layers which may be several kilometres in length, or in numerous large swarms (100 to 1 000 m wide) in harvestable concentrations so that primary searching time is usually considered to be nil. So while newly-caught krill are being processed, trawlers move around to kill time, thus finding many swarms. When the processing is about to finish, trawlers begin launching their nets aiming at the swarm(s) which have just been found. When no swarm is found in the vicinity of trawlers at that time, they return to the swarm(s) which were previously detected and marked on the chart. Searching times may not, therefore, have been suggested as being useful had krill distribution parameters been obtained from surveys covering fishing grounds.

(ii) Prof. Butterworth concluded that the best index of krill abundance is TC/TFISHT/PST. Since it is not practical to collect PST (primary searching time), he suggested that TC/TFISHT/(PST+SST) might be useful, but its effectiveness is slightly less than that of the best index. We are, however, doubtful whether (PST+SST) can be an alternative to PST because SST (secondary searching time) differs according to the type of products being produced (such as boiled and frozen, fresh and frozen, peeled krill and meal). Moreover, the demand for each product can be seen to change from year to year. We do, therefore, agree with him that before considering the routine implementation of collection of searching times, small-scale experiments to test the practicality of collection of this data, as well as further tests of the model to determine the robustness of PST-based indices to errors in recording should be carried out (Butterworth, 1988, p. 43).

(iii) In Butterworth's model the decision whether or not to leave a concentration is made on the basis of CRmin (the minimum catch rate per overall elapsed time). Over a range of 1 to 3 t/h for CRmin, his model shows some inconsistency in that the lower the CRmin, the more a trawler can catch during the fortnightly period, leading to the extreme of remaining in the concentration first found rather than moving between concentrations (Butterworth, 1988, p. 42 and Figure 8i). He suggested that there is a need to take into account temporal variability of distribution parameters and krill quality considerations in order to cover this weakness. We consider, however, that this weakness was caused by an underestimation of variability in within-concentration krill abundance and the searching ability of trawlers. In the model, within-concentration krill distribution parameters are assumed to be more or less the same from concentration to concentration and/or the searching abilities of trawlers are assumed to be not high, which results in the extreme of remaining in the concentrations first found, and makes movement between concentrations a waste of time. In reality, there seem to be a few harvestable concentrations among many unharvestable ones. Also if trawlers set the CRmin at an unreasonably low level, they would obtain a poor total catch. Actually, trawlers set the

CRmin criterion 2 to 2.5 t/h (Butterworth, 1988, p. 22) and manage to detect concentrations (based on information such as the historical distribution of harvestable concentrations) which meet that CRmin criterion. This reinforces the argument that the krill distribution model needs to be improved.

Collecting information on searching times is a burden for fishermen and its usefulness is still doubtful at this stage. Instead, as he strongly suggested, we first need to improve our krill distribution model.

REFERENCE

BUTTERWORTH, D.S. 1988. A simulation study of krill fishing by an individual Japanese trawler. *Selected Scientific Papers, 1988 - Part 1. SC-CAMLR-SSP/5*: 1-108.