論 文 の 内 容 の 要 旨

論文題目　A study on the population viability of small cetaceans in coastal waters
（沿岸性小型鯨類の個体群存続可能性に関する研究）

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Chapter I　Introduction

Cetaceans inhabiting coastal waters can be critically affected by the impacts of human activities such as bycatch (i.e., incidental capture during fishing activities), ship strikes, and the degradation and reduction of habitats. The target species of cetaceans in this study are narrow-ridged finless porpoise (*Neophocaena asiaeorientalis*) and Indo-Pacific bottlenose dolphin (*Tursiops aduncus*). Risk evaluations of these two cetaceans have been conducted at a species level. Although genetically independent populations are identified, no evaluation has been done at a population level due to the lack of information on population dynamics. For conservation of the populations that may be endangered, assessment under uncertainty should be made. The purpose of this study is to attempt the prediction of future population change and the evaluation of extinction risk by using available data of other species and populations, and considering the uncertainty of the data.

Chapter II　Population viability analysis for the narrow-ridged finless porpoises

In section II-1, the annual intrinsic rate of natural increase was estimated by using an age-classified matrix model for expressing the population dynamics. Because there is no information on survival for the porpoises, age-specific survival rates were estimated by randomly sampling from the estimates for other four cetaceans with the similar age at first reproduction (AFR). The annual intrinsic rate of natural increase was estimated to be 1.048/year (2.5–97.5 percentile: 1.021–1.063/year) for the AFR of 6 years.

In section II-2, the impact of human-induced mortality for the Inland Sea population was evaluated. The rapid reduction in population size was reported during the period between 1978 and 2000 for the population. The annual human-induced mortality rate was estimated to be 10%/year (2.5–97.5 percentile: 6.3–12.8%/year) by a Bayesian analysis. This study indicated that the population size reduction after three generations (50 years) would overly exceed 80% when the rate remains in future. It was therefore suggested that the population meets the critically endangered (CR) category according to Criter ion A4 in the IUCN Red List.

In section II-3, the impact of bycatch mortality for the Ariake Sound and Tachibana Bay population was evaluated. Bycatch seems to be a major threat for the population, and the annual bycatch mortality rate in 2007 and 2008 was reported to be 8.1%/year. When the bycatch mortality remains at the reported level, the population size would continue to decrease over the next 100 years. The predictions indicated that the population size reduction after three generations would exceed 30% even if the bycatch mortality rate remains at a minimum estimate of 5.3%/year. It was therefore suggested that the population meets at least the vulnerable (VU) category according to Criterion A4. The effect of age dependence in bycatch was additionally evaluated. The predicted extinction risk was sensitive to target age classes with higher bycatch mortality rates. In particular, bycatches of adults approaching AFR had the pessimistic effect on population viability. It was suggested that the age composition of bycaught porpoises should be considered when evaluating the possible impacts of bycatch mortality.

In section II-4, a versatile method was proposed for evaluating the future risks of various narrow-ridged finless porpoise populations. Abundance estimation has been conducted for all the recognized populations around Japanese waters and then it seems possible to apply the risk evaluation method developed in the previous sections to the populations. A simple procedure was shown for predicting the population size reduction after three generations and the probability of extinction within 100 years from the estimates of the annual human-induced mortality rate and the abundance.

Chapter III Population viability analysis for the Indo-pacific bottlenose dolphins

Photo-identification survey has been carried out every year since 1994 for the dolphin population inhabiting the waters off Amakusa-Shimoshima Island. In section III-1, the survival rates for four groups of all the identified individuals, males, mature females and immature individuals were estimated from the photo-identification data during the period between 2000 and 2012 by the Cormack-Jolly-Seber (CJS) model, which is a kind of mark-recapture approaches. In section III-2, the change in population size was predicted by using the survival rate estimates. The population size would dramatically decrease when the reported mortality rate is attributed to bycatches of calves <2 years. This study indicated that the population size reduction after three generations (60 years) would overly exceed 80%. It was therefore suggested that the population meets the critically endangered (CR) category according to Criterion A4 in the IUCN Red List.

Chapter IV Discussion

This study developed a method for a quantitative analysis on future change in population size. The analysis enabled the risk evaluation at a population level for the cetaceans threatened by human-induced impacts. It also revealed a significant factor which is sensitive to the risk evaluations. This study contributes to highlight that just a little effort for reducing the human-induced mortality can be effective in maintaining persistence of the cetacean populations. The risk evaluated in this study may be underestimated because only a part of human-induced impacts were incorporated. We should point out that the incorporation of other factors will result in more pessimistic predictions. Stochastic variations of life history parameters were not completely incorporated. Therefore, it should be noted that the populations can dramatically decrease by the impact of a catastrophic event such as a great amount of stranding and a spread of endemic disease. As a future work to improve the reliability of analysis, it is desired to update the knowledge on population size, life history parameters, human-induced impacts and their uncertainties. Adaptive managements by repeating the acquisition of latest information and the risk evaluation are expected to act as a stepping stone to conservation of the cetacean populations whose biological information is limited.