生態機能を考慮した南極ロス海における海鳥類の個体数と生物量の推定

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An estmation of seabird abundance and biomass in the Ross Sea based on ecological functions

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The Ross Sea has the most extensive continental shelf in the Antarctic and holds abundant krills, fishes as well as top predators (cetaceans, pinnipeds, birds and large fishes: Smith et al. 2007). As environmental changes such as freshening and increased temperature in the shelf water and southward shift of oceanic fronts have been reported over recent decades, the impacts on the upper trophic revels are concerned (Jacobs et al. 2002; Turner et al. 2009; Rintoul et al. 2012). For assessing the impacts of environmental changes and/or fisheries on the Southern Ocean ecosystem, several ecosystem models have been developped, in which abundance and biomass of the components are the fundamental parameters. However, the seabird abundance and biomass (one of the major component of marine top predators) have not been reported since 1980s when a broad range of oceanographic survey was conducted (Ainley et al. 1984). Therefore this study aimed to estimate seabird abundance and biomass in the Ross Sea based on both taxnomical and ecological functional groups, by using an updated seabird count data with oceanographic survey (Naganobu et al. 2010). The field study was conducted in the Ross Sea (south of 60^{o}S) from December 2004 to February 2005 on board FRV Kaiyo-maru. Bird species, number, behaviour and flight directions were recorded for 15min of every hour that the ship cruised on track lines, within a 300m bow-to-beam arc. We applied the bird flux correction (Spear et al. 1992; Spear and Ainley 1997) by using flight direction and estimated flight speed, after elimination of ship following birds. All seabirds were categorised into 7 ecological functional groups, then the abundance was converted into biomass. During the study period, 391 data set was obtained from 6 track lines (Fig. 1). Fulmarine petrels, pursuite divers and scavenger/chasers were aggregated around shelf break. Also, fulmarine petrels, diving shearwaters and scavenger/chasers were aggregated near sea ice area north of the shelf. On the other hand, only few birds were observed inside the shelf. With these results, seabird abundance and biomass will be estimated based on ecological functions using a statistical model. Further in this study, predator-prey interactions and inter-specific competition will be discussed from the aspects of geography and marine environment, comparing with prey (Taki et al. 2008) and other top predators (Murase et al. in press) distribution.

ロス海は南極海で最大の大陸棚面積を持ち、オキアミ類や魚類の豊富な海域であるとともに、鯨類、鰭脚類、海鳥類、大型魚類などの高次捕食動物が多数生息する(Smith et al. 2007)。近年同海域では、南極底層水の淡水化・温度上昇、フロント位置の南下など急激な環境変化が認められ、それによる海洋生態系への影響が懸念されている(Jacobs et al. 2002; Turner et al. 2009; Rintoul et al. 2012)。海洋生態系の変化を把握したり、生物資源の持続的利用に資するため、様々な生態系モデルが開発されている。このようなモデルを構築する上で、個体数や生物量は基本となるパラメータである。しかしロス海の主要な高次捕食者の 1 つである海鳥類の個体数や生物量は、1980 年代に行われた総合調査以来、報告されていない(Ainley et al. 1984)。そこで本研究では、2004 年から 2005 年にかけて同海域で行われた最新の海鳥目視・海洋観測調査データ(Naganobu et al. 2010)を用いて、種毎・生態機能毎に海鳥の個体数と生物量を推定し、またその地域特性を明らかにすることを目標とした。2004 年 12 月から 2005 年 2 月にかけて、南緯 60 度以南の海域で、水産庁漁業調査船開洋丸船上から、毎正時に 15 分間、船首から正横までの 90^{o}、300m を観測範囲として、種、数、行動、飛翔方向を記録した。同一経度線上を直線的に走っている時のデータのみを用いて、船付き個体を除外した上で、飛翔方位と飛翔スピードによるカウント数補正(Bird Flux Analysis: Spear et al. 1992; Spear and Ainley 1997)を行った。観察された海鳥を 7 個の生態機能上のグループに分類し、それぞれのグループ毎に平均体重を計算して、重量換算した。調査中、6 本のトラックライン上の 391 地点のデータを得た(Fig. 1)。ロス海の陸棚斜面では、フルマカモメ類、追跡型潜水者、腐肉食/空中追跡者などの分布が集中していた。また陸棚より北の季節海氷域では、フルマカモメ類、潜水性ミズナギドリ類、腐肉食/空中追跡者などの分布が集中していた。一方で、大陸棚上では一部の種を除き、ほとんど鳥が観察されなかった。これらの結果をもとに、緯度とトラックラインを説明変数としたモデルを構築して、海上での生態機能群毎の海鳥の生物量推定を行う。さらに、同時期に測定された餌

生物の分布(Taki et al. 2008)、鯨類の分布(Murase et al. in press)と対照させ、同海域における被食－捕食や種間競争など、海洋生態系における種間関係の空間・環境特性について考察する。

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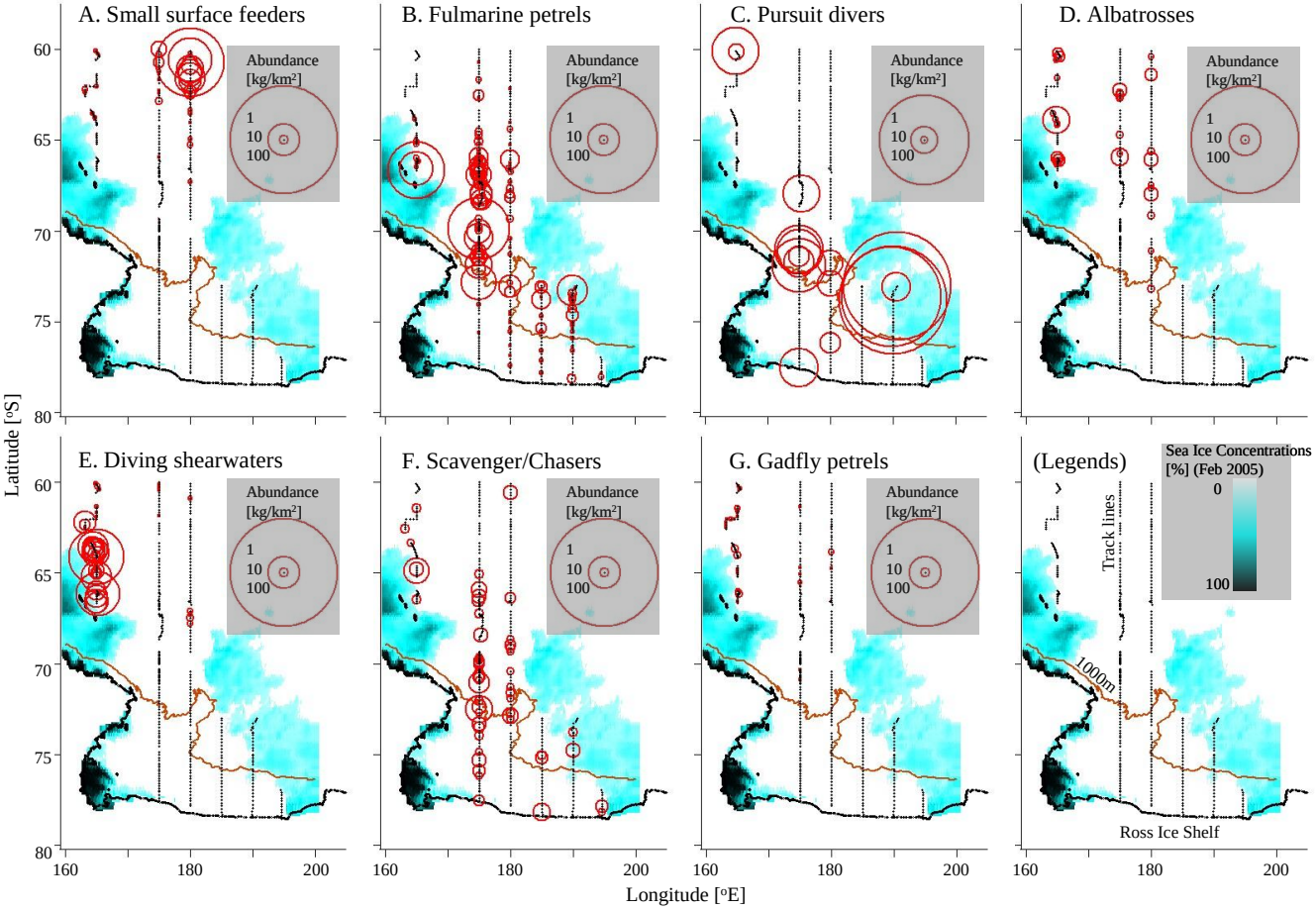

Figure 1. Distribution pattern of 7 groups of seabirds in the Ross Sea, in 2004-2005 austral sumer saeson. Distribution of small surface feeders (A: prions and storm petrels), fulmarine petrels (B: snow, Antarctic and cape petrels, and southern fulmar), pursuit divers (C: penguins and diving petrels), albatrosses (D), diving shearwaters (E: short-tailed and sooty shearwaters), scavengers/chasers (F: skuas and giant petrels), and gadfly petrels (G: mottled and white-headed petrels) are shown in each panel.