南西部オホーツク海沿岸の海跡湖能取湖におけるピコ・ナノプランクトン群集の季節変化

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Seasonal variations in abundance of pico- and nano-plankton in Lagoon Notoro-ko adjacent to the southwestern Okhotsk Sea

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Lagoon Notoro-ko is connected to the Okhotsk Sea by a manmade channel and the fishery resources in this lagoon are abundant. It is considered that higher productivity of lower trophic organisms such as plankton contributes to the higher fishery resources in the lagoon. Microbial food web consists of “Microbes” inludes all single-celled organisms: autotrophic and hetertorophic prokaryotes (bacteria and cyanobacteria), and autotrophic and heterotrophic eukaryotes (algae and phagotrophic protists). In general, the microbial food web functions to enhance efficiency of material cycling in the aquatic ecosystems, and therefore contributes to stability of the ecosystems. However, there is little information on microbial food web in Lagoon Notoro-ko. The present study aimed to clarify seasonal variation in abundance of pico- and nano-plankton in Lagoon Notoro-Ko. Sampling was carried out once or twice a month from 30 June–10 December 2014 at a sampling site, the deepest part of Lagoon Notoro-Ko (about 20 m depth). Temperature and salinity is measured using a CTD. Water samples were collected by a Van Dorn water sampler from five depth layers (0, 5, 10, 15, and 18 m). Dissolved oxygen concentration of the each water sample was measured with the Winkler method. Water samles for observation of pico- and nano-plankton were fixed by 10% glutaraldehyde (final concentration of about 1%). Subsamples for observation of prokaryotes were stained with DAPI and filtered on 0.2-µm black polycarbonate membranes under low vacuum. Subsamples for observations of eukaryotes were stained first with DAPI, treated with proflavine and filtered on 0.8-µm polycarbonate filters. Filters were mounted on glass slides. In prokaryote samples, bacteria (BAC) and cyanobacteria (Cyano) were observed and counted under an epifluorescence microscope. In eukaryote samples, autotrophic pico-eukaryotes (APE), heterotrophic pico-eukaryotes (HPE), autotrophic nano-eukaryotes (ANE) and heterotrophic nano-eukaryotes (HNE) were observed by their size and presence/ absence of chloroplast, and counted under an epifluorescence microscope. Bacteria abundances druing experimental periods have appeared in a range of 39,000–5,175,000 cells/ml, Cyano abundance were 5,142–245,142 cells/ml, APE were 2,228–40,799 cells/ml, ANE were 2,142–32,914 cells/ml, HPE were 171–7,885 cells/ml, and HNE were 171–3,085 cells/ml. Highest abundances of all pico- and nano-plankton were found in the samples taken from 30 June–8 August. On the other hand, lowest abundances were found from 28 Octber–10 December except for HPE and HNE. The positive higher correlations between producers in pico- and nano-plankton (BAC, Cyano, APE and ANE) and water temperature. There were higher positive correlations between consumers (HPE and HNE) and producers. Our results suggest that abundances of pico- and nano-producers were strongly influenced by water temperature in Lagoon Notoro-ko, and that seasonal changes in the pico- and nano-consumer abundances could be explained by those in producer abundances in Lagoon Notoro-ko.

能取湖は、一つの湖口でオホーツク海に隣接する漁業資源が豊な海跡湖である。この豊富な漁業資源は、プランクトンをはじめとする低次生産層の生物に支えられている。微生物食物網は、生態系内を流れる物質循環の効率を向上させる機能を持ち、生態系の安定化に役立っていると考えられている。しかし、能取湖における微生物食物網に関する知見は著しく乏しい。そこで、本研究は微生物食物網を構成するピコ・ナノプランクトンの季節変化を明らかにすることを目的とした。調査は、能取湖の最深部（約 21 m）に設けられた定点において 2014 年 6 月 30 日～12 月 10 日に月 2 回の頻度で行った。水温および塩分は CTD を用いて観測した。また、バン・ドーン採水器を用いて各層（水深 0、5、10、15、および 18 m 層）から海水を採取し、プランクトン観察および溶存酸素濃度測定用に供した。各層における溶存酸素濃度は採水試料をウィンクラー法により測定した。プランクトン試料は、10%グルタールアルデヒド溶液を用いて最終濃度約 1%になるように添加した。原核生物計数用サンプルは、DAPI を用いて核染色した後、0.2 µmのフィルターで吸引濾過した。真核生物計数用サンプルは DAPI とプロフラビンを用いて核とタンパク質を二重染色した後、0.8 µmのフィルターで吸引濾過した。それぞれのフィルターはプレパラートに封入し、蛍光顕微鏡による観察に供した。本研究では、原核生物を Bacteria（BAC）および

Cyanobacteria（Cyano）に分類し、真核生物については、体サイズと葉緑体の有無により Autotrophic pico-eukaryote（APE）、Autotrophic nano-eukaryote（ANE）、Heterotrophic pico-eukaryote（HPE）、Heterotrophic nano-eukaryote（HNE）に分類し、それぞれ計数した。調査期間中のピコ・ナノプランクトンの現存量は、BAC が 39,000–5,175,000 cells/ml、Cyano が 5,142–245,142 cells/ml、APE が 2,228–40,799 cells/ml、ANE が 2,142–32,914 cells/ml、HPE が 171–7885 cells/ml、HNE が 171–3,085 cells/ml の範囲で出現した。最大値を示した採集日はいずれの分類群も 6 月 30 日–8 月 8 日であった。一方、最小値は 10 月 28 日–12 月 10 日に示す分類群が多かった。生産者（BAC、Cyano、APE、ANE）は、水温と高い正の相関（r = 0.52–0.64）。消費者（HPE、HNE）は生産者と優意な正の相関が見られた。調査期間中の能取湖のピコ・ナノプランクトン群集における生産者は水温の影響を強く受け、消費者は生産者の影響を強く受けて現存量を変化させたと推察された。