論文の内容の要旨

論文題目：

Spatial changes in diversity and community structure of harpacticoid copepods around the Kuril and Ryukyu Trenches, north-west Pacific Ocean

（千島海溝および琉球海溝周辺域におけるソコミジンコ類の多様性・群集構造の空間変異）

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Deep-sea habitats cover about two-thirds of the earth's surface. The understanding of spatial patterns of biodiversity and community structure and the processes that regulate them is the fundamental goal of deep-sea ecology. One of the best documented large-scale diversity patterns is that with water depth. Many studies have reported parabolic pattern of diversity with water depth for many taxa. Most studies, however, have focused only on bathyal and abyssal depths, while studies extending into the hadal zone (trench) are limited, due to their remoteness and difficulties to access. In addition, the biodiversity and community structure of meiofauna around trenches were still unknown although meiofauna is one of important components

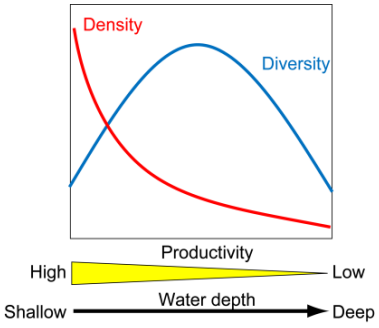

Fig. 1. General relationship between water depth and diversity. In shallower regions, where a high organic matter flux leads to high population density, strong biological interactions depress diversity. In contrast, in deeper regions, where organic matter is scarce, animal density is so low that the probability of extinction is high, again leading to low diversity.

of deep-sea ecosystem. In this thesis, I analyzed harpacticoid diversity and community structure of harpacticoids around two trench regions around Japan: the Kuril Trench, which is located below a highly productive boreal region, and the Ryukyu Trench, which underlies an oligotrophic subtropical ocean. Furthermore, I investigated the relationship between harpacticoid assemblages and abiotic environments. On 11th May 2011, the 2011 off the Pacific coast of Tohoku Earthquake occurred. I also evaluated the effect of catastrophic disturbance caused by the mega earthquake on the deep-sea meiofaunal assemblage on the landward slope of the Japan Trench.

In the Chapter 2, I provided the harpacticoid diversities around the Kuril and Ryukyu Trenches at the genus level. In the Kuril region, harpacticoid diversity indicated unimodal patterns with water depth, with peaks appearing at intermediate depths, while it monotonously decreased along the water depth in the Ryukyu region. These results would reflect the difference in food availability between two regions, that is, in the Kuril region, where productivity is high, the entirety of the general unimodal pattern of diversity along the water depth appeared, and in the Ryukyu region, where productivity is low, only the deeper side of the general pattern appeared. These findings also suggest that the general relationship between water depth and diversity, which has been described for macrofauna and

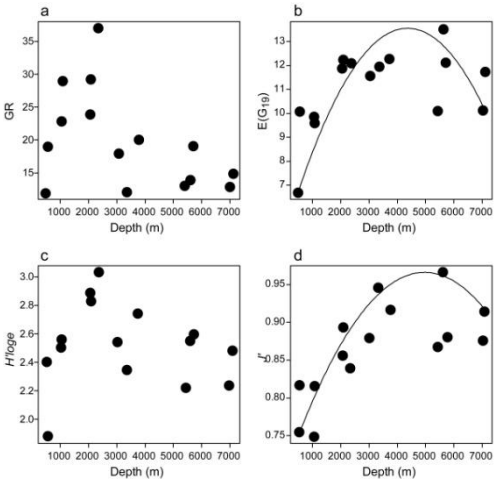

Fig. 2. Bathymetric patterns of harpacticoid diversity in the Kuril region: (a) the number of genera (GR); (b) the expected number of genera ($E(G_{19})$); (c) the Shannon–Wiener index ($H'\log e$); and (d) evenness (J').

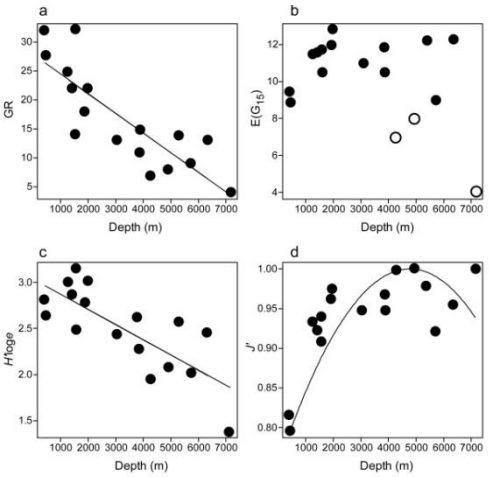

Fig. 3. Bathymetric patterns of harpacticoid diversity in the Ryukyu region: (a) the number of genera (GR); (b) the expected number of genera ($E(G_{15})$); (c) the Shannon–Wiener index ($H'\log e$); and (d) evenness (J'). Open circles indicated the stations where the number of identified adults was less than 10.

megafauna, can be extended to meiofauna at all depth ranges. In addition, food availability would affect the harpacticoid diversity in the Ryukyu region, while a multiplicity of factors appeared to regulate it in the Kuril region.

In the Chapter 3, I investigated the community structures of harpacticoids around the Kuril and Ryukyu Trenches at the genus level. Sampling strategy in this study, with stations ranging from bathyal to hadal depths, enabled me to analyze bathymetric trends among harpacticoid assemblages in detail down to hadal depths. In the both regions, gradual changes of the harpacticoid community compositions from batyal to hadal depths were detected for the first time. This finding suggests that the hadal community structure was continuous from the adjacent trench slopes in both regions. Water depth, or certain factors associated with water depth, would affect harpacticoid community structure in the both regions. A large difference was found between the trench floor and the adjacent environments in the Kuril region, while not in the Ryukyu region. This discrepancy would be attributed to the difference in the geological history of each trench, a certain barrier and topographical features in the Kuril region. When the harapcticoid community structures on the same topographic settings were compared between the Kuril and Ryukyu regions, the dissimilarities were increased with water depth. This result may be attributed to the Izu-Ogasawara arc and trench, which are located between the two regions and may prevent the expansion of harpacticoid distribution ranges from both trenches.

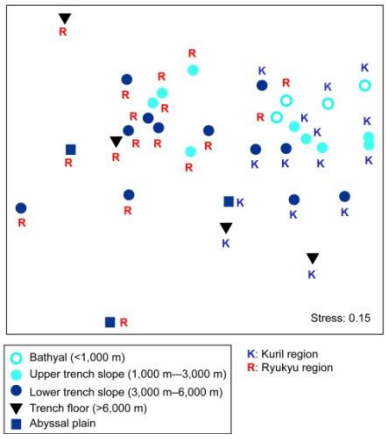

Fig. 4. The nMDS ordination based on the genus composition in the Kuril and Ryukyu regions.

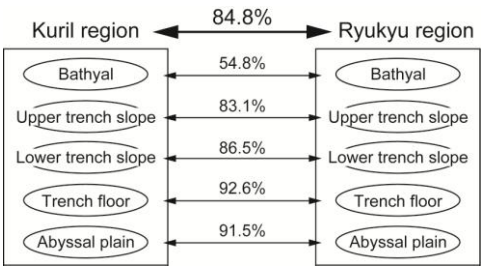

Fig. 5. Dissimilarity values in harpacticoid community structures between the Kuril and Ryukyu regions.

In the Chapter 4, I examined whether the analyses at the family level could

reveal the spatial patterns in diversity and community structure of harpacticoid copepods around the Kuril and Ryukyu Trenches with a same accuracy as those at the genus level. Virtually the same results of the bathymetric diversity pattern could be obtained by analyses at the genus and family levels, although some differences were found. The results of this study suggest that the family-level analyses are sufficient to illustrate the bathymetric pattern in harpacticoid diversity from bathyal to hadal depths. However, the different patterns were found in comparing community structure within the same regions and between the different regions, suggesting that the analyses at the family level are not sufficient to examine the spatial pattern of community structure within and between regions. In addition, the genus composition shifts were detected within some families.

In the Chapter 5, I examined the meiofaunal assemblages on the landward slope of the Japan Trench (120–5,600 m water depth) 4.5 months after the 2011 off the Pacific coast of Tohoku Earthquake and compared with those before the mega earthquake. Unusual vertical distribution of meiofauna in the sediments was found only after the earthquake, while differences were not detected in meiofaunal density and its bathymetric pattern before and after the mega earthquake. This unusual vertical distribution seemed not to be attributable to the effect of turbidite and the change of organic matter supply.

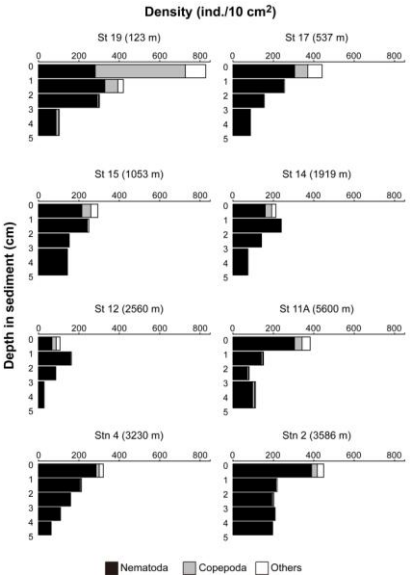

Fig. 6. Vertical profiles of the meiofaunal density on the landward slope of the Japan Trench off Sanriku in the summer of 2011.

The static and dynamic states of the deep-sea ecosystem revealed through the present study would potentially lead us to understand the generation and maintenance mechanism of the deep-sea biodiversity.

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