

Supplementary material for
Seasonal dynamics of nitrogen fixation and diazotrophs community in the
temperate coastal region of northwestern North Pacific

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Introduction

The supplementary material for this manuscript consists of five supplementary figures. The figure captions including methodology are given below.

Fig. S1. Sampling locations for each cruise in the northwestern North Pacific Ocean. Background contours and vectors denote the sea surface temperature (SST) and geostrophic current field during the cruise period. The SST dataset was the daily MODIS level-3 SST with 4-km resolution, and was obtained from the NASA Goddard Space Flight Center (<http://oceancolor.gsfc.nasa.gov/>). Weekly geostrophic current field data with $1/3^\circ$ for approximately the same period as the cruise were obtained from the AVISO data server (<ftp.aviso.oceanobs.com>). The gray line during the KK-13-6 cruise indicates the track of Typhoon Man-yi. The flow volume of the Tsushima Water Current is recognized to be largest in summer and makes an anticyclonic eddy on the Pacific side, and is smallest in winter when it does not form the eddy structure (Conlon, 1982; Nishida et al., 2003). During the KT-12-20, KT-12-27, KK-13-1, and KK-13-6 cruises, the anticyclonic eddy was observed on the Pacific side, and the water flowed

southward along the coast. The Tsugaru Warm water during the KT-13-2 cruise immediately flowed along the coast after it passed the Tsugaru Strait. Although the southward current subsided at the observation lines during the KT-13-2 cruise, all the water at the surface belonged to the Tsushima Water Current. During the KS-14-2 cruise, the flow from the Tsugaru Strait was weak, and water with a temperature less than 3°C spread to the south of the OT transect line, suggesting that the OT transect line was influenced by the Oyashio water. During the KK-13-6 cruise, a low SST belt was observed from south to north on the Pacific side. This belt almost corresponded with the typhoon track, and thus was caused by the passage of the typhoon.

Fig. S2. Surface spatial distributions of (a and b) nitrate concentration [μM] and (c and d) the nitrogen fixation rate [$\text{nmolN L}^{-1} \text{d}^{-1}$] along the OT and ON transect lines for each cruise.

Fig. S3. Vertical profiles of salinity along the OT transect line during the KK-13-6 cruise.

Fig. S4. Maximum likelihood phylogenetic trees of *nifH* amino acid sequences in Cluster I. The recovered sequences in this study are in boldface type. The boldface numbers in parentheses are the number of retrieved clones for each cruise and station. Bootstrap values (>50%) are indicated at branch points. Sequences with an asterisk have >97% similarity at the amino acid level with terrestrial diazotrophs, and with sequences derived from soil, mudflats, and lakes.

Fig. S5. Maximum likelihood phylogenetic trees of *nifH* amino acid sequences in Cluster III. The recovered sequences in this study are in boldface type. Boldface numbers in parentheses are the number of retrieved clones for each cruise and station. Bootstrap values (>50%) are indicated at branch points. Sequences with an asterisk have >97% similarity at the amino acid level with sequences derived from mudflats.

Fig. S6. Vertical profiles of the oxygen concentration [ml L^{-1}] for each cruise.

Fig. S7. Vertical profiles of ammonium [μM] along the ON transect line in each cruise.

REFERENCES

- Conlon, D. M.: On the outflow modes of the Tsugaru Warm Current, *La mer*, 20, 60-64, 1982.
- Nishida, Y., Kanomata, I., Tanaka, I., Sato, S., Takahashi, S., and Matsubara, H.: Seasonal and interannual variations of the volume transport through the Tsugaru Strait, *Oceanogr. Japan*, 12(5), 487-499, 2003.