Macrozoobenthic production and productivity on the northern Norwegian shelf

Jennifer Dannheim[1,2]
Anne Helene Tandberg[2]
Pål Buhl-Mortensen[2]
Lene Buhl-Mortensen[2]
Margaret F.J. Dolan[3]
Børge Holte[2]

[1] AWI [2] HAVFORSKNINGSINSTITUTTET INSTITUTE OF MARINE RESEARCH [3] NGU

background & methods

Benthic animals produce food resources for organisms from higher trophic levels (fish, birds, mammals, and ultimately humans). The spatial distribution of benthic production and productivity are of direct relevance for the identification of essential feeding habitats (i.e. highly productive areas). This is important information for sustainable ecological management. In this context, the MAREANO programme aims to map the environment and fauna off the Norwegian coast by linking environmental parameters to the benthic ecosystem.

In a case study, 6 different biotopes were defined from benthos sampled at the Tromsøflaket Bank (Barents Sea) (fig.1, Buhl-Mortensen et al. 2009). Species biomass (B) and abundance were recorded at each station (N = 23, grab and beam-trawl). Production (P) and productivity (P/B) was estimated by using the model of Brey (2001) and correlated with terrain/environmental parameters from multibeam echosounder/videos (see Buhl-Mortensen et al. 2009, Dolan et al. 2009).

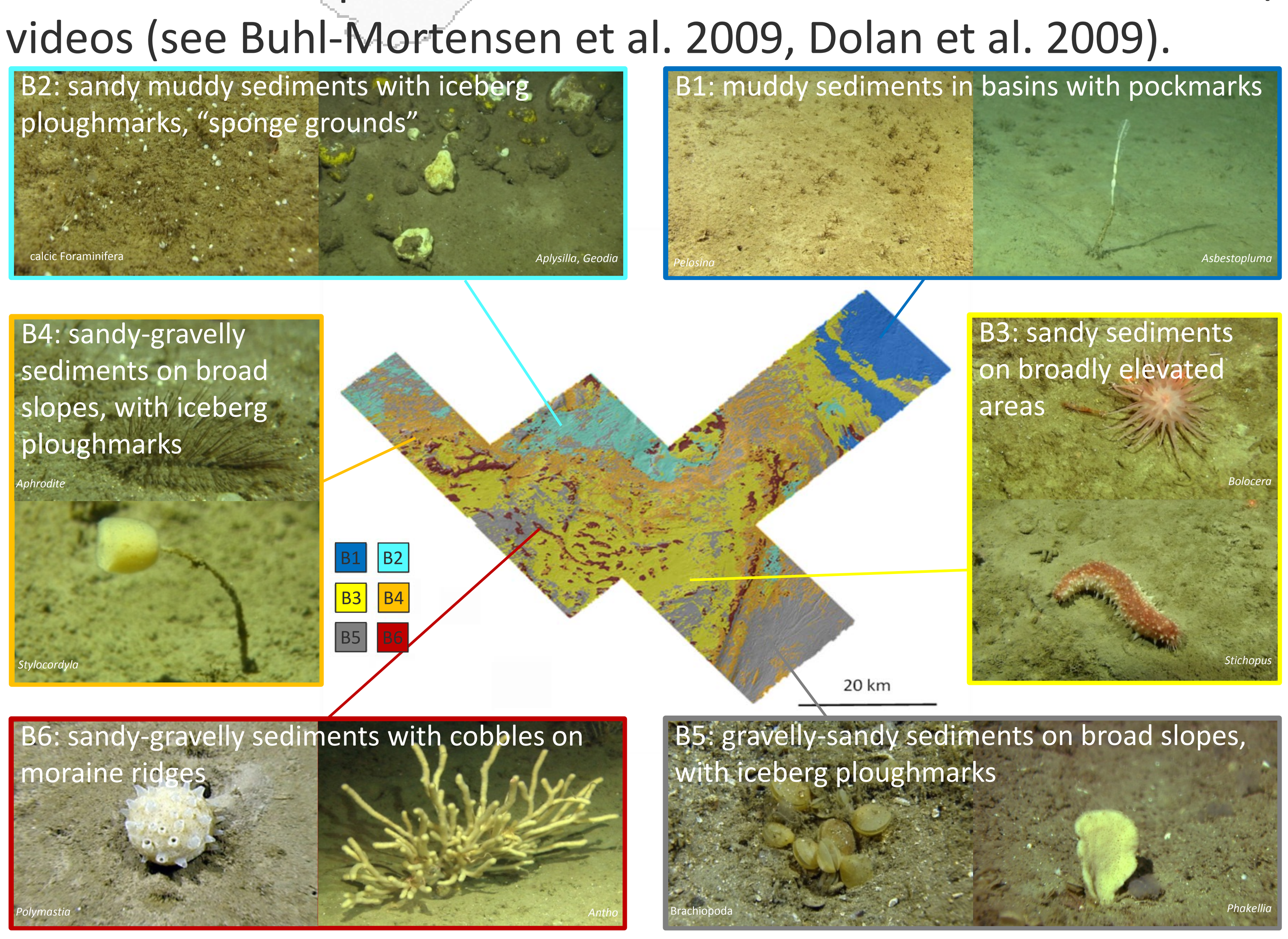

figure 1. Biotopes of Tromsøflaket (biotopes B1-B6) with typical species according to Buhl-Mortensen et al. (2009).

biotope differences

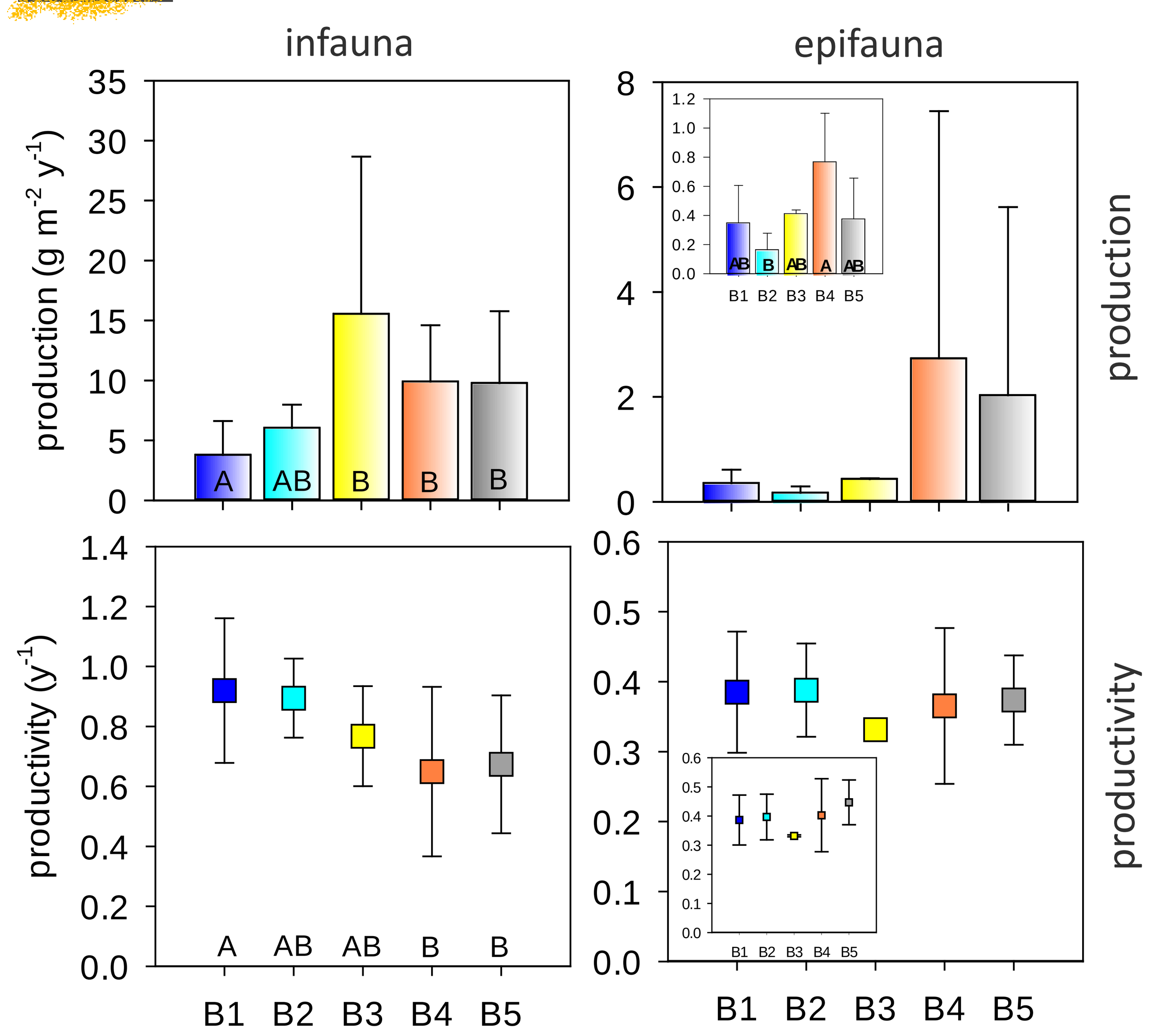

figure 2. Average (± S.D.) production (P, g m^{-2} y^{-1}) and productivity (P/B, y^{-1}) of in- and epifauna from biotopes B1-B5. Different letters indicate significant differences. Inserts show results without the dominant brachiopod *Macandrevia cranium*.

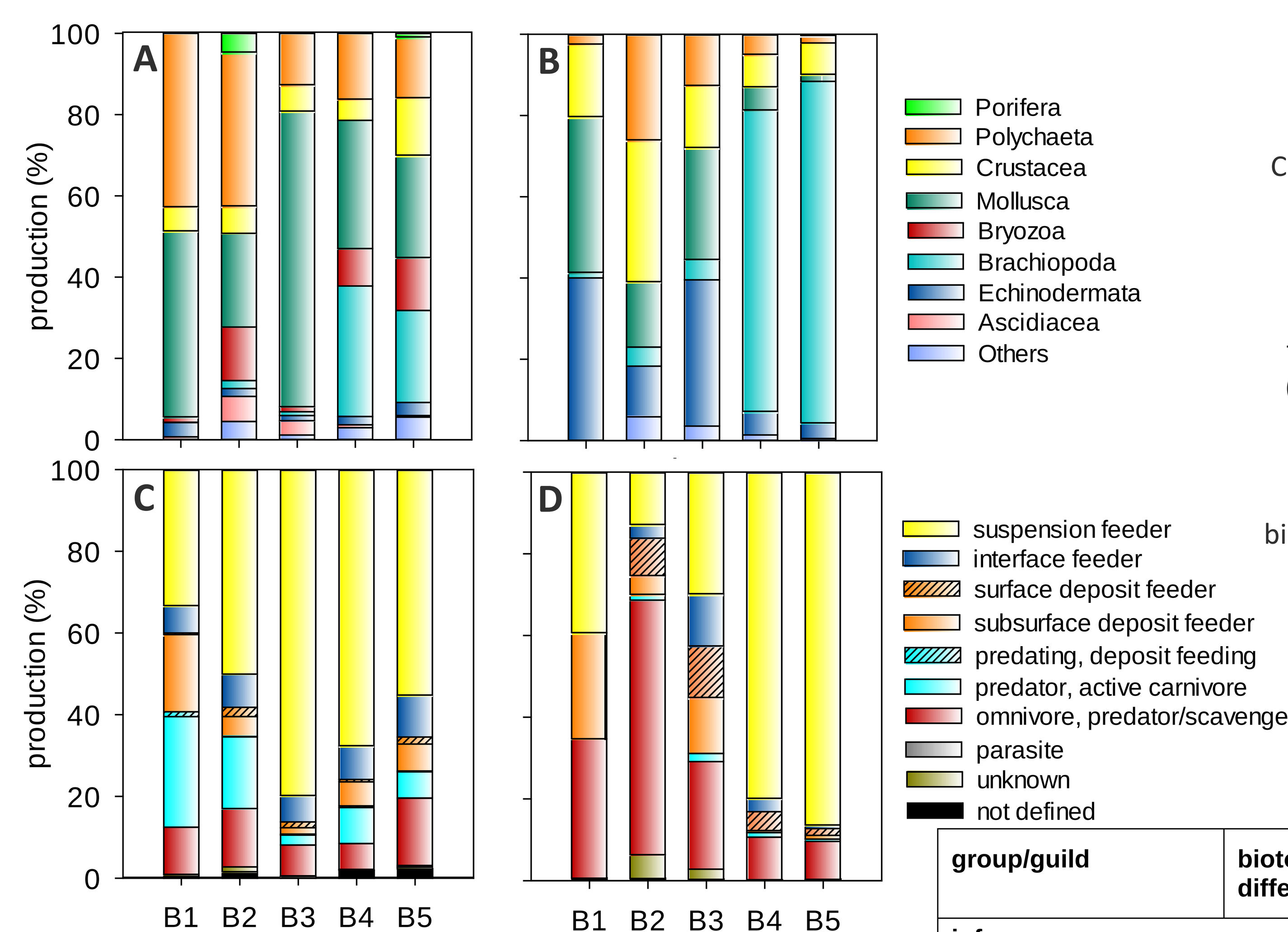

figure 3. Contribution of taxonomic groups (A: infauna, B: epifauna) and feeding-guilds (C: infauna, D: epifauna) to the total production in biotopes B1-B5.

group/guild	biotope differences
infauna	
Mollusca	B3 ≠ all others
Ascidiacea	B3 ≠ B1,B5
Omnivore, predator/scavenger	B1 ≠ B5
suspension feeder	B1 ≠ B3,B4,B5
interface feeder	B1 ≠ B4,B5
epifauna	
predator	B1 ≠ B4

table 1. Taxonomic groups and feeding guilds that differed significantly in production between biotopes B1-B5.

environmental correlations

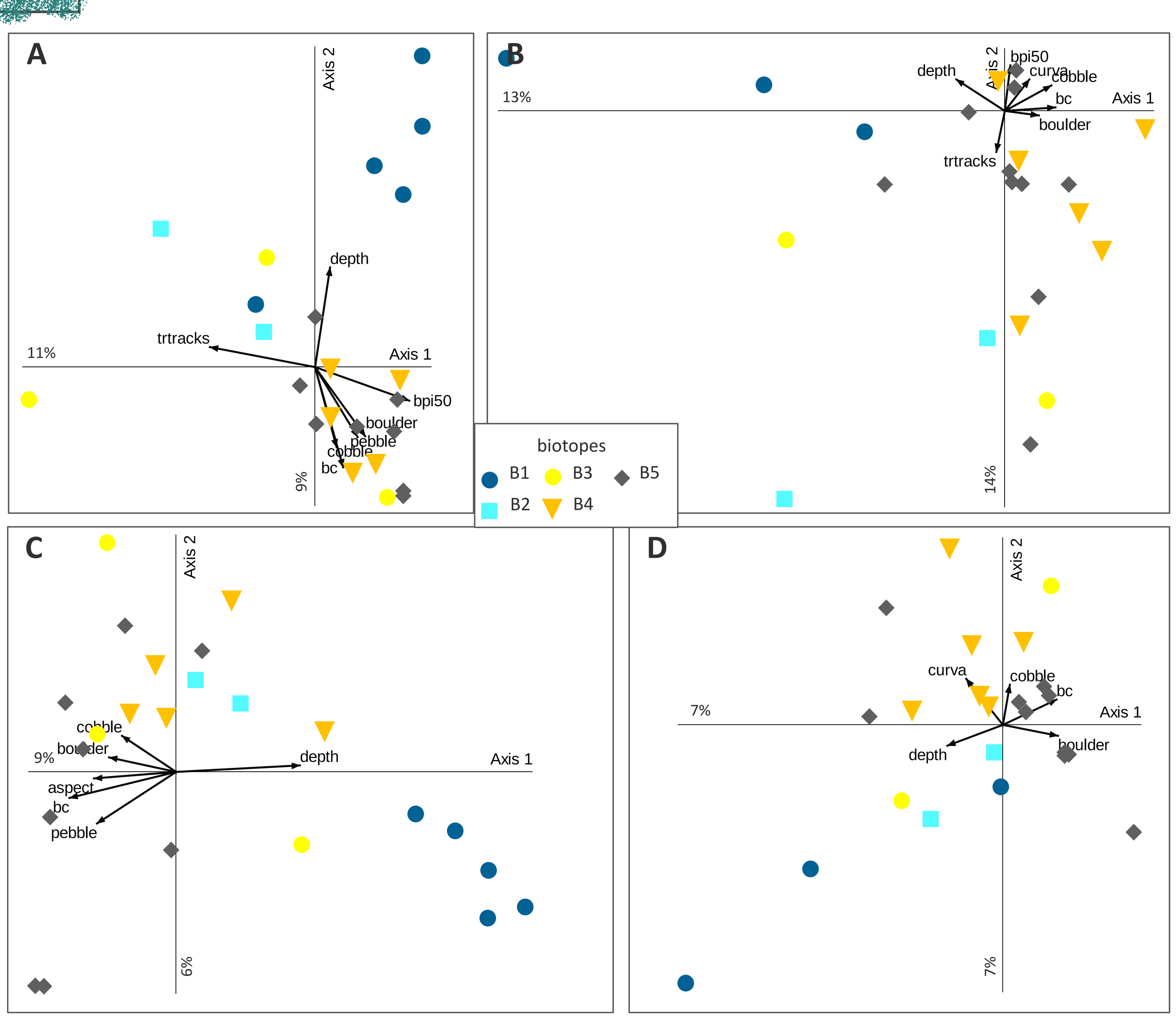

figure 4. Canonical correspondence analysis of production (g m^{-2} y^{-1}; A: infauna, B: epifauna) and productivity (y^{-1}; C: infauna, D: epifauna) of biotopes (B1-B5). Arrow length indicate strength of relationships between biological data and terrain parameters, %-values = variance in species data explained by axis. Pebble, cobble and boulders are %-cover of bottom substrate. bc = backscatter (i.e. degree of bottom softness/hardness), bpi 50 = bathymetric position index (50 ≙ grid size, i.e. concave/convex bottom surface), curva = curvature (i.e. change rate of aspect), trtracks = trawl tracks (N/100m^2).

results & conclusions

Production was lowest in deep, muddy and sandy muddy biotopes (B1, B2; fig. 2) and highest on shallow sandy to gravel banks (B3, B4: mainly Mollusca & Brachiopoda). Production decreased with depth but increased towards harder bottoms (fig. 4; Nilsen et al. 2006, Cusson & Bourget 2005). Productivity of infauna was diametrically affected by depth and bottom structure (fig. 2, high P/B by Polychaeta). Bottom-trawling frequency was higher on soft sediments, thus trawling indirectly affected benthic production at the Norwegian shelf (fig. 4).

At the spatial scales investigated, terrain parameters are poor descriptors of spatial variability of production and productivity (see low %-values in fig. 4). Other environmental variables such as organic input into the system and biological parameters (e.g. biodiversity, species life-span, mobility, feeding mode) seem to be locally more important than terrain parameters (Buhl-Mortensen et al. 2012, Gogina et al. 2010, Cusson & Bourget 2005, see also fig. 3 & table 1). At broader scales (e.g. landscape scale), terrain parameters might be more appropriate descriptors for mapping of production (fish-feeding habitats) for e.g. ecological management (Buhl-Mortensen et al. 2012, see talk of Tandberg et al. 2013, this conference).

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Correspondence:
Jennifer Dannheim
Alfred Wegener Institute
Bremerhaven, Germany
Jennifer.Dannheim@awi.de