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Organic enrichment and structure of macrobenthic communities in the glacial Baker Fjord, Northern Patagonia, Chile

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In this study we describe community parameters such as densities, biomasses, species composition, feeding modes and normalized biomass size-spectra (NBSS) of macrobenthic invertebrate communities from three stations located in the Baker Fjord obtained on four seasonal campaigns in 2008 and 2009. The macrobenthic communities were dominated by small-bodied polychaetes (Paraonidae, Capitellidae and Cirratulidae) characterized by continuous year-round breeding, short life-spans, and fast turnover rates, which in turn regulated the standing stock in the communities. Principal component analysis and multiple-regression analysis demonstrate the distribution of macrobenthic communities in the study area to be mainly controlled by few local environmental conditions. Macrofaunal densities, diversity and feeding modes were significantly correlated with the total organic carbon (TOC; $R^2 = 0.74$; $P < 0.001$*) and chlorophyll- a (Chl-a;* $R^2 = 0.55$; $P < 0.05$*) content in the sediments. This study also suggests that feeding modes and NBSS can be used to detect and follow possible changes caused by natural perturbations such as glacial lake outburst floods or anthropogenic stressors associated with ecological impacts generated by the construction and operation of hydroelectric power stations in the Baker River.*

Keywords: Baker Fjord, benthic communities, environmental relationships, organic matter in sediments

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INTRODUCTION

Covering almost 240,000 km² Patagonia in Southern Chile constitutes one of the most important and extensive fjord regions worldwide. This region is characterized by a highly fragmented coastline and thousands of islands, many channels and fjords, and complex marine–terrestrial interactions. In this fjord and estuarine ecosystem with highly turbid river plumes, the interaction between autochthonous organic matter (OM) and river or glacier derived allochthonous detritus contribute nutrients and particularly silicate, which control primary production in many of the channels and fjords (Iriarte *et al.*, 2007; González *et al.*, 2010; Torres *et al.*, 2010). In addition, large inputs of forest litter into the fjords result in highly organic marine sediments. Terrestrial derived OM has been demonstrated as an important carbon source for macroinfaunal communities in New Zealand fjords (McLeod *et al.*, 2010), although vascular plant detritus may be considered as a poor quality food source for marine invertebrates, and only few infauna species are capable of assimilating this material via heterotrophic and chemoautotrophic microbes (McLeod & Wing, 2009; McLeod *et al.*, 2010). The terrestrial derived OM constitutes important subsidies to coastal benthic environments controlling macrobenthic standing stock, diversity and functional group (or feeding mode) composition (e.g. Syvitsky *et al.*, 1989; Wieking & Kröncke, 2005; W10darska-Kowalczuk *et al.*, 2005, 2007; McLeod *et al.*, 2010).

Macrobenthic communities play an important role in the functioning of the fjord and estuarine ecosystems in affecting rates and pathways of exchange and transformation of OM (Jørgensen, 1996). Macrobenthic communities in the coastal areas influenced by rivers are impacted (Akoumianaki *et al.*, 2006) in different ways, although the physical environment is less detrimental than off the mouth of temperate rainforest rivers (McLeod & Wing, 2009; McLeod *et al.*, 2010). A suite of macrobenthic process indicators were recognized for the description of changes in benthic ecosystem functioning associated with particulate OM or nutrient imput to coastal ecosystems. Such indicators are secondary production, P/B ratios, normalized biomass size-spectra (NBSS) and trophic structure (e.g. Rakocinski & Zapfe, 2005; Quiroga *et al.*, 2005; Akoumianaki *et al.*, 2006; Wang *et al.*, 2010). These macrobenthic process indicators can be estimated in a straightforward manner from macrobenthic samples (e.g. Rakocinski & Zapfe, 2005; Akoumianaki *et al.*, 2006).

Another important consideration is the element of timelines: many Chilean fjords appear to be suitable for aquaculture (Buschmann *et al.*, 2006). Salmon farming has grown

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