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South Georgia palaeo-productivity and glacial evolution over the past 15 ka

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The island of South Georgia is a biodiversity hotspot, and is particularly sensitive to climate change due to its position close to the Polar Front in the Southern Ocean. However, due to a low number of well-dated subantarctic palaeoclimate archives, there is still uncertainty about how the climate of South Georgia changed in the recent geological past. Here, we reconstruct primary productivity changes and infer Holocene glacial evolution by analysing two marine gravity cores (GC666: 15.1 to 0.3 cal. kyr BP; GC673: 9.3 to 0.3 cal. kyr BP) on the inner South Georgia shelf. The study cores come from the northern ends of cross-shelf troughs that propagate from Royal Bay (GC666) and Cumberland Bay (GC673), on the northern part of the South Georgia Shelf. GC666 is more distal being ca. 21 km from the modern shore and GC673 is in the mouth of Cumberland Bay. We analysed benthic foraminiferal assemblages, stable isotopes, sedimentary total organic carbon and biogenic silica to reconstruct primary productivity changes and infer Holocene glacial evolution in both cores. Using Detrended Correspondence Analysis, we identified three different assemblages of benthic foraminifera: *Miliammina earlandi*, *Fursenkoina fusiformis*, and *Cassidulinoides parkerianus*. The assemblage of particular interest in reconstructing glacial changes is the *F. fusiformis* assemblage, which represents high productivity in both cores and may be associated with glacial runoff. Our multiproxy analysis from both cores provides evidence that the latest Pleistocene (15.1 to 12.3 cal. kyr BP) and early Holocene (12.3 to 7.5 cal. kyr BP) were periods of high productivity associated with increased glacial meltwater discharge. The middle Holocene (7.5 to 2.9 cal. kyr BP) is associated with a fall in sedimentation rates and lower productivity associated with a reduction in the size of South Georgia's glaciers, but with several short-lived episodes of glacial advance. The late Holocene (2.9 to 0.3 cal. kyr BP) saw an increase in productivity and glacial advancement associated with cooling temperatures (based on ice core data from James Ross Island) and increased precipitation. We propose that shifts in the South Westerly Winds drive the glacier dynamics reconstructed from cores GC666 and GC673. The relative abundance of *F. fusiformis*, interpreted here as a proxy for increased terrestrial runoff associated with the spring-summer melting of glaciers, is closely aligned with glacial trends previously constrained with plant macrofossil and pollen evidence from peat bogs and dating of glacial moraines. Thus we conclude that palaeo-productivity can be used as an indirect proxy for glacier readvancements on the South Georgia shelf.