Appendix VIII

Details of the continuing project: Ecological quality assessment of Kongsfjorden Fjord in the arctic environment: integrating macrobenthic communities and benthic indices

Name of the project	Ecological quality assessment of Kongsfjorden Fjord in the arctic environment: integrating macrobenthic communities and benthic indices
Name of the PI, **Affiliation and contact details**	Dr. Sivaraj Sigamani Assistant Professor (Research) Centre for Ocean Research Sathyabama Institute of Science and Technology Chennai – 600119
Period of field access	2025-2026

Details of sampling:

Kongsfjorden spans approximately 20 km in length and varies in width from 4 to 10 km. At the fjord's head are two prominent glaciers, Kronebreen and Kongsvegen. For benthic sediment sampling, twelve stations (St-1 to St-10) were strategically selected along the length of Kongsfjorden at regular intervals to ensure comprehensive coverage. The triplicate benthic samples will be collected using van Veen grab by following the standard protocol (Mackie et al. 1994).

Details of analysis:

From that 250gm of sediment sample will be transfer to the polythene bag for the sediment quality parameters (soil pH, texture, grain size and TOC). The remaining collected sediments will be sieved through 0.5 mm mesh screen to separate the organisms, followed by 10 drops of Bengal dye and preserved with 5% formalin. The organisms will be sorted, enumerated, and identified under the stereomicroscope using standard references (Fauvel 1953; Day 1967; Ramakrishna 2003; Barnes 1980; Lyla et al. 1999; Subba Rao et al. 1991).

Results (in 300 words):

In recent years, the habitats of Kongsfjorden Fjord have been exposed to a range of natural disturbances, including forest fires, volcanic eruptions, soil erosion, and enhanced melting of Arctic snow, as well as anthropogenic pressures such as mining

activities, garbage dumping, industrial effluents, and landfills. These combined stressors are regarded as major drivers of organic matter enrichment (OME), leading to alterations in the structure and functioning of benthic communities. The analysis of benthic faunal composition in Kongsfjorden revealed that polychaetes were the dominant group, accounting for 54% of the total benthic assemblage. Bivalves, crustaceans, and gastropods contributed 31%, 8%, and 7%, respectively. Species diversity indices ranged from 3.656 to 4.219, with the highest diversity recorded at Station 10 (St-10) and the lowest at Station 3 (St-3). A total of 52 macrobenthic species were identified during the study; however, one taxon was excluded as it did not belong to the soft-bottom macroinvertebrate fauna (fish). Of the remaining species, 46 were classified into five ecological groups following the AZTI classification, while six species could not be assigned. Among the classified taxa, 17 species (36%) belonged to EG-I, 15 species (32%) to EG-II, 8 species (17%) to EG-III, 6 species (13%) to EG-IV, and one species (2%) to EG-V. The AMBI values derived from the macrobenthic community ranged from 1.07 to 3.10, indicating that the sampled stations varied from normal to unbalanced benthic ecosystem conditions. Likewise, the M-AMBI values ranged between 0.63 and 0.77, corresponding to ecological quality statuses classified as “good” to “high.”

Discussions:

In recent years, there has been a growing demand for reliable tools to detect environmental disturbances caused by anthropogenic pressures in coastal and marine ecosystems (Crain et al., 2008). Among biological components, benthic invertebrates play a pivotal role in marine ecosystem functioning and are well-established targets for assessing environmental health. They are regarded as “veritable indicators” of ecosystem condition due to their close association with sediments, which serve as an interface between the benthic environment and the overlying water column. Consequently, benthic communities effectively reflect the cumulative impacts of pollution, integrating recent contamination history in sediments as well as the synergistic effects of multiple pollutants, thereby making them reliable indicators of environmental quality (Forni and Occhipinti-Ambrogi, 2004).

Species diversity indices in the present study ranged from 3.656 to 4.219, with the highest diversity observed at Station 10 (St-10) and the lowest at Station 3 (St-3). Based on these values, the ecological status of the study area was classified as “high” to “good”

(Blanchet et al., 2008). In this context, several benthic indices have been developed to evaluate ecosystem health, among which the recently introduced AZTI Marine Biotic Index (AMBI) and its multivariate extension (M-AMBI)—incorporating Shannon diversity, species richness, and multivariate analyses—have proven to be effective tools for ecological status assessment and are widely applied in the US and UK (Prior et al., 2004). Previous studies have demonstrated that AMBI and M-AMBI possess a strong capacity to detect a range of anthropogenic impacts, including anoxia, hypoxia, eutrophication, effluent stress, and sediment contamination by metals and hydrocarbons (Muxika et al., 2007; Borja et al., 2008; Bigot et al., 2008; Pinto et al., 2009; Sivaraj et al., 2014).

In the present study, AMBI values ranged from 1.07 to 3.1, indicating that the sampled stations in Kongsfjorden could be classified as exhibiting normal to unbalanced benthic conditions. Similarly, M-AMBI values varied between 0.63 and 0.77, corresponding to ecological quality classes ranging from “good” to “high.” These stations were primarily located in the mid-fjord region of Kongsfjorden, characterized by comparatively low organic loading and sandy substrata. Consistent with this observation, Venturini et al. (2004) reported that sandy sediments favor the dominance of species belonging to Ecological Groups I and II.

Conclusions:

In summary, the present study demonstrates that AMBI indices are highly effective in evaluating the ecological health of Kongsfjorden Fjord. The results indicate that stations St-1 to St-10 exhibit normal to moderately unbalanced benthic conditions. Likewise, M-AMBI values ranged from 0.63 to 0.77, corresponding to ecological quality classes from “good” to “high.” Overall, this study provides a valuable baseline dataset and offers important insights into the current ecological status of Kongsfjorden Fjord.

Output (in terms of publications, reports and PhDs):

Publication : Ecological status assessment through indices by understanding source and sink of heavy metals (Under Progress)

PhDs : Nil

Whether data submitted to NCPOR (If not, please submit it before applying for a new field access)	Submitted