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A multi-nitrogen stable isotope techniques for tracking nitrogen source causing *Ulva* bloom

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Recently a large bloom of opportunistic macroalgae, with *Ulva lactuca* as the dominant species, covered the lower reach of the permanently Bangdu Bay in Jeju island. The occurance of an opportunistic species is globally considered a sign of eutrophication. The aims of this study were to determine the cause of the bloom using multi-isotope techniques($\delta^{13}C$, $\delta^{15}N$, $\delta^{15}N$-NH_4, $\delta^{15}N$-NO_3 and $\delta^{18}O$-NO_3) and investigate why the bloom sustained in the lower reach of the bay. *Ulva* coverd Bangdu bay were measured along 9 line transects(20 sites). Water column samples including seawater, groudwater, aquaculture and agriculture drainage were collected for nutrinet and isotope analysis to investigate the flux of nitrogen from the anthropogenic source. *Ulva* tissue was collected and analysed both concentration and isotope values for N, C and metals(Cd, Cu, Pb.. etc) to evaluate if the algae could potentially be harvested and used as fertilizer. The results showed that anthropogenic nitrogen source, specifically ammonium and nitrate, from the agriculture and aquaculture drainage and input from a nearby groundwater acted as a consistent source of nutreint that enabled the bloom to persist in Bangdu bay, Jeju island. With the modeling approach we found a high range in the estimate proportion of groundwater N, indicating that the mixing models is good tool to reveal contribution of N source. The low concentration of metals and high concentration of N in the tissue of *U. lactuca* mean this algae has the potential to be used as a fertilzer or composted if harvested. Better characterization of tributary $\delta^{15}N$-NH_4 and $\delta^{15}N$-NO_3 by better measurements or a more detailed modeling approach will aid in understanding N-cycle dynamics in estuary ecosystem.