# Stable isotope approach for feeding structure of mudskipper *Periophthalmus argentilineatus* at different habitats in Okinawa Islands, Japan

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## Introduction

Barred mudskipper *Periophthalmus argentilineatus* is an amphibious gobioid fish, inhabiting in mudflats, mangroves and port. Mudskippers are known as a carnivorous fish that feed insects as well as benthic animals such as small crustacea on intertidal area [1, 2]. While adult males of the mudskipper have territory around their nests, adult females move along with tidal migration front without their nests. Because the adult individuals have not been observed to move wide range habitats (e.g. between river systems), food differences of barred mudskippers are expected to reflect food availability of each habitat. Stable isotope is one of the powerful tools for studies of food chain in an ecosystem. This study is to reveal food differences attributed to differences of habitat environment and feeding behavior between males and females, using stable isotopic methods.

## Materials and Methods

Mudskipper, other benthic animals, particulate matter and sediments were taken from intertidal area of mudflats and mangroves around tropical coral reefs of Okinawa, Japan. Mudskipper samples were separated into gut and muscular tissues. Then, all the organic tissue were freeze-dried and analyzed $\delta^{13}C$, $\delta^{15}N$, $\delta^{34}S$ using a continuous flow EA/IRMS (Delta V advantage, Thermo).

## Results and Discussion

Muscular tissues of mudskipper showed $\delta^{13}C$ = -17.4‰ and $\delta^{15}N$ = 7.4‰ at Iriomote Island; $\delta^{13}C$ = -21.3‰ and $\delta^{15}N$ = 11.8‰ at Okinawa Island. These results suggested significantly different food sources and availabilities of the two islands.

[1] Kruitwagen *et al*. (2007) *J. Fish Biol*. **71**, 39–52. [2] Nanjo *et al*. (2008) *Fisheries Sci*. **74**, 1024–1033.

# Assessment of cloud droplet growth based on the measurements of hygroscopicity and CCN activity of aerosol particles in Nagoya, Japan

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To better understand the aerosol-cloud relationship in the atmosphere, we investigated hygroscopicity and CCN activity of aerosol particles by ground-based observation, and performed model calculations to predict the concentrations and the effective radii of cloud droplets ($N_d$ and $R_{eff}$, respectively) formed from the observed particles. The field observation was conducted in the city of Nagoya, from 29 July to 3 August, 2010. The hygroscopic growth of aerosol particles were measured using a Hygroscopicity Tandem Differential Mobility Analyzer (HTDMA). The aerosol particles were classified by the dry mobility diameter in the first DMA, and were further classified by the diameter under the condition of 85% relative humidity in the second DMA. A CCN counter (CCNC) and a condensation particle counter to measure CCN and condensation nuclei were connected to the second DMA. The CCN were measured at supersaturations of 0.17%, 0.48%, and 0.93%. The hygroscopic growth factors (HGFs) of studied particles were 1.0, 1.1, 1.25, and 1.4.

The measured CCN activation diameters ($d_{act}$) were smaller than those predicted; i.e. the actual CCN activity was higher than that predicted. Whereas the differences between predicted and measured $d_{act}$ were not very large for more hygroscopic particles, they were remarkable for particles with HGF of 1.0. Based on the HGF data, we performed model calculations to investigate how the differences of particle hygroscopicity and the differences between predicted and measured $d_{act}$ for particles with HGF of ~1.0 affect the cloud droplet formation. If less hygroscopic aerosol particles in addition to more hygroscopic particles are considered in the cases of large updraft velocity conditions, $N_d$ and $R_{eff}$ are, respectively, substantially larger and smaller than those calculated with consideration of only more hygroscopic particles. Further, if we correct the model inputs based on the differences between predicted and measured $d_{act}$, $N_d$ increase and $R_{eff}$ decrease slightly. These results suggest that less hygroscopic aerosol particles in the urban area could contribute to the cloud droplet formation, and play an considerable role in the formation of clouds.