

Study on elemental and morphological differences between originated and “bathed” *Eriocheir sinensis* in the Yangcheng Lake, China

Junren Xue^a, Hongbo Liu^b, Tao Jiang^b, Xiubao Chen^b, Jian Yang^{a, b, *}

^aWuxi Fisheries College, Nanjing Agricultural University, Wuxi 214081, China;

^bKey Laboratory of Fishery Ecological Environment Assessment and Resource Conservation in Middle and Lower Reaches of the Yangtze River, Freshwater Fisheries Research Center, Chinese Academy of Fishery Sciences, Wuxi 214081, China

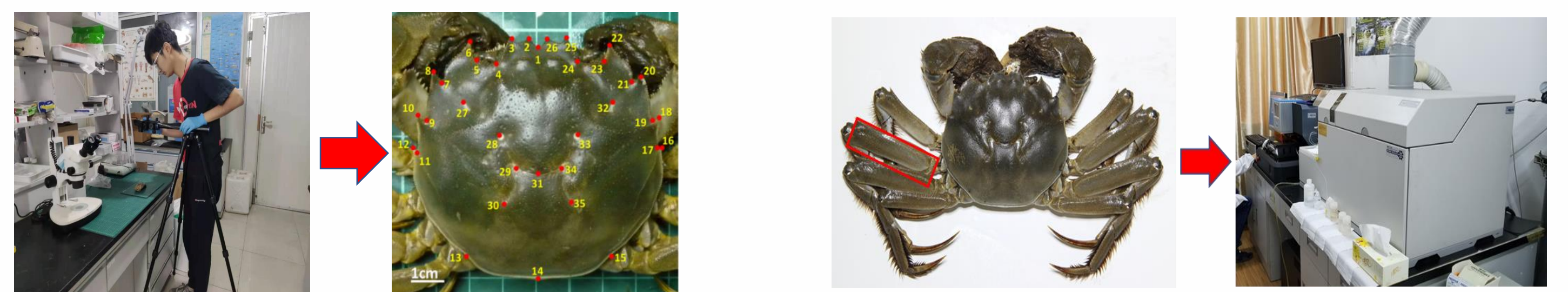
Corresponding author: Jian Yang, E-mail: jiany@ffrc.cn

Introduction

Authentication of high-quality fishery products originating from specific geographical regions is urgently needed worldwide. Chinese mitten crabs (*Eriocheir sinensis*), originating from Yangcheng Lake are prime counterfeiting targets for the same reasons. Ecdemic crabs that are cultured briefly in the lake, known as “bathed” crabs are illegally marketed as natives. Through this study, we have improved the origin traceability model used in the crabs and provided reference approaches for origin identification of other aquatic products.

Methods

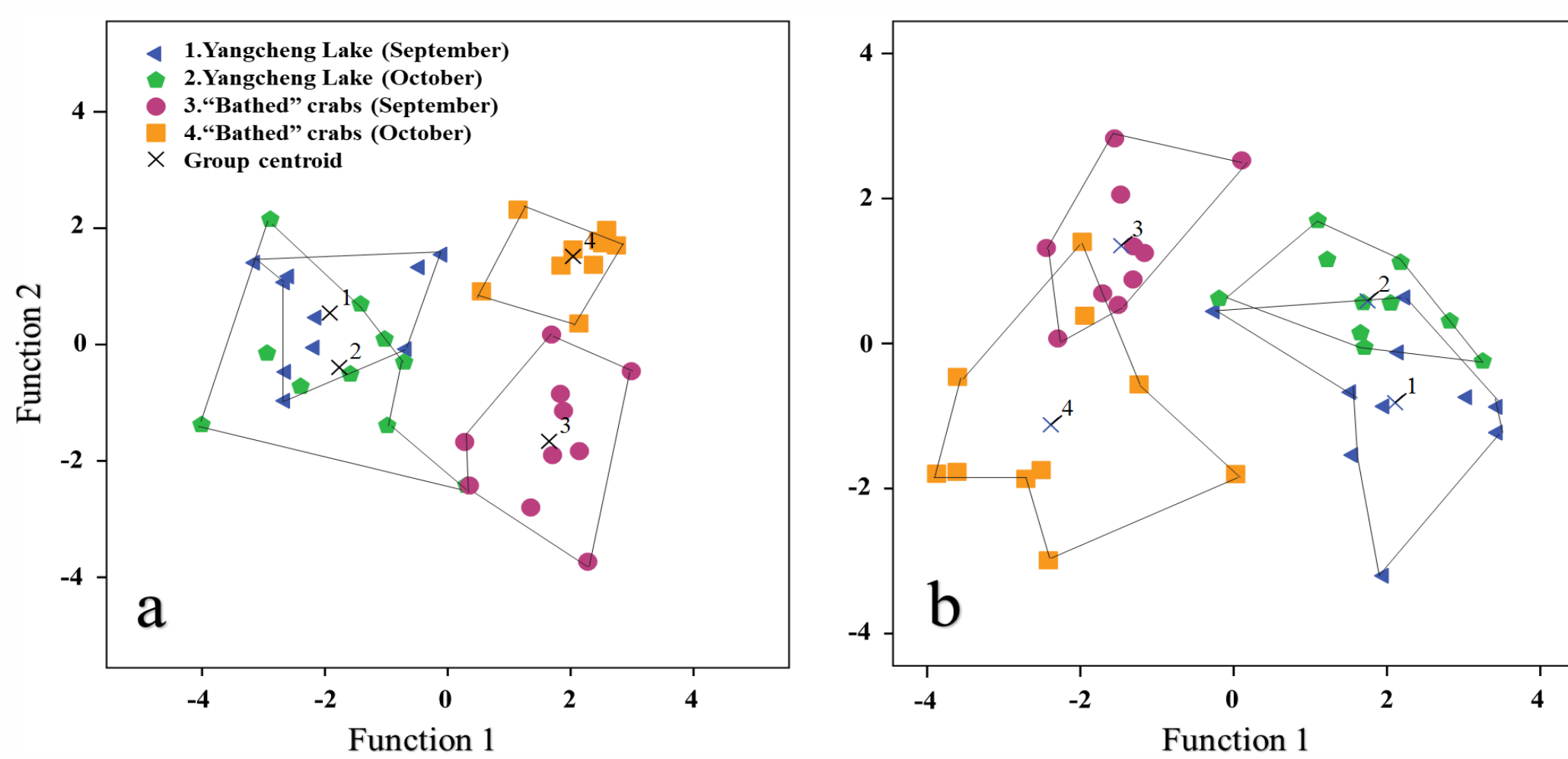
Multi-mineral element analysis by 7500ce Inductively Coupled Plasma Mass Spectrometer and morphological analysis by landmark-based geometric morphometric were used to comparatively study the corresponding elemental and morphological characteristics between the native and one-month “bathed” crabs in the Yangcheng Lake.



Carapace geometric morphometric analysis Multi-mineral element analysis of third pereiopod

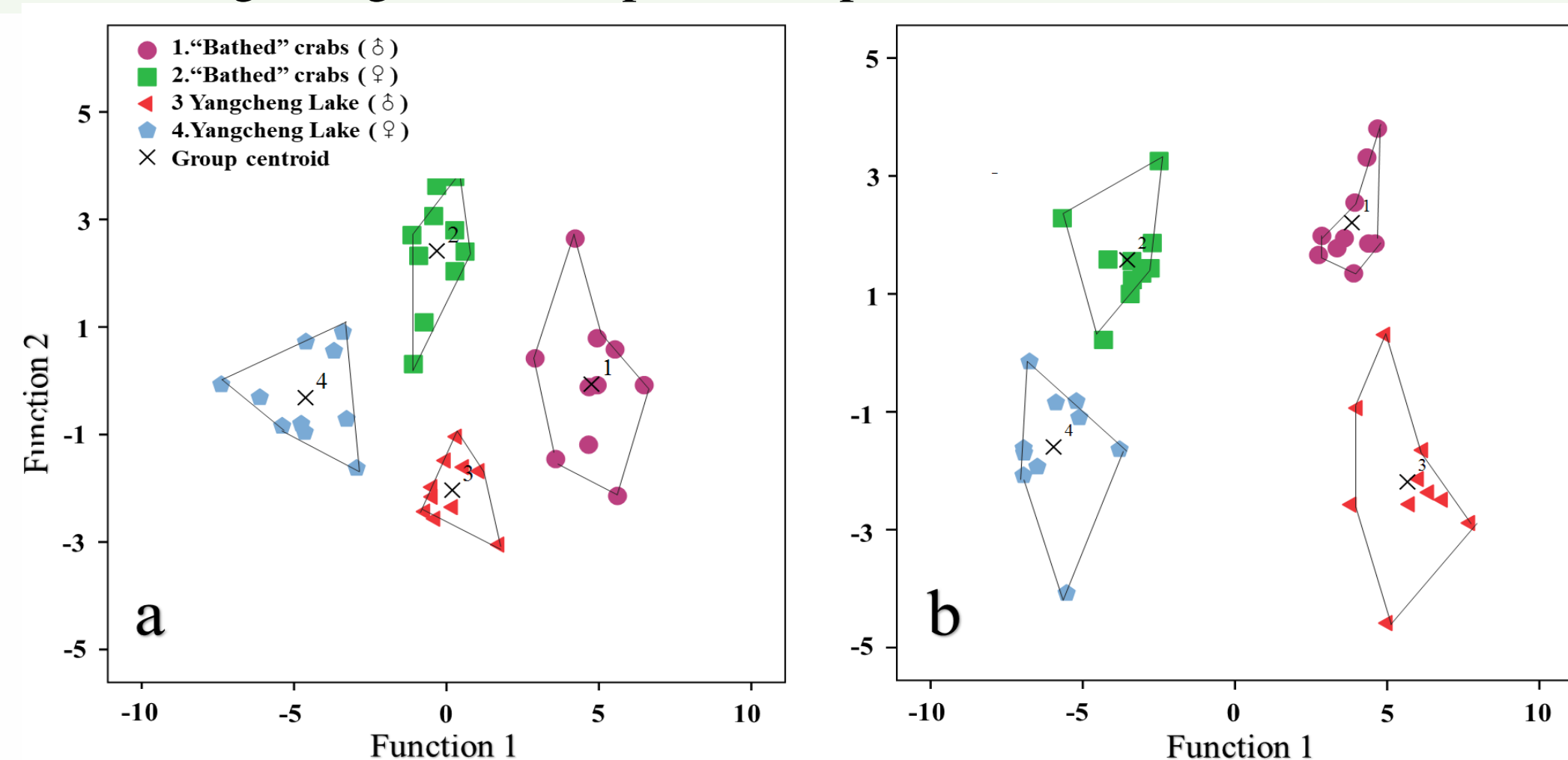
Results and Discussion

Carapace geometric morphometric analysis



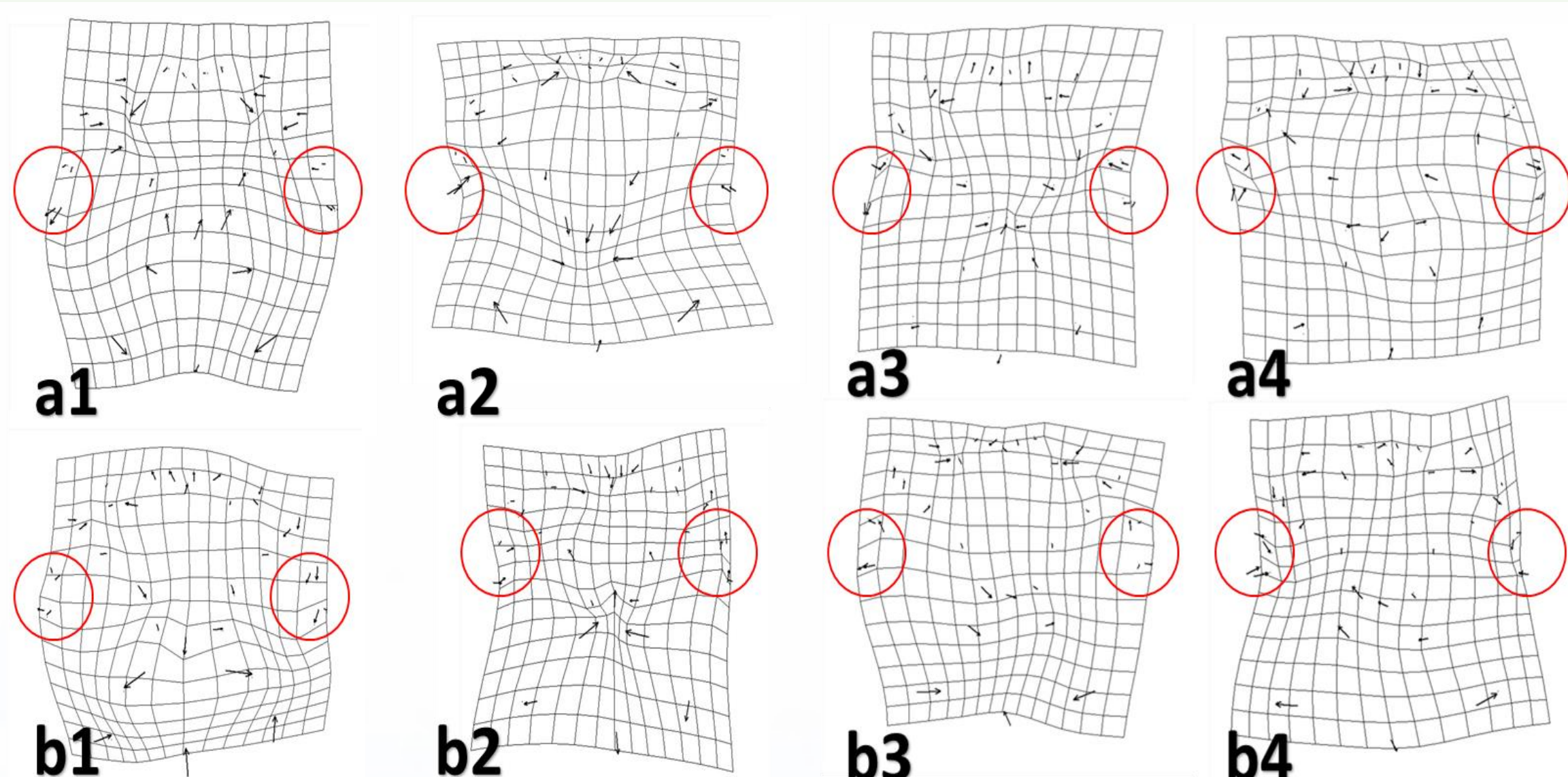
The discriminate analysis plots of the crabs by carapace geometrical morphometry a. The discriminate analysis plots (♂); b. The discriminate analysis plots (♀).

After a month of bathing, the carapace morphology of the “bathed” crabs began to change, but it still could not be the same as the Yangcheng Lake originated crabs. In contrast, the Yangcheng Lake samples in September and October were relatively stable.



The discriminate analysis plots of the crabs by carapace geometrical morphometry a. The discriminate analysis plots (September); b. The discriminate analysis plots (October)

Both Yangcheng Lake originated crabs and “bathed” crabs can be accurately identified in September and October.



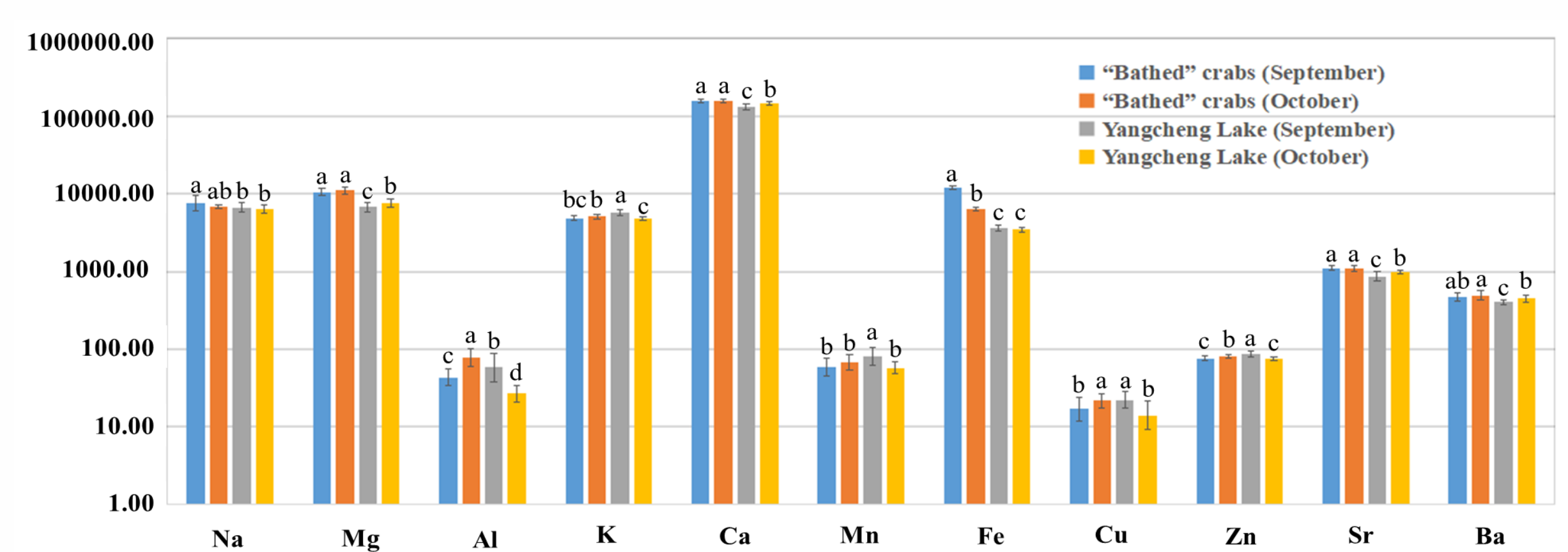
Grid deformation and variation visualization of the carapace for the crabs (variation enlarged 10 times) a. Male crab; b. Female crab; 1. Bathed crabs (September); 2. Yangcheng Lake (September); 3. Bathed crabs (October); 4. Yangcheng Lake (October)

The difference between “bathed” crab and originated crab is mainly reflected in the third and fourth lateral teeth before and after bathing in the same month.

Conclusion

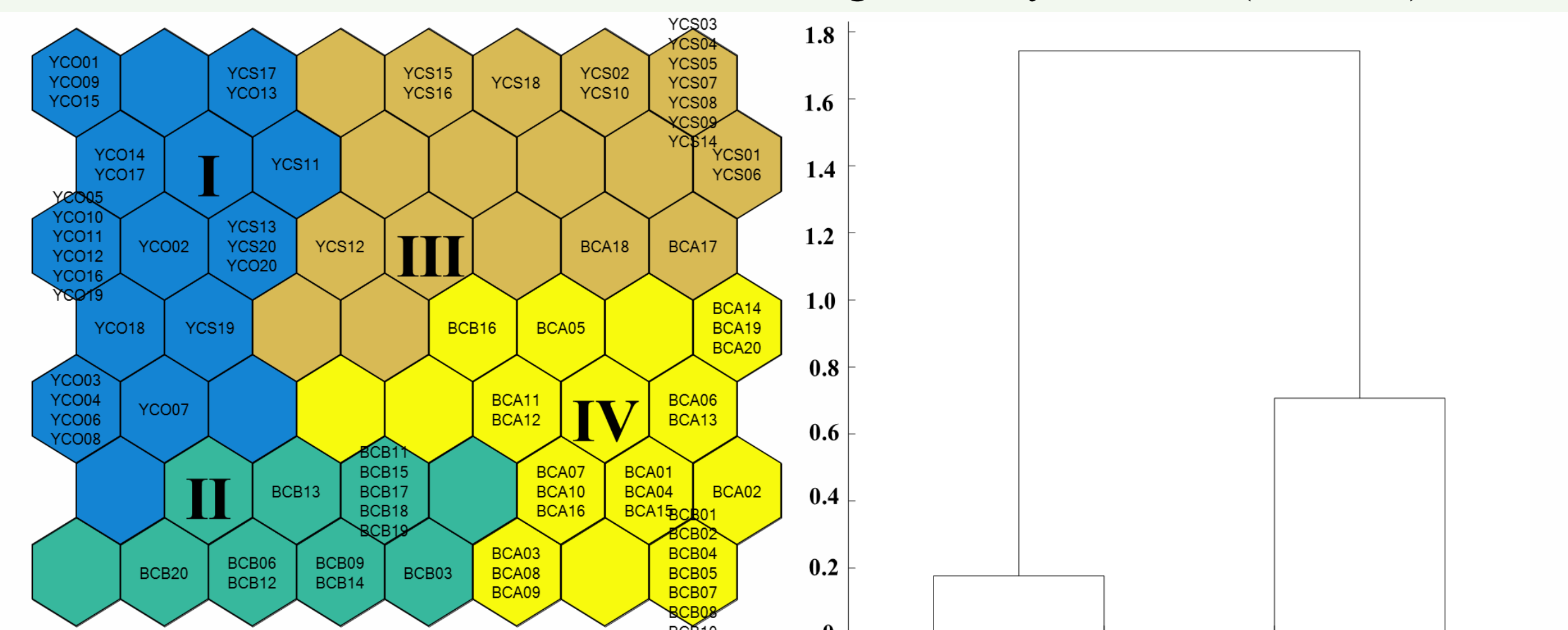
- Both multi-mineral element analysis and morphological analysis can accurately distinguish “bathed” crabs from originated crabs.
- One-month bathing culture was unable to make the “bathed” crabs have the morphological and elemental characteristics of the originated crabs.
- Our study offers a rare and important point of reference for the identification of adulteration in other commercially important aquatic products.

Multi-mineral element analysis of third pereiopod



The content of mineral elements in the third pereiopod of the crabs (mg/kg, dry weight) Different superscript letters in each row indicate significant differences ($P < 0.05$)

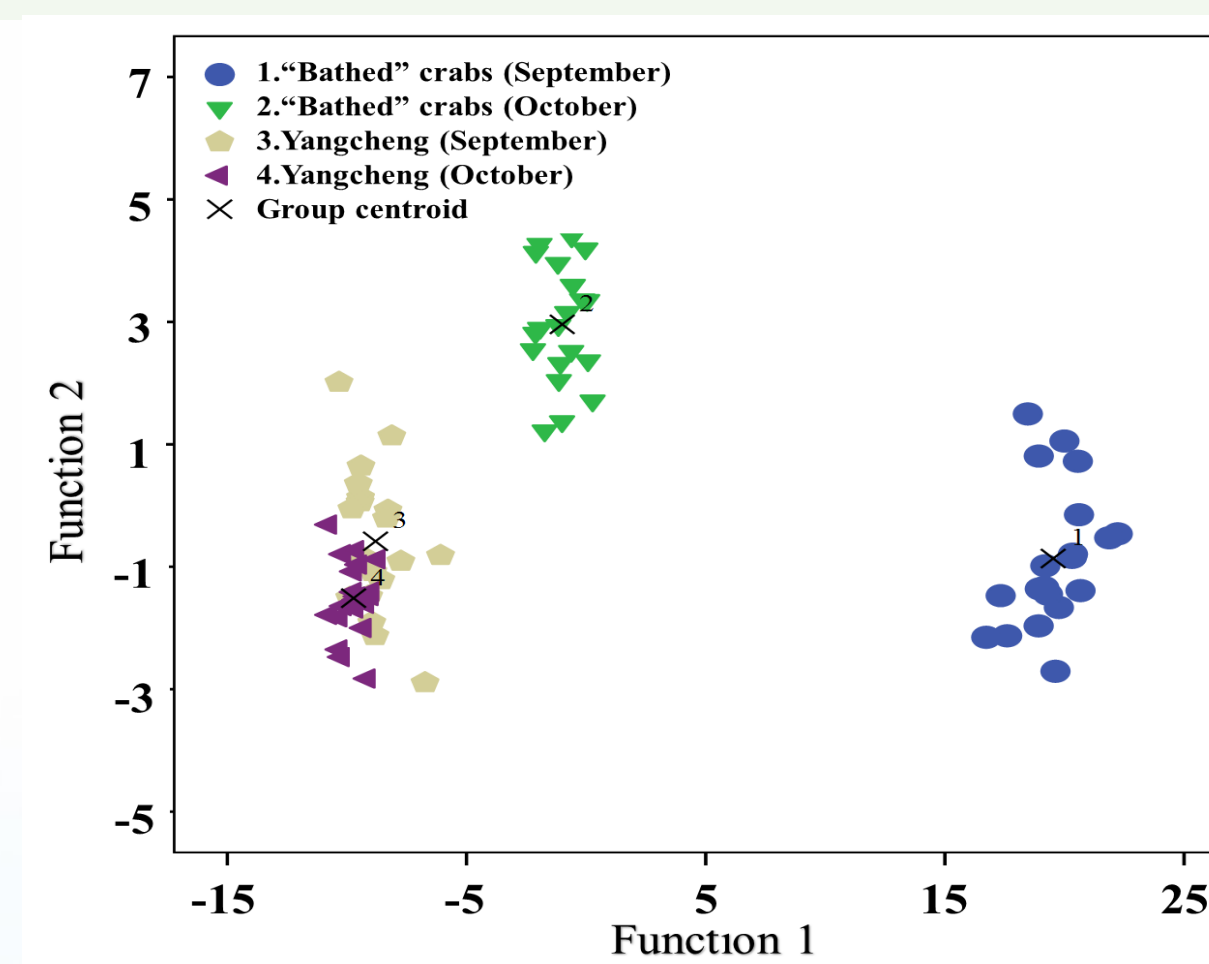
The 11 elements determined in this study were significantly different between the samples from Yangcheng Lake and “Bathed” crabs ($P < 0.05$) groups in September. In October, only Na and Mn were not significantly different between the samples from Yangcheng Lake and “Bathed” crabs, whereas all other elements were significantly different ($P < 0.05$).



Self-organizing map cluster distribution map of the crabs

BCB: “Bathed” crabs before bathing culture; BCA: Bathed crabs after one-month of bathing culture; YCS: Yangcheng Lake originated crabs from September; YCO: Yangcheng Lake originated crabs from October

Areas II and IV were clustered into one category, and areas I and III were clustered into one category. Areas I and III on the upper side contain all samples from YCS and YCO as well as two samples from BCA. The lower areas II and IV contain all samples from BCB and the remaining samples from BCA.



Scatter diagram of discriminant analysis based on the third pereiopod mineral elements of the crabs

The discrimination results revealed significant differences between the “bathed” and originated crabs before and after bathing in the same month. The samples of the “bathed” crabs in September and October changed significantly. However, the changes between the Yangcheng Lake samples in September and October were insignificant.