Identification of origin of faunal remains

carbon and nitrogen isotope analysis of marine fishes

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Introduction

Animal remains are not always discovered from the original habitat. For example, marine shellfish or marine fish remains could be excavated in the mountains or an inland area. These were presumably brought in by human activities. If the origin of animal remains is identified, we will obtain a strong evidence of interchange between areas. Japanese archpelago is surrounded by the Sea of Japan, the Pacific Ocean, the Inland Sea, and the East China Sea. Among the archipelago, the Honshu, the main island of Japan, faces the Sea of Japan, the Pacific Ocean and the Inland Sea. However, there is little information about interchange between inland Honshu with coastral areas. If the each sea area is identified by carbon and nitrogen isotope ratio of modern fish, we can expect a similar results in remains.

In this study, we aim at the establishment of the method of isotope analysis to identify the origin of marine fish.

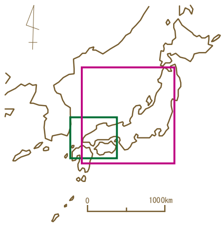

FIgure 1. Location of sampling sea area of modern fish
● = girella, ▲ = red sea bream(R), black porgy(B), Japanese sea bass(S)
( )= each sample number

Materials & Methods

We chose red sea bream (*Pagrus major*), black porgy (*Acanthopagrus schlegeli*) and Japanese sea bass (*Lateolabrax japonicus*) which are often excavated from Japanese sites. We have analyzed carbon and nitrogen isotope ratios of bone collagen of modern fishes as well as excavated remains.
In addition, we analyzed those of muscle of a modern fish : girella (*Girella punctata*) where a significant difference is not admitted by DNA analysis in order to test the generality of the difference. Figure 1 and Figure 2 show the location of sampling sea areas and number of fishes that we analyzed.

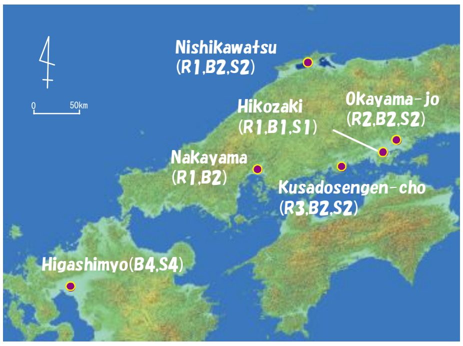

Figure 2. Location of the site and number of fish samples
Red sea bream = R, Black porgy = B, Japanese sea bass = S

Results & Discussion

δ^{15}N values in red sea bream, black porgy and Japanese sea bass were significantly different between the Sea of Japan, the Inland Sea and the Pacific Ocean (one-way ANOVA $p < 0.05$, followed by Scheffe's post hoc test) (Figure 3,4,5). Moreover, significant difference was found among the region within the sea area. δ^{15}N value was the highest at the Inland Sea, followed by the Pacific Ocean, and the Sea of Japan had the lowest δ^{15}N value. The difference was distinct in the red sea bream and the Japanese sea bass, but not in the black porgy because they had wide range of δ^{15}N value.

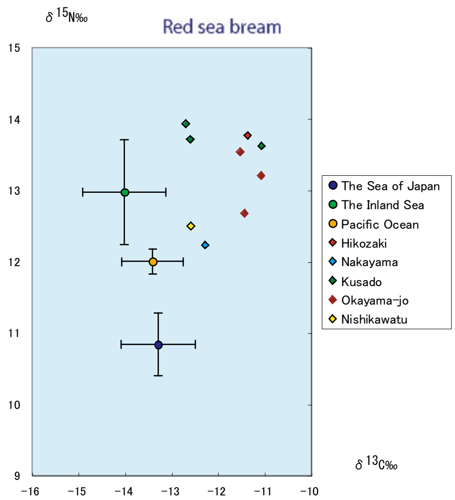

Figure 3. Stable isotope composition of Red sea bream
The Sea of Japan, The Inland Sea and the Pacific Ocean are modern samples.
Hikozaki (late Jomon), Makayama (early Yayoi), Kusado (mediaval times),
Okayama-jo (early modern times), Nishikawatsu (early Yayoi)

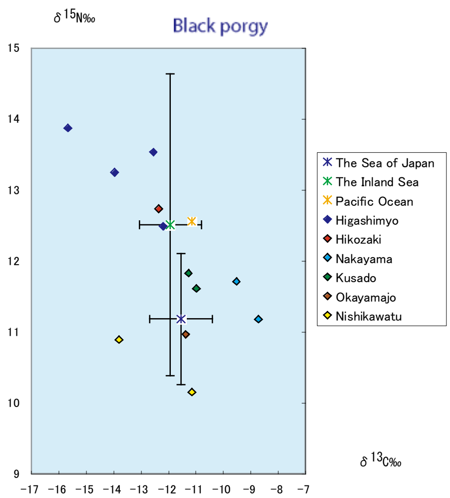

Figure 4. Stable isotope composition of Black porgy
The Sea of Japan, The Inland Sea and the Pacific Ocean are modern samples.
Higashimyo (initial Jomon), Hikozaki (middle Jomon), Makayama (early Yayoi),
Kusado (mediaval times), Okayama-jo (early modern times), Nishikawatsu (early Yayoi)

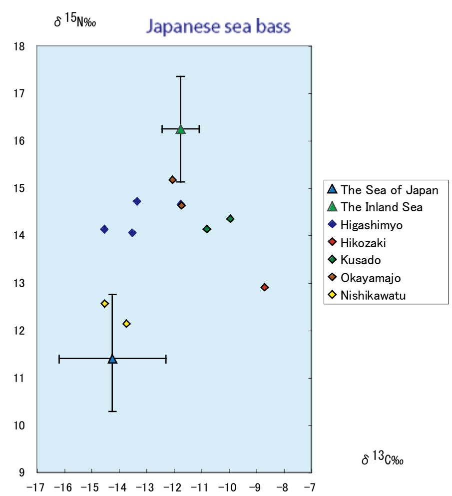

Figure 5. Stable isotope composition of Japanese sea bass
The Sea of Japan, The Inland Sea and the Pacific Ocean are modern samples.
Higashimyo (initial Jomon), Hikozaki (late Jomon), Kusado (mediaval times),
Okayama-jo (early modern times), Nishikawatu (early Yayoi)

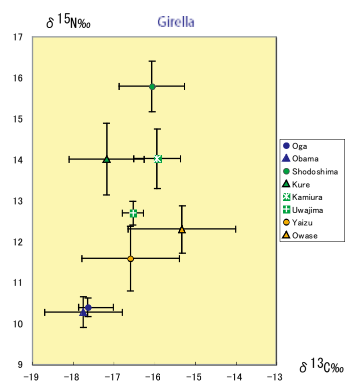

Figure 6. Stable isotope composition of Girella

In the result of girella, δ^{15}N value was also the highest at the Inland Sea, followed by the Pacific Ocean, and the Sea of Japan had the lowest δ^{15}N value (Figure6). The fact confirmed the difference in δ^{15}N value between the sea areas other than red sea bream, black porgy and Japanese sea bass. We obtained the similar δ^{15}N values of the fish remains which correspond to the results of the modern fishes (Figure3,4,5). Clear differences in δ^{15}N values between the Inland Sea and the Sea of Japan were observed both in black porgy and Japanese sea bass, but we need more specimens for red sea bream to compare. Overall distributions of δ^{15}N values of fish remains were similar to those of modern fish, which indicates that δ^{15}N value was mostly constant from Jomon until now. It suggests that human impact on ecosystems, e.g. eutrophication, did not affect δ^{15}N value on fish remains.

Therefore, we propose δ^{15}N value to a potential indicator of sea areas where the fish remain was originally captured. We are trying to obtain more data to confirm the validity of the method. This method would be useful to identify the origin of marine fishes which were brought in inland region and to reconstruct a trade route.

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