Genetic distances between *Donax marincovichi* and *Donax obesulus* confirmed by morphological features

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Introduction

The genus *Donax* is worldwide distributed and numerically dominates sandy beaches [1]. The taxonomy of Donacides is controversially discussed [2]. One of the reasons is the high variability in shape, size and color. The same holds true for the two Pacific American *D. marincovichi* and *D. obesulus* (Fig. 1). At ten different Chilean and Peruvian exposed sandy beaches (Fig. 2) both species were collected along their distributional range. Genetic analyses of the cytochrome oxidase (COI) gene supported the unclear taxonomic status of the two species, *Donax asper* and *Donax hanleyanus* were collected as reference species. In the case of *D. marincovichi* and *D. obesulus* the COI data showed no indication of reproductive isolation (Fig. 3). Therefore, the comparison of morphological features was conducted to confirm the genetic study.

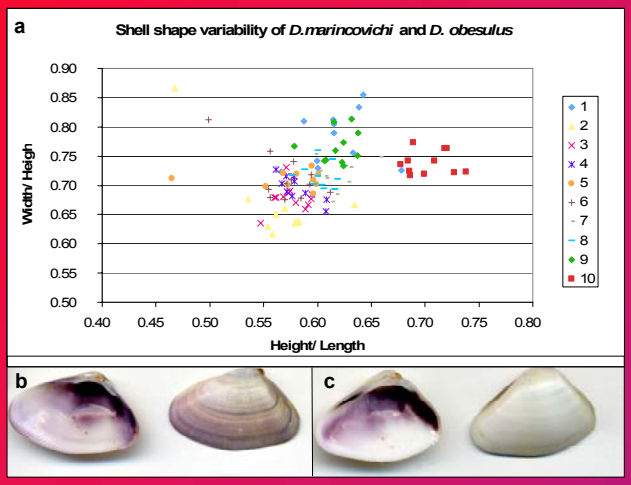

Fig. 1a: Shell shape variability of *D. marincovichi* and *D. obesulus* populations (1-10) from the Pacific coast of northern Chile and Peru. Width to height ratios (W/H) are plotted against height to length ratios (H/L). **Fig. 1b and c:** *D. marincovichi* (23 mm) and *D. obesulus* (17 mm).

Fig. 2: Biogeographical distribution (------) and sampling localities (1-10) of *D. marincovichi* and *D. obesulus* along the Chilean and Peruvian coast.

Material and Methods

From 10 beaches (Fig. 2) 11 clams were collected and shells measured with a digital caliper (±0.01mm) for length (anterior-posterior), height (ventro-dorsal) and width (left-right) (Fig. 4). Height/length (W/L) and width/height (W/H) relations were calculated and the nonparametric Kruskal-Wallis applied. Significant morphological differences between populations from distinct beaches were proofen by Dunn test.

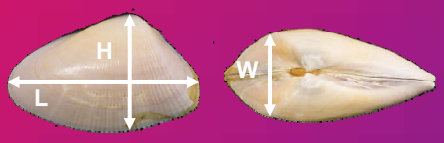

Fig. 4: *D. marincovichi* (25mm), with marked measuring points. On the left shell lenght (anterior-posterior) and height (ventral-dorsal). On the right shell widht (left-right).

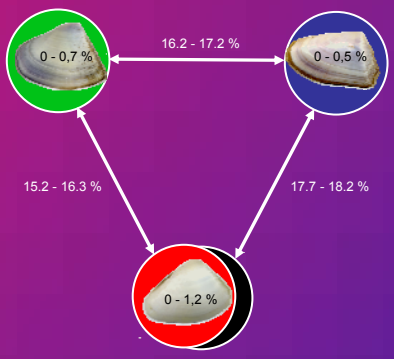

Fig. 3: Interspecific and intraspecific (in circles) genetic distances between *D. asper*, *D. hanleyanus*, *D. obesulus*, and *D. marincovichi*. *D. obesulus* and *D. marincovichi* cannot be distinguished based on the COI data.

Results

Kruskal-Wallis test showed a high significant difference between width/height as well as height/length ratio between populations ($p<0.001$). The shells from the upper north of Peru are higher and shorter indicating a compacter shape than clams from the other sites (Fig. 1). The comparison of single beaches revealed a difference between beach 10 and 2 ($p<0.001$) and beach 10 and 3 ($p<0.001$ and $p<0.01$) for both ratios (H/L and W/H). Shells were flatter and less wedge shaped. Further a significant difference was detected in the H/L ratio between beach 10 and 4, 5 and 6 ($p<0.001$). All other comparisons did not show any significant results ($p>0.05$).

Discussion

The morphological comparison reveals significant difference in shell shape between upper northern of Peruvian (10) populations and populations south of Lima (beach 2 and 3). As [4] reported morphological plasticity may already appear in juvenile stages resulting from a directional selection [5]. Future studies should therefore take beach profiles and predator abundance into account. Exclusive morphometric comparison seems not to be sufficient to explain intraspecific shell variations and to confirm the genetic study. Sperm morphology, which delivers good possibilities for taxonomic investigations [3] will be carried out to confirm the genetic results.

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References

[1] Ansell, A.D. (1983). The biology of the genus *Donax*. In: McLachlan, A., Erasmus, T. & Junk, W.E. (eds). Developments in Hydrobiology Vol. 19. Sandy Beaches as Ecosystems. Dr. W. Junk, 19: 607-635.
[2] Coan, E. (1983). The Eastern Pacific Donacidae. 25 (4): 273-298.
[3] Introíni, G.O., De Magalhães, C.A., Aguiar Jr., O., Quaresma, A.J.C., Lino-Neto, J. & Recco-Pimentel, S.M. (2004). Spermatozoan morphology of *Brachidontes darwinianus* and *Brachidontes solisianus* (Bivalvia, Mytilidae) from the southern Brazilian coast. Invertebr. Reprod. Dev. 46 (2-3): 149-158.
[4] Laudien, J., Flint, N.S. & Bank, F.H.v.d. (2003). Genetic and morphological variation in four populations of the surf clam *Donax serra* (Röding) from southern African sandy beaches. Biochem. Soc. Ecol. 31: 751-772.
[5] Trueman, E.R., Brand, A.R., Davis, P., 1966. The effect of substrate and shell shape on the burrowing of some common bivalves. Proc. Malac. Soc. Lond. 37, 97–109.

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