Pismo clams (*Tivela stultorum*) exhibit promising escape burrowing potential

Bignami, S.*, Niccum, L., Becker-Ursini, A., Mai, K., & Carrillo, Z.

CONCORDIA UNIVERSITY IRVINE

MARINE LAB CONCORDIA UNIVERSITY IRVINE

Introduction

- Beach habitats experience natural (e.g. storms) & anthropogenic sediment disturbances (e.g. beach nourishment, Fig. 1)[1], shifting sand depth by *meters* [2,3]
- Ability to "escape burrow" after burial varies by species & is critical for post-burial survival [4]
- The Pismo clam (*Tivela stultorum*, center image) is an iconic bivalve on southern CA beaches; likely subject to burial disturbances

Figure 1. Beach nourishment adds sand to beach habitats, & subjects infaunal animals to burial stress. (Photo: San Diego Union Tribune)

Objective: test the escape burrowing potential of Pismo clams in captivity

Methods

- Clams & sand collected at two beaches.
- Two size classes: "small" 5-21 mm (n=58), "Medium" 37-71 mm (n=33)
- Buried with native sand while submerged (n=65), or aerial damp sand (n= 26) then resubmerged (Fig. 2)
- Excavated if failed to escape within 72 hrs
- 7 d monitored recovery

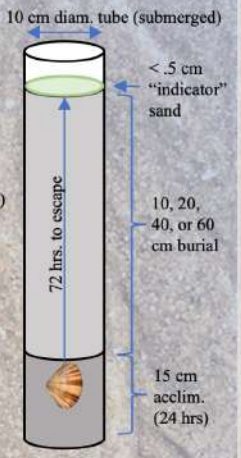


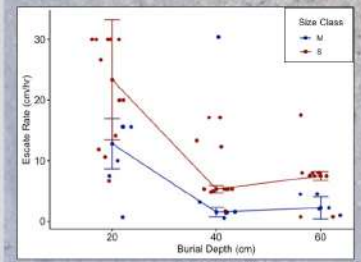
Figure 2. Escape burrowing experimental system diagram (not to scale)

Results

Escape burrowing success : 97%
(submerged burial only)

Burial while submerged improves escape success

Fig. 3. Pismo clams buried while submerged were nearly 30-times more successful at escape burrowing, compared to aerial burial ($p<0.001$, Fisher's Exact Test).



Clam size and burial depth affect escape burrowing rate

Fig. 4. Median (±mad) escape rates of small (S) and medium (M) Pismo clams buried at different depths. Small clams ($p<0.01$) and those buried under 20 cm of sand ($p<0.001$) exhibited faster escape rates (K-W test).

Conclusions

- Pismo clams have **strong ability to rapidly escape burrow under lab conditions,** at least to 60 cm burial depth
- **Escape success is reduced if buried in aerial conditions** (versus submerged); similar to previous report [5]

Additional factors of interest:

- Effect of sediment grain size [4,6]
- Capability of larger clams [4]
- Maximum depth & duration of escape
- Ability to escape burrow *in situ* [5]

Take-home message:

Pismo clams of all sizes appear resilient to burial disturbance, but this depends upon burial circumstances (i.e. aerial or submerged). This should be considered when planning beach nourishment work.

References & Acknowledgements

1. Defeo, O. *et al.* Threats to sandy beach ecosystems: A review. *Estuar. Coast. Shelf Sci.* **81**, 1–12 (2009).
2. Aubrey, D. G. Seasonal patterns of onshore/ offshore sediment movement. *J. Geophys. Res.* **84**, 6347–6355 (1979).
3. Speybroeck, J. *et al.* Beach nourishment: An ecologically sound coastal defence alternative? A review. *Aquat. Conserv. Mar. Freshw. Ecosyst.* **16**, (2006).
4. Kranz, P. M. The Anastrophic Burial of Bivalves and its Paleoecological Significance. *J. Geol.* **82**, 237–265 (1974).
5. Armstrong, L. R. Burrowing limitations in Pelecypoda. *Veliger* **7**, 195–200 (1965).
6. Mauret, D. *et al.* Vertical migration and mortality of benthos in dredged material: Part II-crustacea. *Mar. Environ. Res.* **5**, 301–317 (1981).

We would like to acknowledge the Concordia University Summer Research Institute for providing the opportunity & funding to conduct this research. We are indebted to the numerous field work volunteers who assisted with collections & are gracious for the support of C. Stafford & R. Pratt in providing access to CA State Beaches (CASP Permit # 20-820-49). Work conducted under CDFW Permit # S-183620001-19015-001

* Corresponding author: sean.bignami@cui.edu