

Application of ecological quality assessments in the Eastern Mediterranean using live and dead molluscan assemblages

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Introduction:

The EU has established monitoring directives to preserve and protect marine environments around the Mediterranean in response to increasing anthropogenic stress. An 'ecological quality status' (EcoQS) of a system is quantified by deviation from pre-impacted conditions. However, in many cases information on pre-impacted conditions is incomplete or missing, leading to potential bias. This missing information can be obtained from death assemblages. Shelly faunas accumulate on the sea floor creating death assemblages that average out short-term variations in the community and can serve as a baseline for the composition and structure of the live community.

Recent urbanization of the Israeli coast resulted in considerable input of nutrients to the shallow shelf. The largest single discharge is the Dan Region Wastewater Project (Shafdan) south of Tel Aviv that has been discharging on average 16,000 m³/day of excess sewage sludge onto the shelf at 38 m water depth and 5 km offshore since 1987.

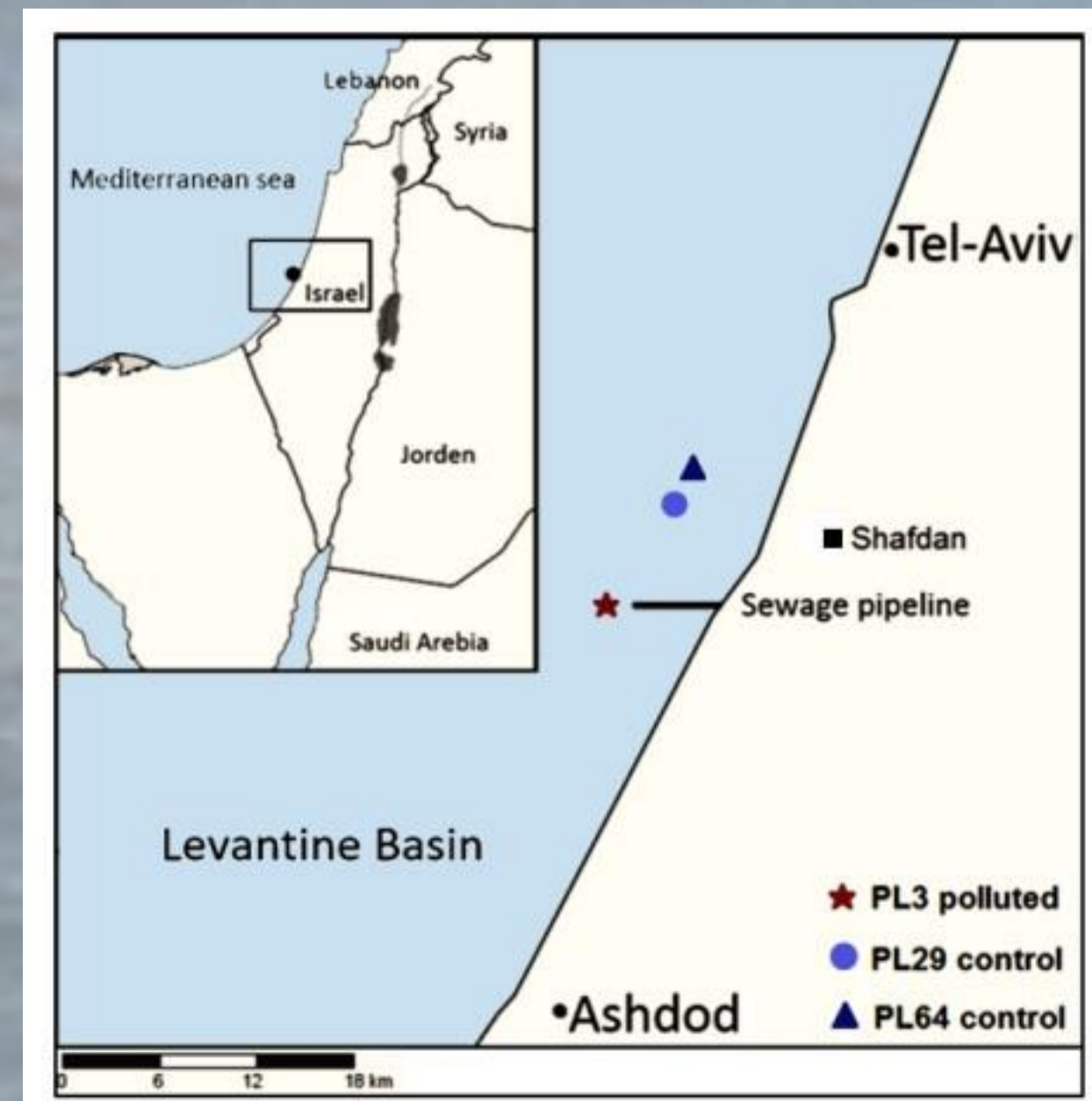
This study compared live and dead shelly molluscan assemblages across an eutrophication gradient in the highly oligotrophic Israeli shallow shelf. The AMBI, Bentix and Shannon-Wiener (H') indices were calculated for live and dead assemblages from polluted and control stations near the Shafdan. This is the first application of the AMBI and Bentix indices on molluscan death assemblages, thus adding important baseline information for the live communities of the eastern Mediterranean.

Methods:

Sampling took place in winter (Jan), spring (May-Jun), summer (Jul) and fall (Nov) of 2012 at three stations:

- **PL3** - polluted station, 200 m NE of the outfall at 36 m water depth
- **PL29** - control station, 5.5 km NE of the outfall at 34 m water depth
- **PL64** - control station, 7 km N-NE of the outfall at 35 m water depth

Three replicate sediment samples containing dead mollusks were collected from the top 1.5 cm of a GOMEX box-corer or a Van Veen Grab on each cruise at each station. Replicate samples for live mollusks were collected by dragging a dredge over 30 m of seafloor. Samples were sieved at 2 mm and specimens were identified to the species level. Total organic carbon (%wt TOC) of the sediment was measured on each cruise at each station.



Location map: polluted and control stations sampled near the Shafdan

References

Borja, A., Elliott, M., Henriksen, P., and Marbà, N., 2012. Transitional and coastal waters ecological status assessment: Advances and challenges resulting from implementing the European Water Framework Directive. *Hydrobiologia* 704, 213–229. doi:10.1007/s10750-012-1276-9.

Kidwell, S.M., 2007. Discordance between living and death assemblages as evidence for anthropogenic ecological change. *PNAS* 104, 17701–17706. doi:10.1073/pnas.0707194104.

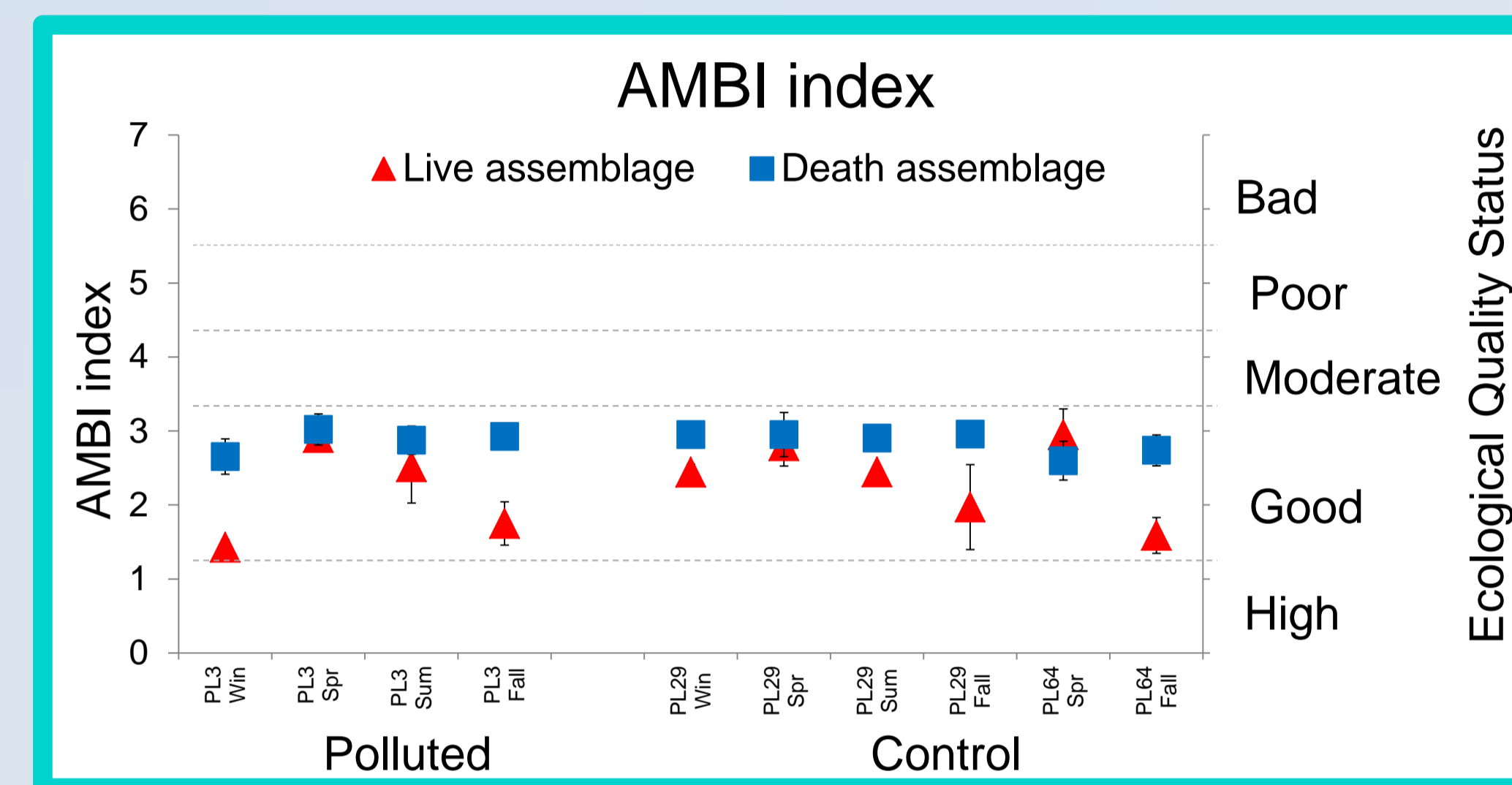
Van Hoey, G., Borja, A., Birchenough, S., Buhl-Mortensen, L., Degraer, S., Fleischer, D., Kerckhof, F., Magni, P., Muxika, I., Reiss, H., Schröder, A., and Zettler, M.L., 2010. The use of benthic indicators in Europe: From the Water Framework Directive to the Marine Strategy Framework Directive. *Mar. Pollut. Bull.* 60, 2187–96. doi:10.1016/j.marpolbul.2010.09.015.

Are differences detected between

- live and dead assemblages?
- polluted and control stations?

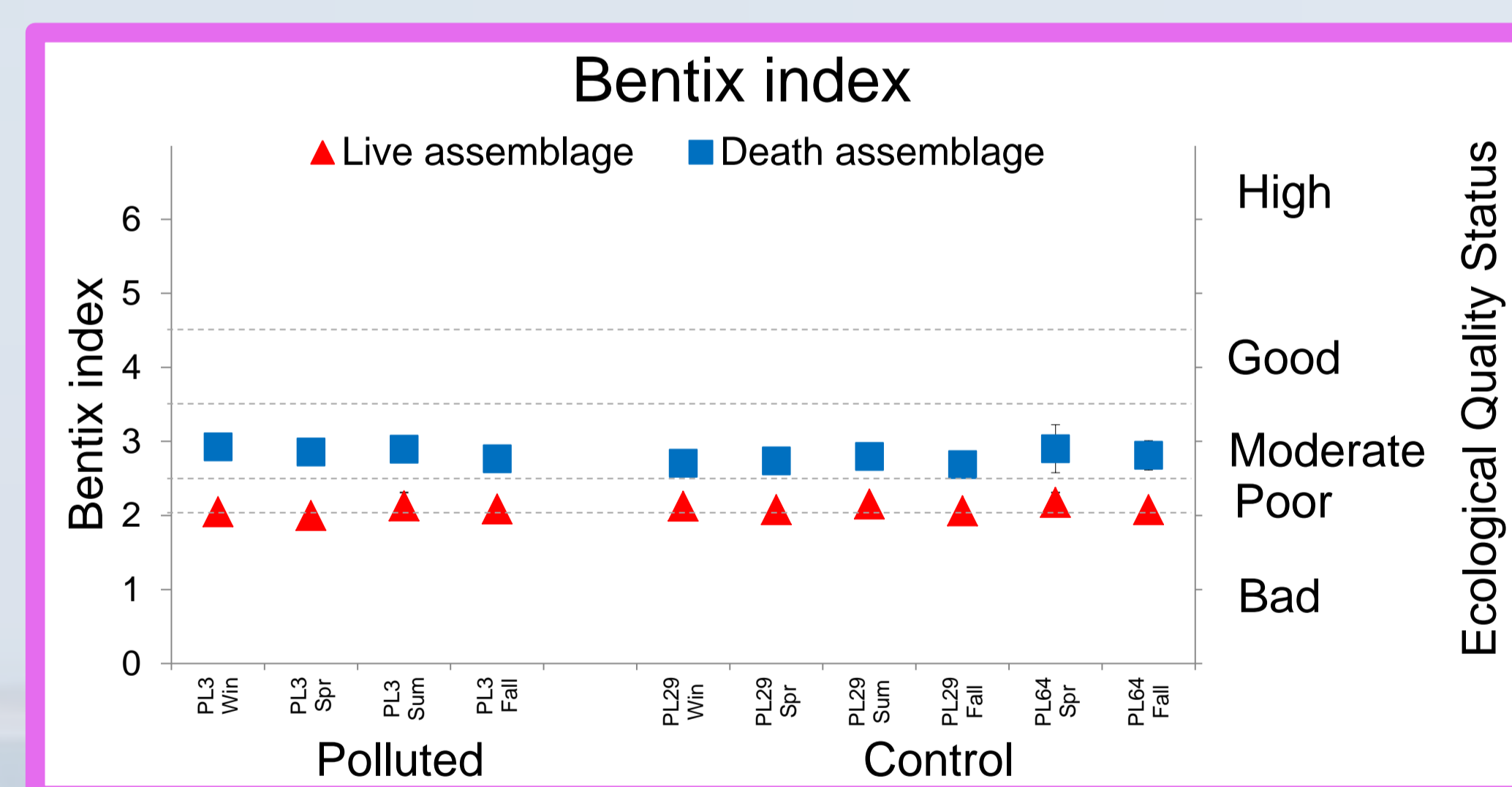
AMBI index: no differences

- live = dead assemblages
- polluted = control stations



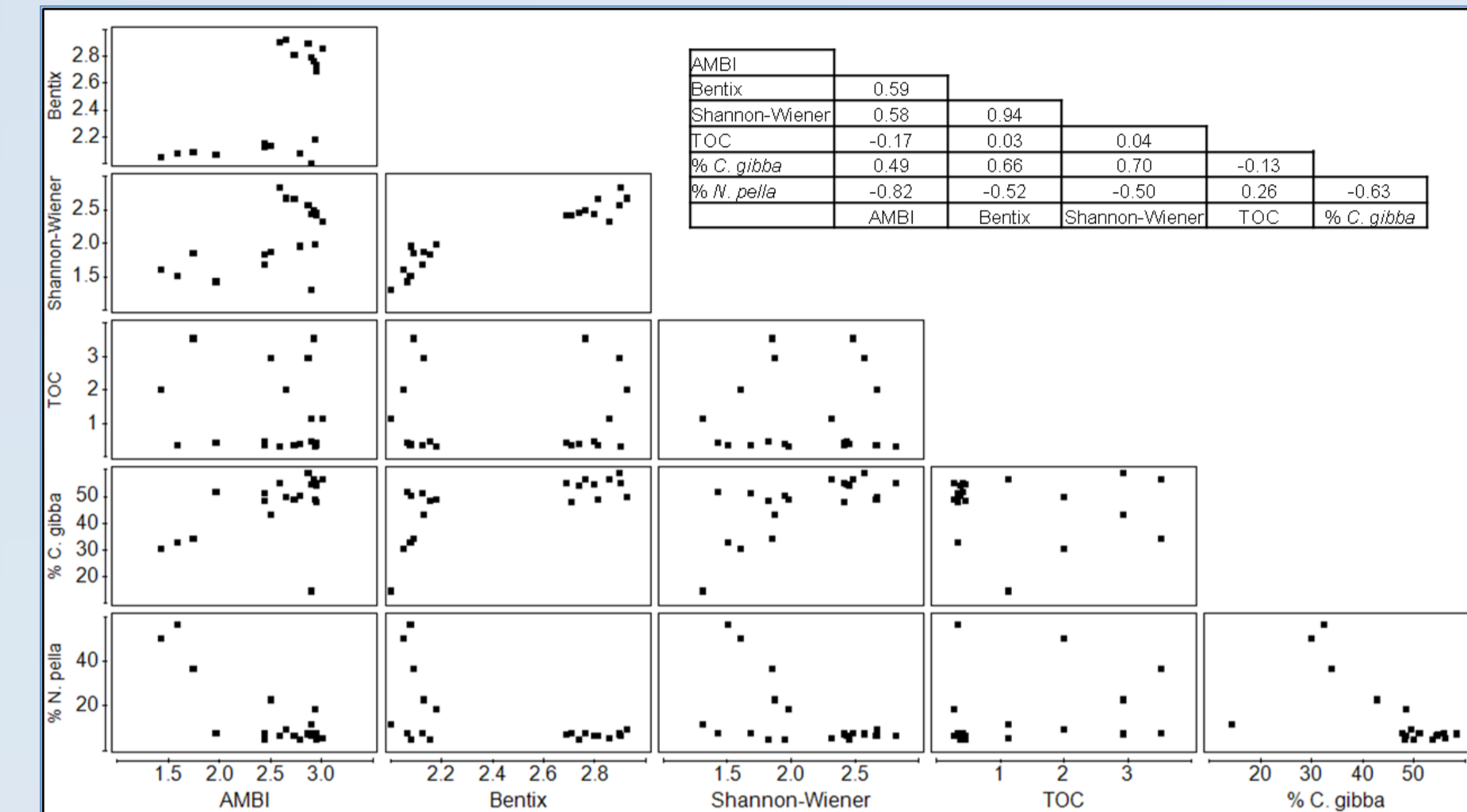
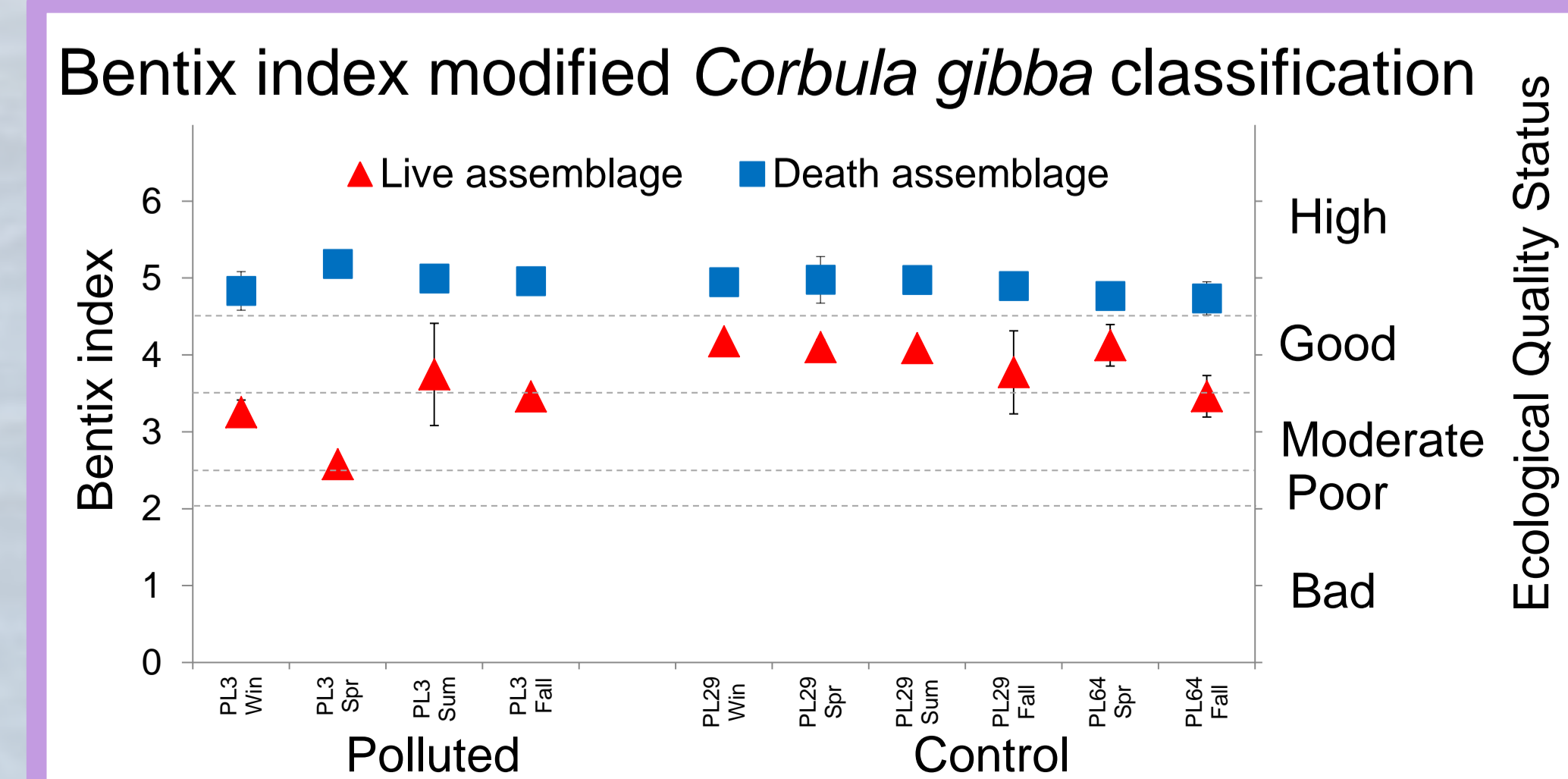
Bentix index: only temporal differences

- live ≠ dead assemblages
- polluted = control stations



Revised Bentix index: both temporal and lateral differences

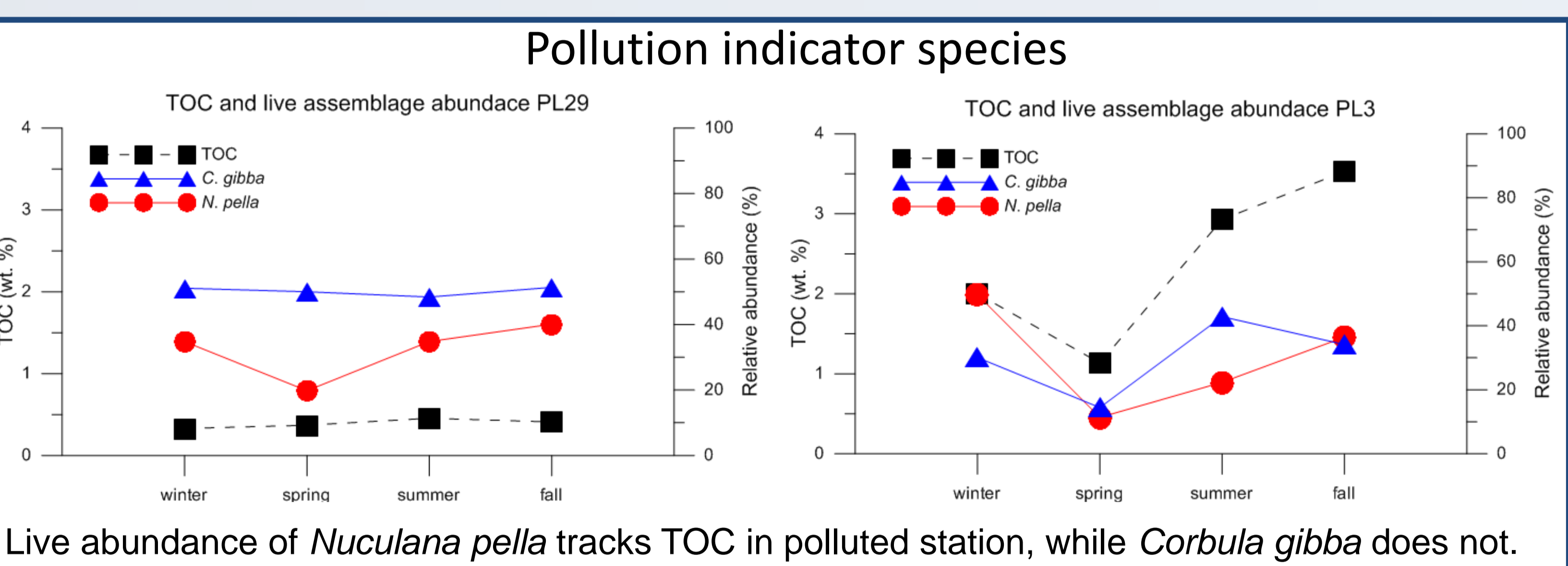
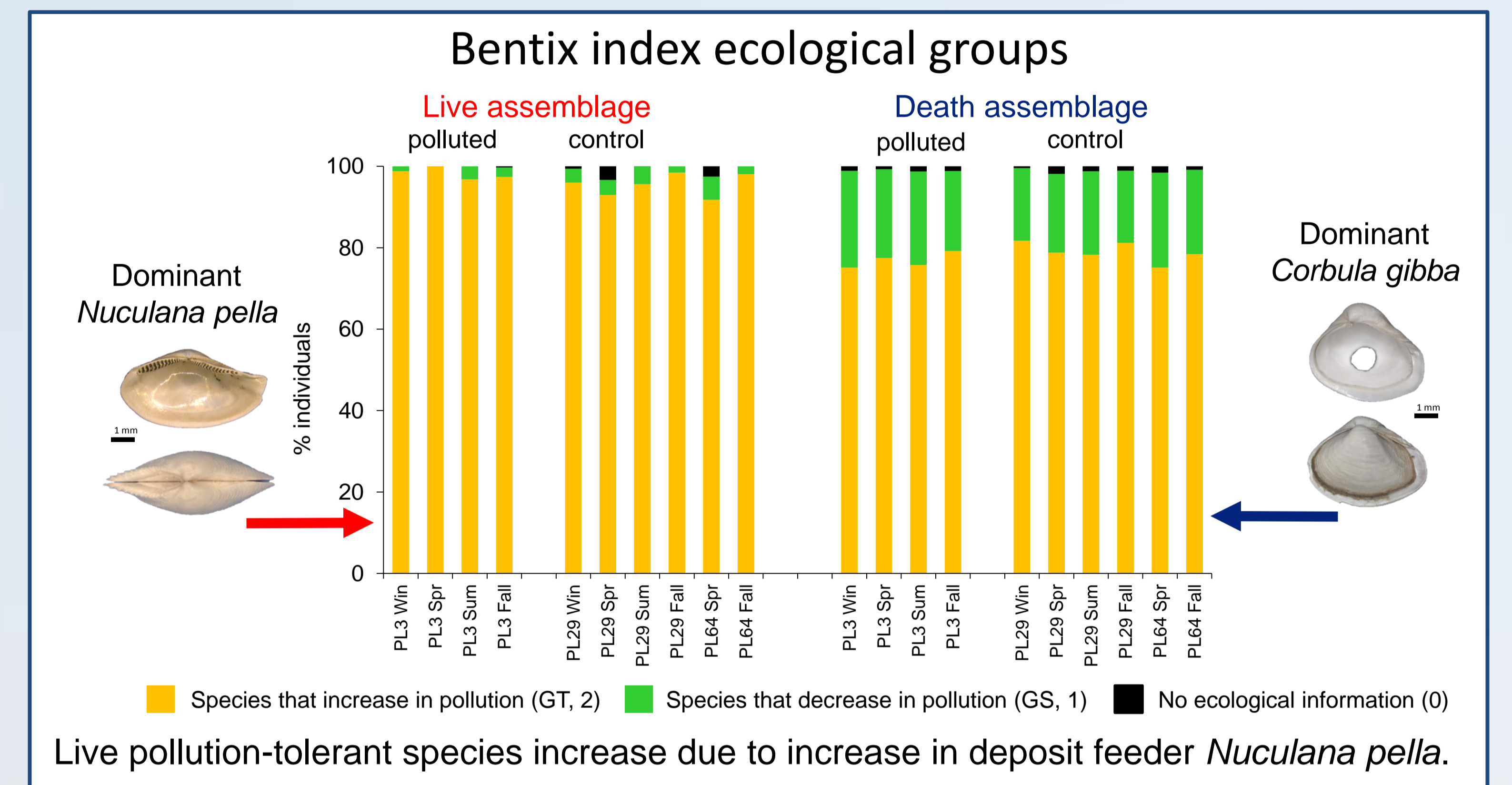
- live ≠ dead assemblages
- polluted ≠ control stations



Pearson correlation coefficients

Positive correlation:
Bentix : Shannon-Wiener (0.94)
%*Nuculana pella* : TOC (0.26)

Negative correlation:
%*Corbula gibba* : TOC (0.70)



Conclusions:

- Bentix and Shannon-Wiener indices are more sensitive than AMBI. They show decrease in ecological quality over time, from a moderate EcoQS in the dead- to a poor EcoQS in the live assemblage.
- *Corbula gibba* is common at all stations, and does not increase with pollution. In contrast, *Nuculana pella* does respond by increasing with pollution and thus can be used to quantify its effect.
- The ecological meaning of the most abundant species in the eastern Mediterranean, *C. gibba*, should be revised and scored among the non- indicators of pollution. This modification will enable Bentix to differentiate polluted from control stations.
- Dead molluscan assemblages can evaluate ecological conditions from before the onset of human activity and can be usefully applied to future monitoring. This can be accomplished by applying the modified Bentix using death assemblages to datasets over longer time scales than seasons.