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## Note

## Fluctuating asymmetry in grass goby *Zosterisessor ophiocephalus* Pallas, 1811 inhabiting polluted and unpolluted area in Tunisia

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## ABSTRACT

Fluctuating asymmetry, a random deviation of bilateral traits, is assessed on grass goby *Zosterisessor ophiocephalus* Pallas, 1811 living in one disturbed site and in one unpolluted site Gulf of Gabes (Tunisia). Statistical analysis showed that assessed asymmetries are fluctuating. FA of orbital diameter, sub-orbital distance, pectoral fin and post-orbital length are higher in polluted site compared to control. Chemical pollution seems to be responsible for this high FA.

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## 1. Introduction

Monitoring the impacts of environmental stressors on biological systems is of interest to biologists concerned with management and sustainability (Depledge and Galloway, 2005).

Fluctuating asymmetry (FA) has become a popular method for measuring phenotypic response to environmental stress (Leamy and Klingenberg, 2005). FA is defined as small, random deviations of bilateral traits from perfect symmetry due to subtle variations in the developmental environment (Palmer and Strobeck, 2003). Thus, significantly increased levels of FA in a population may indicate that individuals are having more difficulty maintaining precise development, resulting in negative effects on the population over time (Markow, 1995).

The Gulf of Gabes (located southeast of Tunisia) suffers from urbanization, industry, over-fishing, tourism and from the discharge of huge amounts of phosphogypsum and other pollutants (Smaoui-Damak et al., 2003; Messaoudi et al., 2009; Rekik et al., 2012). Indeed, fish production is gradually decreasing parallel to the decline of littoral beds of the endemic Mediterranean seagrass *Posidonia oceanica* (L.) Delile species (Ben Brahim et al., 2013). In addition, a remarkable decline in marine faunas and floras in the Gulf of Gabes has also been observed (e.g.; Louati et al., 2001; Zaghden et al., 2005; Dhib et al., 2013; Ben Brahim et al., 2013). Even though biodiversity surveys and monitoring can detect

changes both in species levels and community structures, this approach is time consuming and requires very high efforts. The use of fluctuating asymmetry could be an effective alternative for monitoring.

The significant advantage of FA over other approaches, however, is this method is simple, cheap and needs only unskilled labor to carry out. These features are highly appropriate to the monitoring programs in Gulf of Gabes, where financial and scientific skills are typically constrained. The measurement of FA is easily carried out and does not need highly sophisticated equipment. Only simple equipment such as vernier calipers or microscopes are needed for measurement of FA (Palmer and Strobeck, 1986).

This preliminary study aims to access, using a common fish in the Gulf of Gabes, if FA in a contaminated site would be higher than in an unpolluted site, and if so, what are the best traits which show higher FA in order to use them in subsequent more extensive studies.

## 2. Materials and methods

Chosen specie is the grass goby (Gobiidae), *Zosterisessor ophiocephalus* (Pallas, 1811), a demersal fish species living on soft-bottoms in shallow brackish water. The size of matured females and males was respectively 12.65 cm and 13.91 cm total length (TL) at 2.9 and 3.5 years (Hajji et al., 2013).

Ninety-six specimens of *Z. ophiocephalus* were collected during September–November 2012 from the littoral zone using a long handled sweep net (40 cm × 55 cm with a 0.5 mm mesh). Sampling sites were selected in the Gulf of Gabes, in southeastern coast

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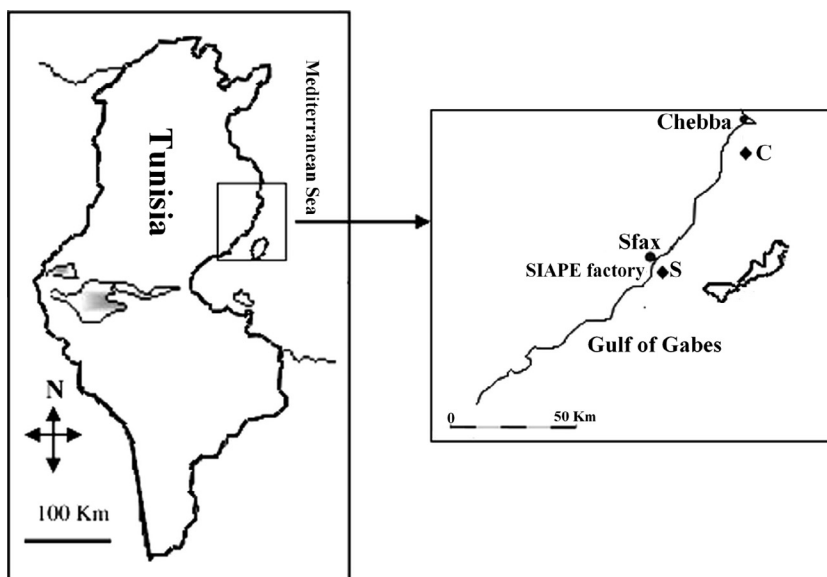


Fig. 1. Map of the study area, showing the sampling sites: C, Chebba site; S, Sfax site.

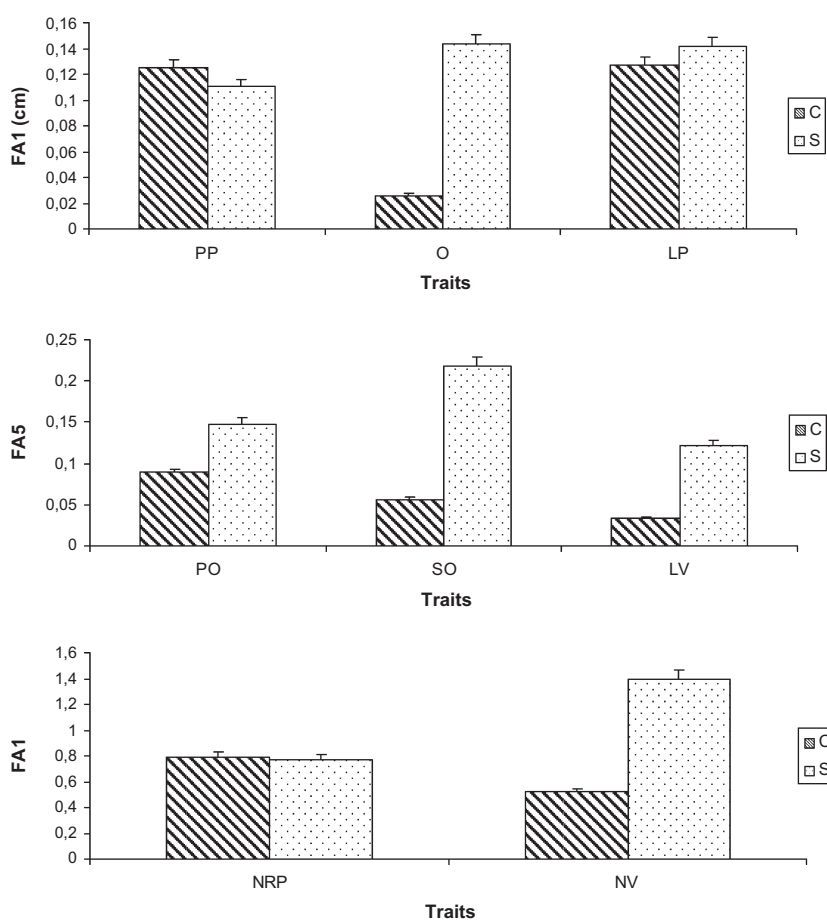


Fig. 2. Mean  $\pm$  sd of fluctuating asymmetry indexes at sampling sites.

of Tunisia (Fig. 1); the industrialized coast of Sfax (S), surrounded by important industrial activities especially the factory of phosphate treatment 'SIAPE', was chosen as the disturbed site contaminated with heavy metals, essentially Cadmium (Smaoui-Damak et al., 2003) and the control site in coast of Chebba (C), located

about 70 km north of Sfax (S), which is unpolluted (Mabrouk et al., 2014).

Chosen characters for accessing FA were previously used in fish (e.g. Hechter et al., 2000; Lucentini et al., 2002). They are 6 bilateral metric and 2 meristic characters: as follows: (1) the length of the

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