

Impacts of Chernobyl Radioactivity on Fecundity and Developmental Stability in the freshwater crustacean, *Asellus aquaticus*

Neil Fuller¹, Jim T. Smith², Liubov L. Nagorskaya³, Dmitri I. Gudkov⁴ & Alex T. Ford¹

¹ Institute of Marine Sciences, School of Biological Sciences, University of Portsmouth, Ferry Road, Portsmouth, PO4 9LY, UK
² Burnaby Building, School of Earth & Environmental Sciences, University of Portsmouth, Burnaby Road, Portsmouth, PO1 3QL, UK
³ Applied Science Center for Bioresources of the National Academy of Sciences of Belarus, 27 Akademicheskaya Str., 220072 Minsk, Belarus
⁴ Department of Freshwater Radioecology, Institute of Hydrobiology, Geroyev Stalingrada Ave. 12, UA-04210 Kiev, Ukraine

Introduction

Email Contact: neil.fuller@port.ac.uk

- The 1986 Chernobyl accident dispersed vast amounts of radioactivity into the environment which persists to date. Despite thirty years of research, the chronic effects of the Chernobyl accident on non-human organisms remain unclear⁽¹⁾.
- Understanding the effects of environmental radioactivity on non-human organisms is fundamental to mitigating the impacts of releases of radiation to the wider environment.
- Crustaceans are important model organisms in radioecology and are one of the International Commission on Radiological Protection's (ICRP) eight Reference Animals and Plants (RAPs) ⁽²⁾. RAPs are used as models to relate radiation exposure to effects and are the focus of impact assessments in contaminated environments.
- The present study aimed to use two cost effective indicators to assess effects of chronic radiation exposure on the freshwater crustacean, *Asellus aquaticus*; fluctuating asymmetry (FA) and fecundity. Fluctuating asymmetry assesses deviations from the expected perfect bilateral symmetry of an organism and is a commonly used indicator of developmental stability in ecotoxicology.

Materials & Methods

- Asellus aquaticus* was collected from six lakes of varying contamination in Belarus and the Ukraine in May – June of 2015/2016.
- Historic samples from an additional five sites were collected in 2004/2005 for FA analysis. Dose rates are shown in Table 1..

Table 1. – Total dose rate at 9 sites of varying radionuclide contamination in the Chernobyl region.

Site	Sampling Year	Total Dose Rate (μGy/hr)
Glubokoye	2015	27.1
	2004	35.2
Yanovsky Crawl	2015	20.6
	2004	7.41
Svatoye #3	2015	2.2
	2004	2.74
Stoyacheye	2015	0.872
	2015	0.786
Gorova	2015	0.064
	2004	0.0694
Rita River	2004	0.0694

- Dose rates were calculated using deposition data for ¹³⁷Cs and ⁹⁰Sr at sampling sites using the ERICA tool (v 1.2)
- A total of five traits were used to assess FA (See Fig. 1) and were measured using Image J (v 1.48).
- Fecundity was assessed in a total of 394 individuals over two years of sampling

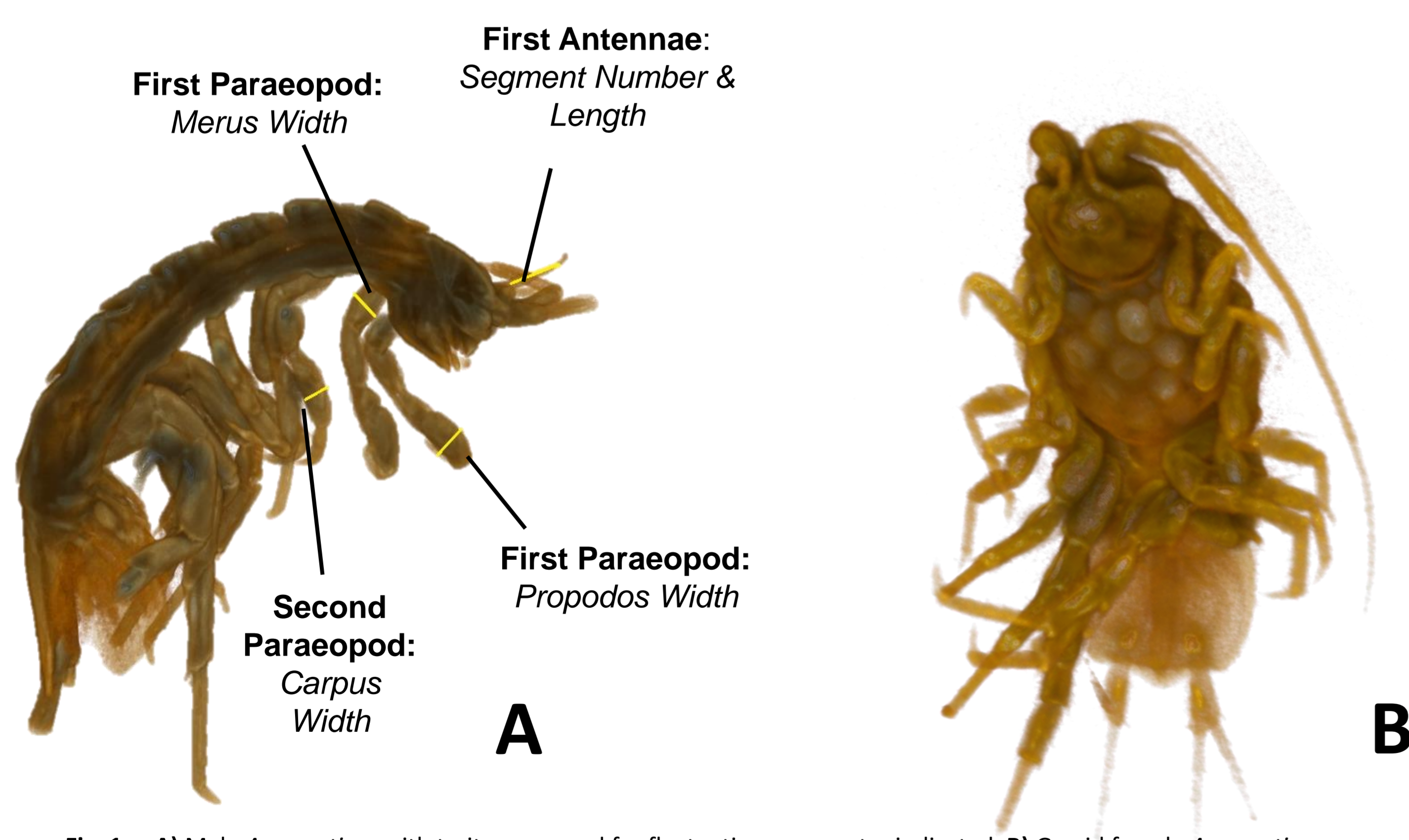


Fig. 1. – A) Male *A. aquaticus* with traits measured for fluctuating asymmetry indicated. B) Gravid female *A. aquaticus*.

Results & Discussion

Fluctuating Asymmetry

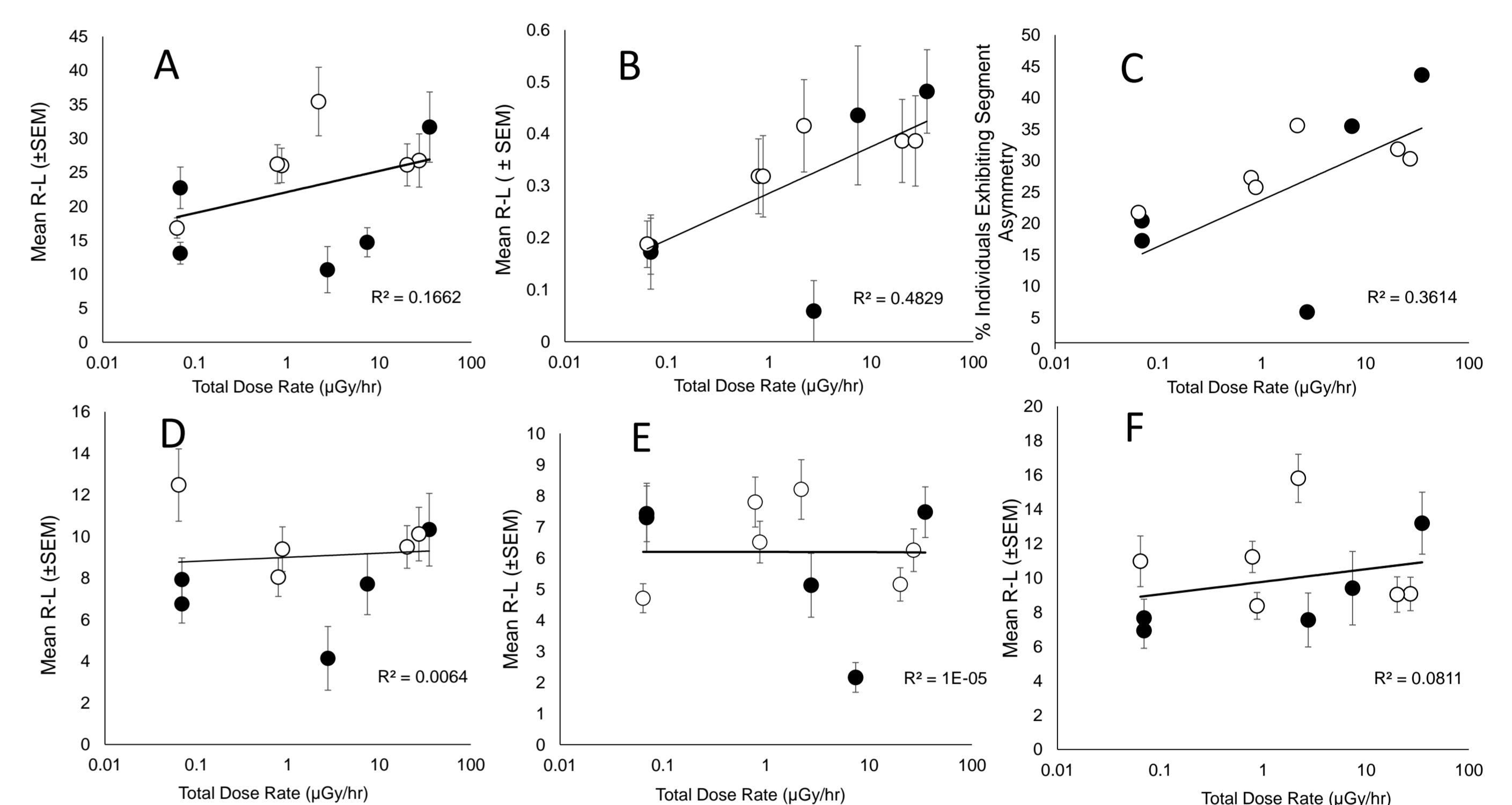


Fig. 2. – Relationship between radiation dose rate and fluctuating asymmetry in A) First Antennae Length B) Number of Antennal Segments C) % of Individuals displaying segment asymmetry D) Propodos width E) Carpus width and F) Merus width at 9 sites along a gradient of radiation contamination at Chernobyl. 2015 = ○ 2004 = ●

- A significant positive relationship between FA and total dose rate was recorded for one of five measured traits (See Fig. 2B, Regression analysis, $p < 0.05$)
- This suggests limited effects of chronic radiation exposure on the developmental stability of *A. aquaticus*.

Fecundity

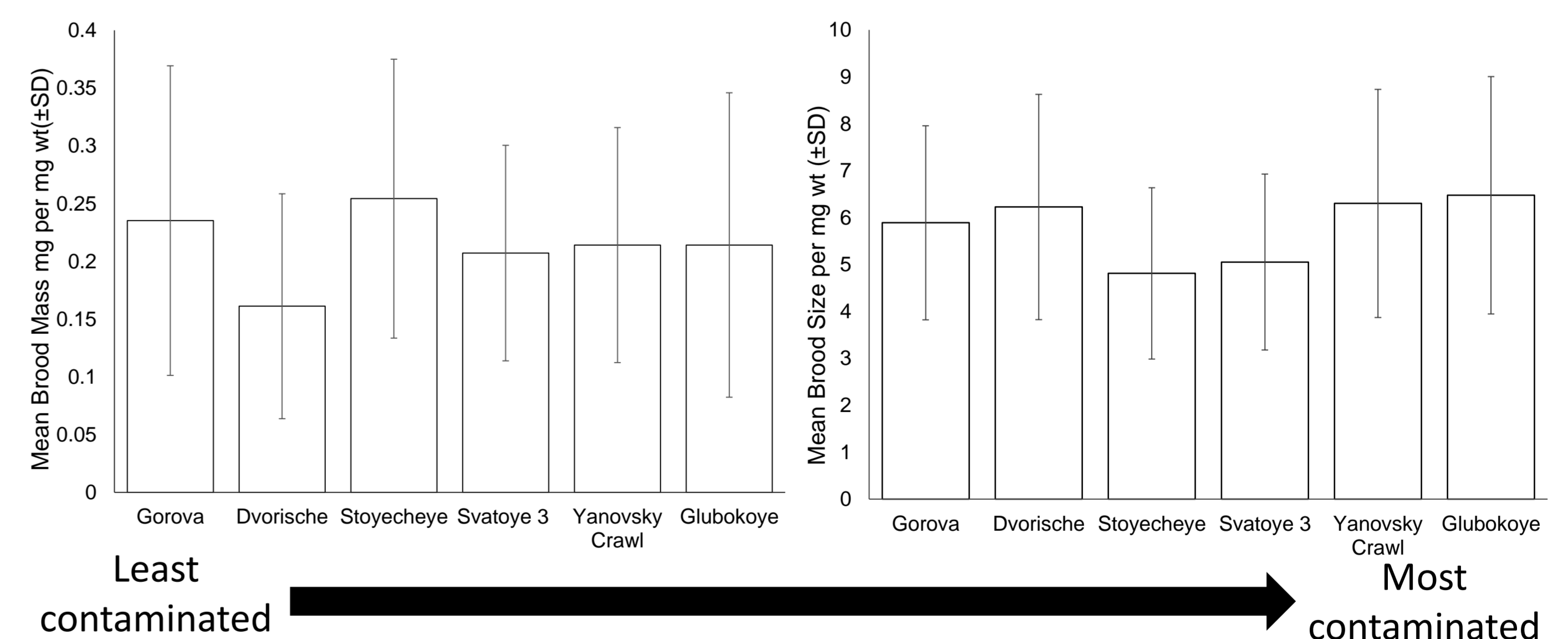


Fig. 3. – A) Brood masses and B) Brood sizes normalised to maternal weight at six sites of varying radionuclide contamination in Belarus and the Ukraine.

- No significant differences in brood masses or sizes at sites of varying contamination (LMM, $F_{1,80} = 2.402$, $p = .494$)

Conclusions

- Present study demonstrates minimal effects of Chernobyl radiation on developmental stability of the freshwater crustacean, *A. aquaticus*
- No effects of 30 generations of radiation exposure on reproduction in *A. aquaticus*
- Populations may have adapted to chronic radiation stress

References & Acknowledgments

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