South American crustaceans as organic extractive species of omnivorous fish culture: effects of fish feed on growth, survival and proximal composition

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Introduction

Aquaculture expansion has led to environmental consequences worldwide, among which the discarding of large amounts of organic waste, derived from intensive feeding, could be mitigated through the species diversification in integrated multitrophic aquaculture (IMTA). The incorporation of freshwater decapods, native to South America with a broad trophic spectrum, could biomitigate the discharge of nutrients in fish culture and increase profits. In Argentina we are developing an Aquaponics system with native species: The most cultivated fish in the country (Pacu, *Piaractus mesopotamicus*), native crustaceans and vegetables (Fig. 1). In order to choose the appropriate species of crustacean for this IMTA, we carried out the present study.

> The aim of this study was to evaluate the effect of a commercial feed used in culture of omnivorous fishes (PA 27-Garay SRL, Argentina), on growth, survival and proximal composition of three species of crustaceans (*Macrobrachium borellii*, *Trichodactylus borellianus*, *Aegla uruguayana*)
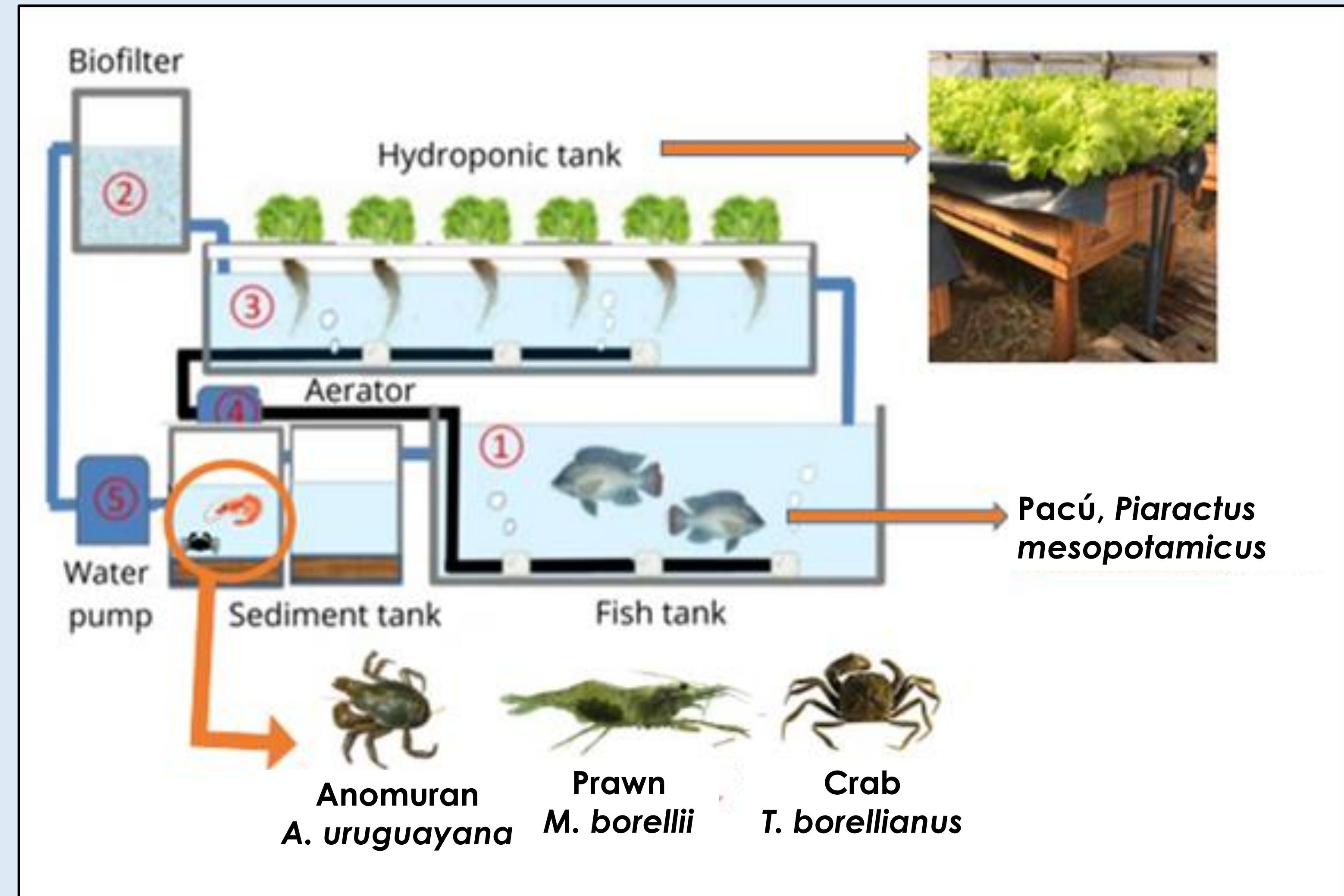

Figure 1 hypothetical aquaponics system design with native species of different trophic levels and complementary ecosystem functions. The wastes of one species become the food source for the other.

Materials and methods

Juveniles of the three species were captured in the wild and placed in nine 90L-tanks with PVC tubes and nets as shelters (initial weights: prawn=0.2g; crabs=0.13g; anomuran=0.5g). A total of 150 prawn, 29 crabs and 68 anomuran were randomly delivered to the tanks, three replicates (Fig. 2) Individuals were fed *ad libitum* twice a day.
Monthly biometric measurements were taken to estimate growth increment, survival and biomass. At the end of the experiment, the juveniles were killed and pooled. The proximal composition of crustacean bodies was estimated for each tank.
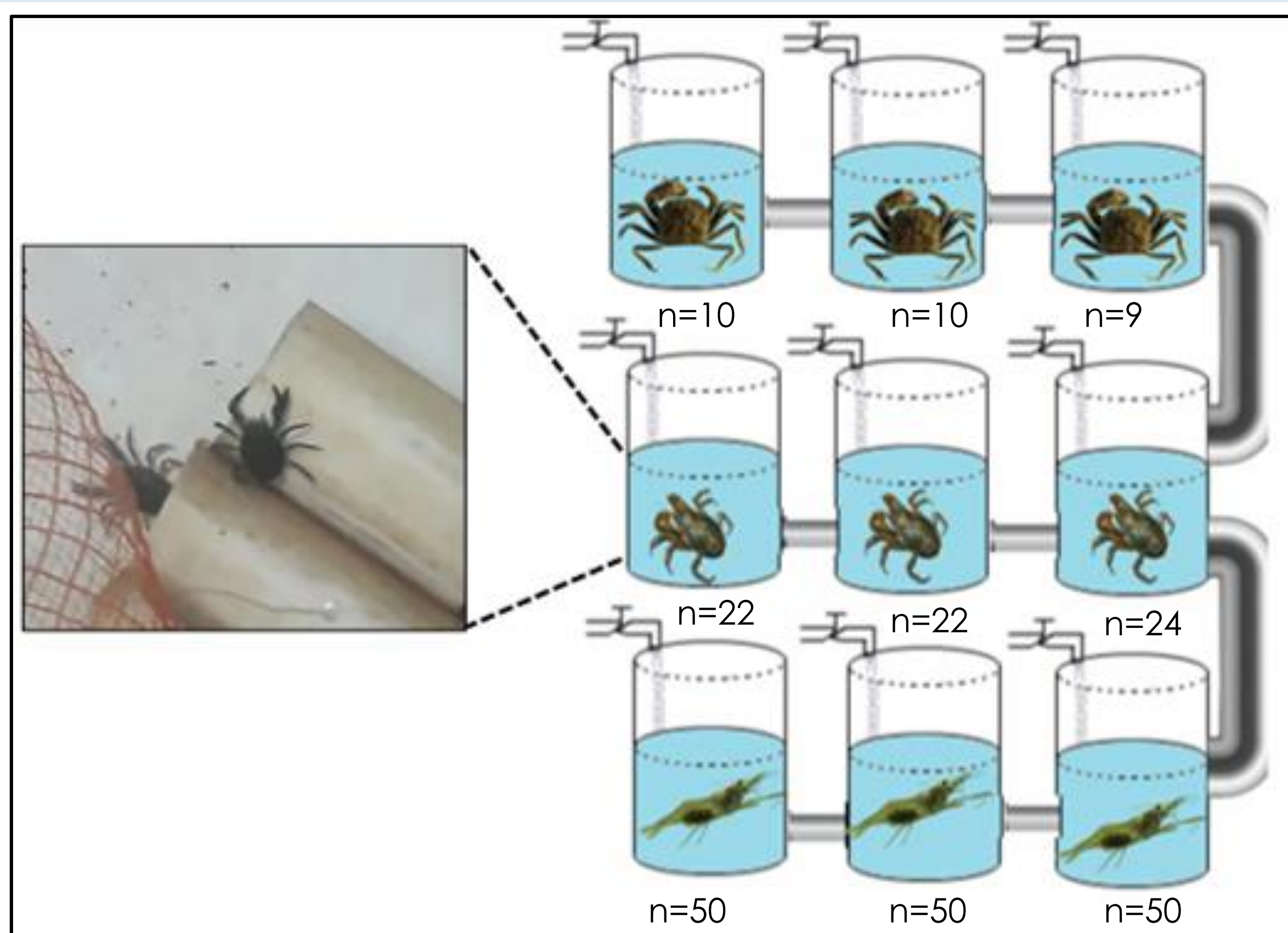
Experimental conditions and parameters:
- Photoperiod 12:12
- Constant aeration
- T: 24.86 ± 1.13 °C
- pH: 7.45
- Dissolved oxygen: 8.15mg / l
- Conductivity: 744microS
- Dissolved solids: 373.80ppm
- 84 days of experimentation

Figure 2 Experimental design used for compared the zootechnical performance of three native crustaceans

Results and discussion

Under these experimental conditions, anomurans showed the best zootechnical performances (biomass, survival and growth Increment). However, prawns presented the most interesting proximal composition (64 % of total protein in dry matter) and high survival.

Table 1 Survival and growth increment by crustaceans

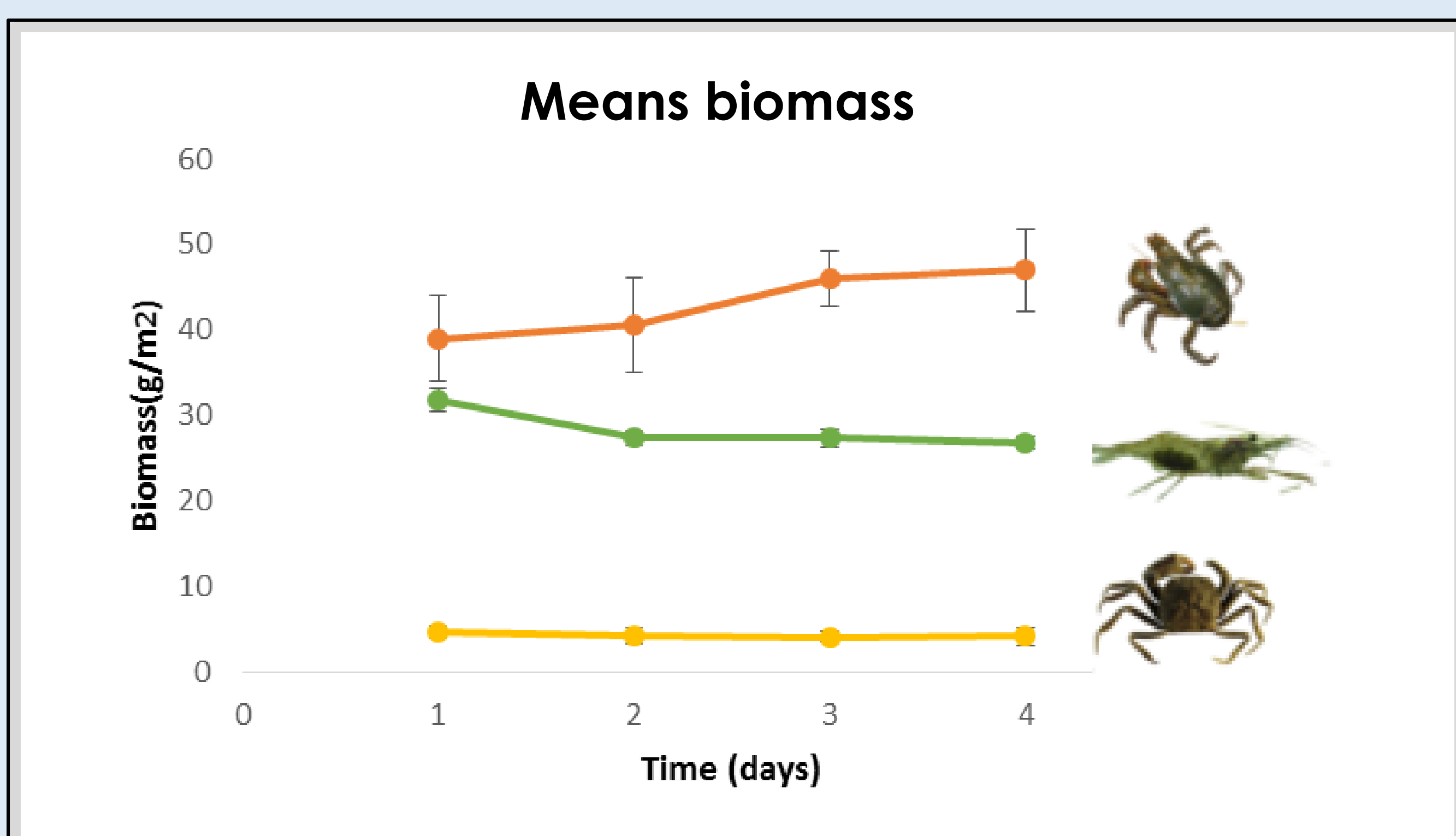| Crustacean	Survival	Growth increment
Anomuran	64,8 ± 7,1	66,02 ± 14,45%
Prawn	82 ± 3,5	2,94 ± 4,36%
Crab	31,1 ± 10,2	194,76 ± 55,34%

Figure 3 Mean biomass of three crustaceans during the experiment. The ANCOVA showed significantly different biomass slopes between species ($F_{(30,2)} = 10.9$; $p < 0.001$)
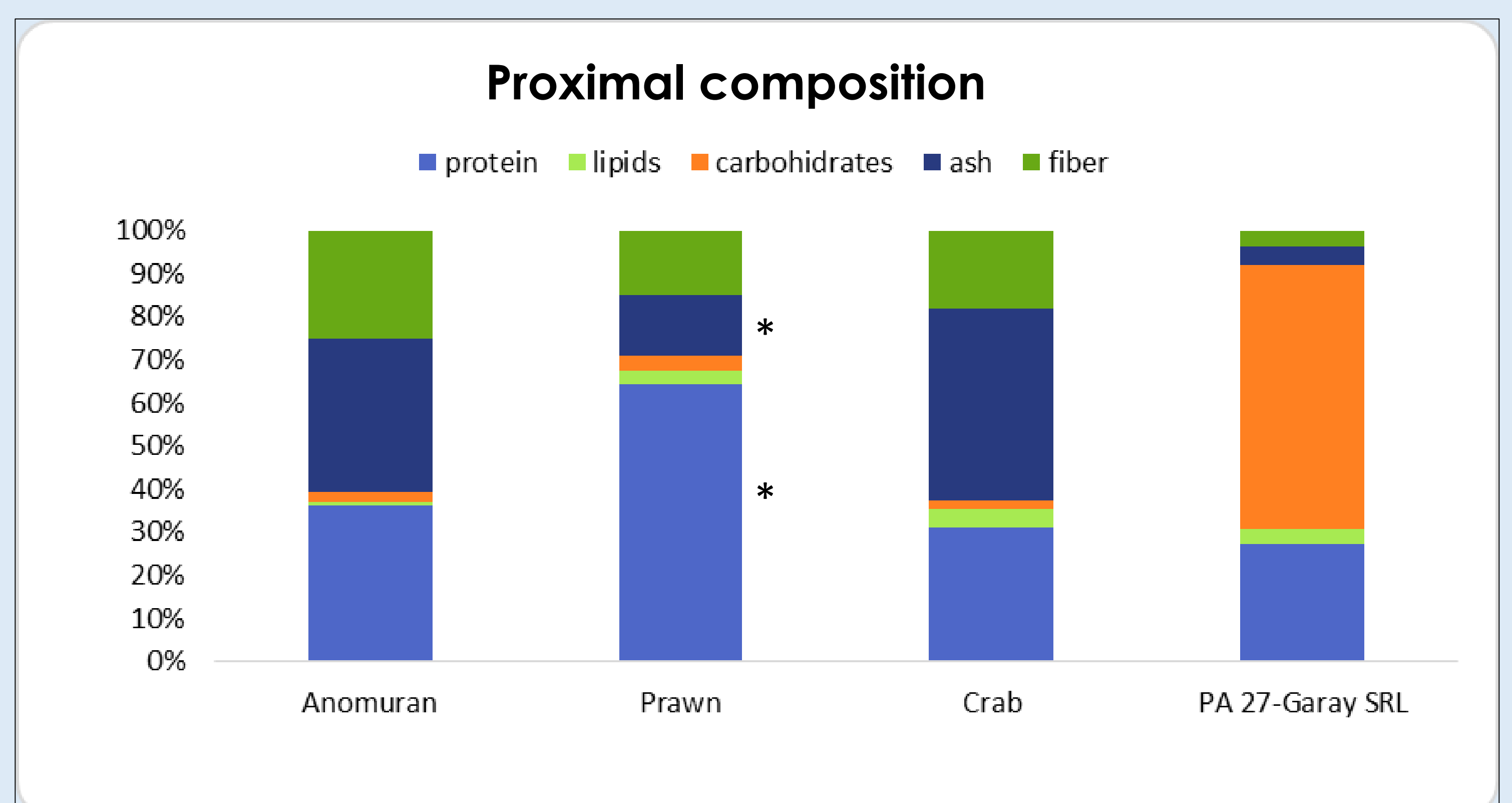

Figure 4 Proximal composition in dry base presented by the three crustaceans species and by the commercial feed used. (*) Means significantly different to other species ($p < 0.05$)

The results obtained provide useful information to choose species of crustaceans that could biomitigate feed waste in an IMTA culture integrated with omnivorous fish, enhance water quality and generate profits through species diversification.

Conclusion

Aegla uruguayana (anomuran) is proposed as a biomitigator species to be used in aquaponics systems because it presents an adequate zootechnical development under the conditions tested.