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Research Article

# DISTRIBUTION AND INDIVIDUAL CHARACTERISTICS OF THE PRAWN *PALAEMON ELEGANS* (CRUSTACEA, DECAPODA) FROM THE GULF OF GDAŃSK AND THE DEAD VISTULA RIVER

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## Abstract

The aim of this study was to determine the distribution of a prawn species new to the Gulf of Gdańsk – *Palaemon elegans* – as well as to undertake an initial characterization of the length and mass of individuals of this species with respect to sex and site of occurrence. The investigation was carried out in late June and early July 2004 at four stations situated on the shores of the Gulf of Gdańsk and the Dead Vistula River.

The total lengths of males ranged from 23 to 40 mm and those of females from 27 to 50 mm. The relationship between total length and wet weight for males and non-ovigerous females was $W_w=10^{-6}*L_t^{3.15}$, R=0.97, and that between the total length and the carapace length of males and females was $L_k=0.42*L_t-0.19$, R=0.91. These relationships for *P. elegans* may be of use in assessing the size and mass of prawns consumed by predators.

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## INTRODUCTION

The crustacean *Palaemon elegans* Rathke, 1837 (synonym: *Leander squilla elegans* (Rathke, 1837)) inhabits intertidal rock pools on the Atlantic coast of Europe, the North Sea, the Mediterranean (Campbell 1994), and the Black Sea (Başçinar *et al.* 2002). In the 1930s, *P. elegans* was accidentally introduced with fish (mullet) to the Caspian Sea. It was also the first invertebrate invader in the Aral Sea (Aladin *et al.* 2001, Aladin et al. 2002). As a euryhaline species, it migrates into the shallow waters of lagoons and river mouths (*e.g.*, in Sweden and Norway) (Dolmen *et al.* 2004). *P. elegans* has been recorded in the western Baltic Sea (Campbell 1994). Although it was known in 2001(Wysocki pers. com.), or possibly earlier, that *P. elegans* was already inhabiting the Gulf of Gdańsk, not until 2003 was it investigated there for the first time (Janas *et al.* 2004).

The aim of the present study was to determine the distribution of *P. elegans* in the Gulf of Gdańsk and the Dead Vistula River and to characterize the length and mass of individuals of this species with respect to sex and site of occurrence.

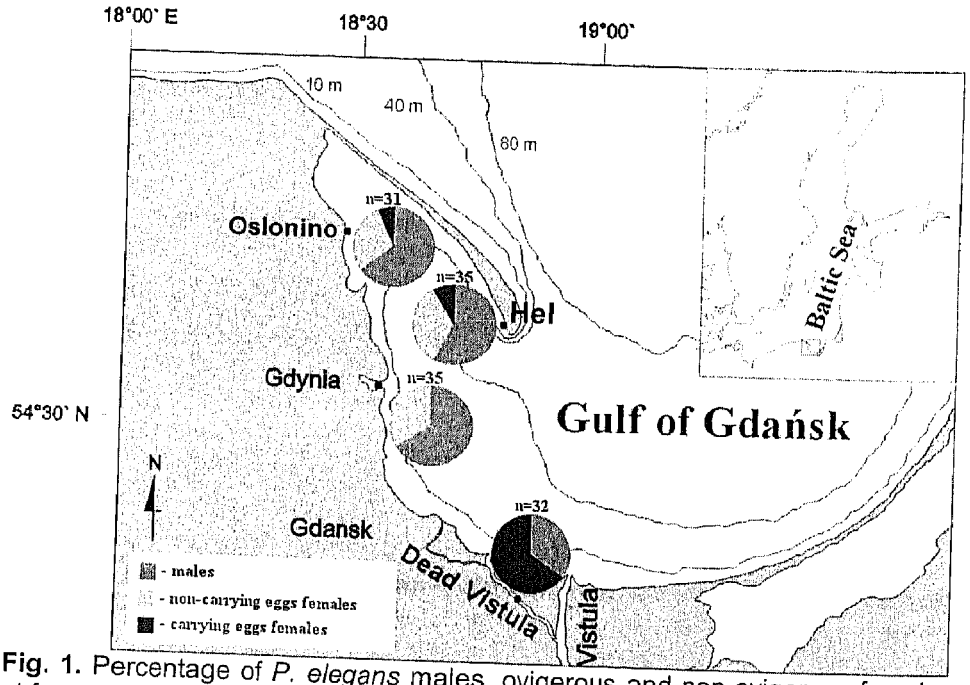


**Fig. 1.** Percentage of *P. elegans* males, ovigerous and non-ovigerous females at four studied stations in June-July 2004 (n- number of animals).

## MATERIALS AND METHODS

The prawns were collected from the surface water (to a depth of approximately 1 m) with a 4 mm mesh hand net at four stations (Hel, Osłonino, Gdynia, Dead Vistula River) from 24 June to 1 July 2004 (Fig. 1). A total of 133 specimens were caught. Concurrently, the surface water temperature and salinity were measured with a conductometer (WTW, Germany).

The prawns were measured from the rostral tip to the posterior edge of the telson (total length) and to the posterior carapace edge (carapace length); both lengths were measured to the nearest mm. The endopodite of the second pair of pleopods was used to determine sex (Hayward and Ryland, 1996). In the males this endopodite is cleft and forms the *appendix masculina.* The wet weight of each specimen was measured with a precision balance (±0.001g). Ovigerous females were weighed together with their eggs. Total lengths and wet weights are given as means with standard deviation (±SD).

The total length-wet weight relationship was calculated for males and non-ovigerous females according to the power equation $W_w = aL_t^b$, where: $W_w$ – wet weight in g; $L_t$ – total length in mm; a – slope; b – the exponent; R – correlation coefficient. Linear regression was used to determine the relationship between the total length and carapace length of all the animals collected, as follows: $L_k = aL_t+b$, where: $L_k$ – carapace length in mm; $L_t$ – total length in mm; a – intercept; b – allometric coefficient; R – correlation coefficient;

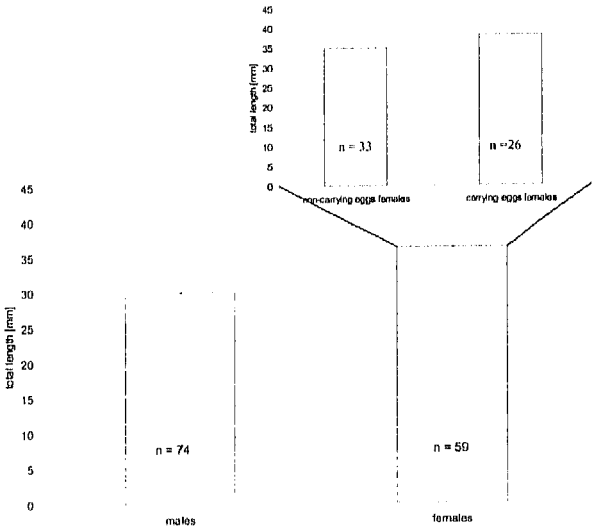


**Fig. 2.** Average length (±SD) of *P. elegans* males and females - non-ovigerous and ovigerous.

## RESULTS

The water temperature at the time of sampling was 14.0-16.3°C in the Gulf of Gdańsk and 18.3°C in the Dead Vistula River. Salinity was approximately 6.6 PSU in the gulf and 5.6 PSU in the river.

Of the *P. elegans* caught in the Gulf of Gdańsk, males were prevalent (57-66%), whereas ovigerous females comprised <10% of the total number of prawns caught (Fig. 1). In contrast, only 34% of the animals caught in the Dead Vistula were males, and all females were ovigerous.

The body length of *P. elegans* males was 30±3 mm, while that of females was 36±5 mm. Ovigerous females were slightly longer than those without eggs at 38±4 mm and 35±4, respectively (Fig. 2).

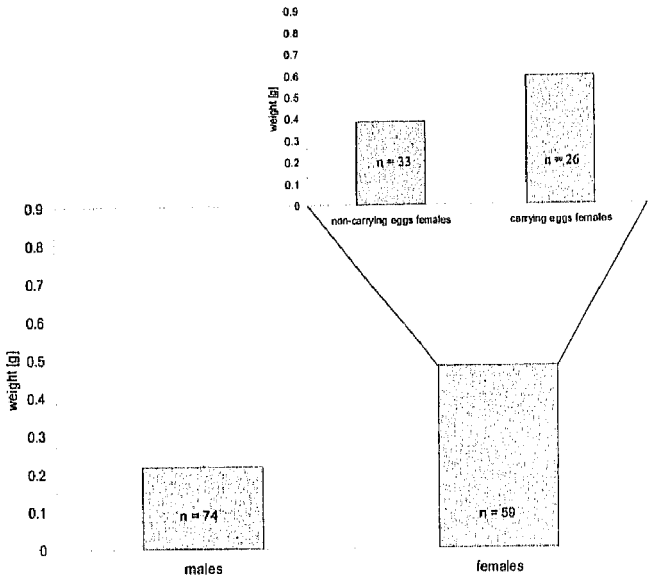


**Fig. 3.** Average weight (±SD) of *P. elegans* males and females - non-ovigerous and ovigerous.

All of the females were heavier than males, whether or not they were ovigerous (Fig. 3): males – 0.22±0.08 g; ovigerous females – 0.59±0.25 g; non-ovigerous females –0.39±0.14 g. The relationship between total length ($L_t$) and wet weight ($W_w$) was similar for males and non-ovigerous females at all four stations:

$$W_w = 10^{-6} * L_t^{3.15}, \; R=0.97 \text{ (Fig. 4).}$$

The relationship between total length ($L_t$) and carapace length ($L_k$) of *P. elegans* was similar in both males and females collected at the four stations and was described by the function:

$$L_k = 0.42*L_t-0.19, R=0.91 \text{ (Fig. 5).}$$

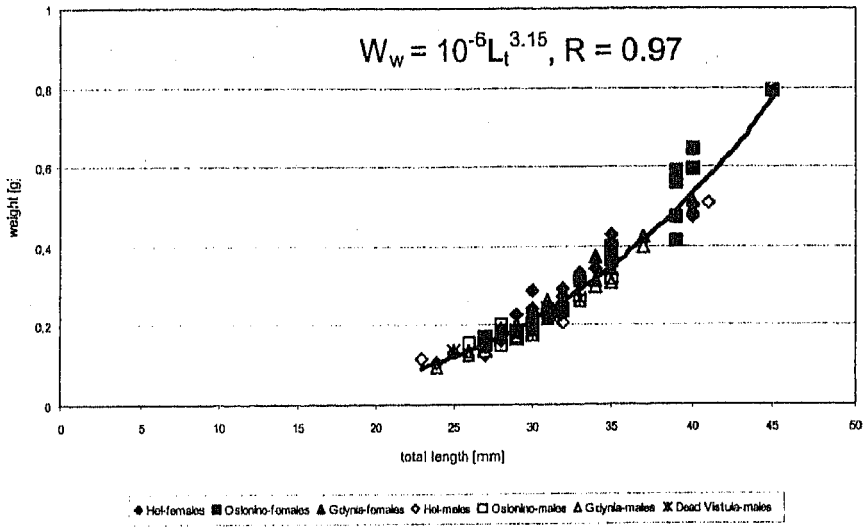


**Fig. 4.** Relationship between total length and wet weight of *P. elegans*.

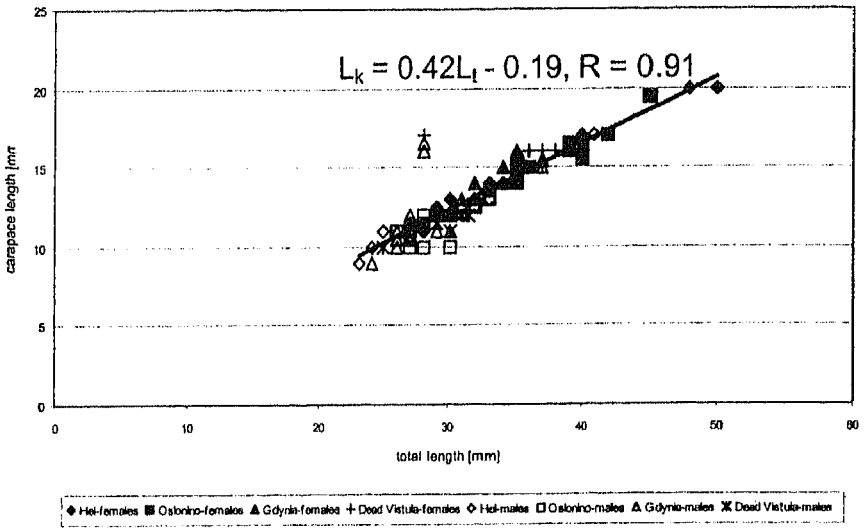


**Fig. 5.** Relationship between total length and carapace length of *P. elegans*.

## DISCUSSION

The first sighting of *P. elegans* in the Gulf of Gdańsk was thought to have been in 2003 (Janas *et al.* 2004). However, analysis of archival film has revealed an earlier record of this species near the Sopot pier in November-December 2001 (Wysocki pers. com.). Since that time, the littoral zone throughout most of the Gulf of Gdańsk has been colonized on a large scale. In 2004, *P. elegans* was found in Hel (in port areas and near concrete breakwaters), Osłonino, and Gdynia (on the stony bottom and in the port). It has also been observed under piers in Gdynia, Sopot, and Gdańsk, on derelict forts near port entrances, and on wrecks (Wysocki pers. com.). In May 2004, *P. elegans* was found along the full length of the Polish coast from the Szczecin to the Vistula lagoons (Jażdżewski *et al.* 2005).

The species is especially numerous on hard, stony bottoms or near concrete quaysides. It is frequently found on the filamentous green and brown algae growing on hard substrates. In western Europe, *P. elegans* colonizes similar substrates, and most often these are stony bottoms covered with algae (Berglund 1984, Dolmen *et al.* 2004).

*P. elegans* was most abundant in Gdynia and in the Dead Vistula River. According to a preliminary assessment, abundance there may be as high as several dozen specimens per square meter, whereas in Osłonino and Hel there were no more than a few per square meter. *Palaemon adspersus*, another prawn living in the same habitats in the Gulf of Gdańsk, was less abundant than *P. elegans*. Due to its large size, it is plausible that the contribution of *P. elegans* to the biomass of epibenthic macrofauna is significant.

Further detailed studies of both density and biomass are essential for a reliable assessment of the significance of this new population in the ecosystem. Due to the habitat preferences of *P. elegans*, it is not possible to estimate its density and biomass using grabs, drag-nets, or trawls. The most appropriate way of assessing the density of this species is to apply techniques used with certain fish species, *i.e.*, photographing or filming an area of known dimensions (Cappo & Brown 1996).

*P. elegans* migrates to the deeper parts of the gulf for the winter and returns to the coastal waters in spring. This species undertakes a similar type of migration in the Black Sea (Kobyakowa and Dolgopol'skaya 1969). Adults reappeared in early May 2004 in the shallow water of the Gulf of Gdańsk. The first ovigerous females were observed in June when the temperature was above 14°C. At Hel and Osłonino, only single ovigerous female specimens were noted and none were noted in Gdynia; however, in the Dead Vistula, where the water was warmer (18.3°C), all of the females caught were ovigerous. In Norwegian

waters, the maturation of *P. elegans* begins at a much lower temperature (probably <5°C). Dolmen *et al.* (2004) reported that in June 1998 many *P. elegans* females bore pigmented (eyed) embryos. Additionally, many of these specimens already had large, mature ovaries within their carapaces, which meant that they were preparing for the next clutch. In the Skagerrak, *P. elegans* can breed twice, whereas in the Black Sea and the Sea of Azov *P. elegans* females lay eggs as many as three or four times in one summer (Kobyakowa and Dolgopol'skaya 1969).

In the Gulf of Gdańsk, *P. elegans* displays sexual dimorphism – females are larger than males. This regularity was also observed in *P. elegans* from the Black Sea and the Skagerrak (Kobyakowa and Dolgopol'skaya 1969, Berglund 1981). The larger size in females is advantageous as it provides for a high egg-carrying capacity, while the small body size of the males reduce predation pressure and the costs of locomotion (Berglund 1984).

In the brackish waters of the Gulf of Gdańsk, females of *P. elegans* grow to 50 mm in length and the males to 40 mm. In rock pools on the British coast, females of *P. elegans* reach a length of 63 mm, while males may be up to 50 mm long (Gurney 1923). The maximum length of female *P. elegans* recorded in western Europe is 65 mm (Barnes 1994), but females from the Black Sea did not exceed 59 mm (Başçinar *et al.* 2002). Gurney (1923) assumed that *P. elegans* females > 50 mm are two years old, whereas those with a length of 60 mm and more are in their third year. However, it is not yet known how long this species can live in the Baltic Sea.

The relationships found between total length and carapace length, and total length and wet weight of *P. elegans* may be of use in assessing the size and mass of prawns consumed by predators. In fish stomachs, often only fragments of consumed prawns are found, yet the carapace is one of the most durable parts of the body.

*P. elegans* may be an important food component for such fish as cod *Gadus morhua*. Gruszka and Więcaszek (2004) found this species in the stomachs of almost 90% of the cod caught in the Gulf of Gdańsk in December 2003. *P. elegans* is very likely a new type of food for fish like eel, perch, round goby, eelpout (Sapota pers. com.), which had until now fed on *Palaemon adspersus*, another prawn species. Both of these prawn species are often used by anglers as fish bait. *P. elegans* is an omnivore that feeds on molluscs, crustaceans, polychaetes, bryozoans, fish larvae, as well as algae and detritus (Köhn & Gosselck 1989).

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