UNIVERSIDADE DO ALGARVE

BIOLOGY, ECOLOGY AND DYNAMICS OF PENNANT´S SWIMMING CRAB *(Portumnus latipes)* IN THE SOUTH OF PORTUGAL

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Declaração de autoria de trabalho:

Declaro ser autor deste trabalho, que é original e inedito. Autores e trabalhos consultados estão devidamente citados no texto e constam da listagem de referências incluida.

“What we know is a drop, what we don't know is an ocean.”

Isaac Newton (1643-1727)

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ABSTRACT

The sand crab (*Portumnus latipes*) is found on exposed sandy beaches of the north-east Atlantic and parts of the Mediterranean, where it burrows in the fine sand in the surf zone. Little is known of the biology and ecology of the species that is caught as by-catch in dredges and is an important prey of several commercial species such as sea bass (*Dicentrarchus labrax*), gilthead seabream (*Sparus aurata*) and white seabream (*Diplodus sargus*). Samples were taken bi-monthly between February and June 2015 in Faro beach, on the coast of the Algarve, southern Portugal. Individuals were collected using manual Ganchorra. Sampling for experimental fieldworks was carried out at low tide using *Sardine pilchardus* as a bait attached to metal stakes to attract the crabs that were then caught by hand. Female:male sex ratio was 1.56:1 and highest percentage of berried females was recorded between February and April. Fecundity values were 35.334, 45.201 and 26.448 for Stage I, II and III respectively. Number of eggs per gram of sample was constant across all sizes. Minimum and maximum length was 11.10 mm - 25.30 mm for males and 10.54 mm -21.85 mm for females. Estimated Von Bertalanffy growth parameters were L_∞= 34.83mm; K= 0.52y^{-1}; t_0= -0.41 and L_∞= 27,16mm; K= 0.74y^{-1}; t_0= -0.39y for females using ELEFAN implemented in the LFDA package. Mark-recapture field studies recorded a density of 6 individuals per m^2. Minimum distance at which there are no overlapping between traps was 10.6 m, with an area of attraction of 88.099 m^2/trap. *Portumnus latipes* is widely distributed along the Portuguese coast. During an IPMA (Portuguese Institute for the Ocean and Atmosphere) survey, P. latipes was recorded from 3 to 28m depths, with greatest abundance at 3m and highest abundance per tow from the south coast of Portugal.

Key words*:* Sandy beach, *Portumnus latipes*, Growth, Reproduction, Distribution.

RESUMO

No presente estudo o Caranguejo-de-areia, *Portumnus latipes* (Pennant, 1777), um crustáceo pertencente ao grupo dos decápodes, é estudado. Esta espécie possui uma distribuição geográfica no Nordeste do Oceano Atlântico e em algumas partes do Mediterrâneo, sendo tipicamente encontrado em praias de areia e zona de arrebentação (classificado com um organismo do *"foreshore"*). O Cranguejo-da-areia vive enterrado entre, 100 e 150 mm abaixo da superfície da areia, e provavelmente nada apenas acima da camada superficial. Podem ser capturados durante a baixa-mar, na zona de lavagem, onde as ondas quebram. São também muitas vezes capturados nas ganchorras utilizadas pelos pescadores de Conquilha (*Donax* spp.), sendo no ententanto considerado como uma espécie acessória. Pouco ainda se sabe acerca da biologia e ecologia desta espécie que serve como uma importante presa de várias espécies comerciais como o Robalo (*Dicentrarchus labrax*), a Dourada (*Sparus aurata*) e o Sargo (*Diplodus sargus*).

A amostragem foi realizada bimensalmente, entre Fevereiro e Junho de 2015, na praia de Faro, na costa do Algarve, sul de Portugal. Pelo menos 60 indivíduos foram recolhidos em cada amostragem usando uma ganchorra manual, sempre durante marés vivas de baixa-mar. Durante a amostragem foram registados valores de temperatura e salinidade com um sensor (YSI oxygen, conductivity, salinity and temperature 85CE/10) e recolhidas amostras de sedimento para a análise de granulometria.

No laboratório, todos os indivíduos foram classificados taxonmicamente, medidos, pesados e armazenados em recipientes de plástico em álcool 96%. Foi também determinado o sexo (com base na morfologia do abdomém) e o estado de desenvolvimento dos ovos das fêmeas ovadas, segundo a sua cor coloração em que: I - amarelados; II – alaranjados; III – cinzentos. De cada estado de desenvolvimento foram selecionados 20 indivíduos, de diversos tamanhos, com a maior amplitude de comprimento possível, de forma a estimar a fecundidade desta espécie. Posteriormente, os ovos foram extraídos do abdómen das fêmeas e procedeu-se à contagem de uma subamostra de ovos com recurso a uma lupa binocular.

O método de ELEFAN, implementado pelo software LFDA foi utilizado para estimar os parâmetros de crescimento desta espécie. Em paralelo, usando uma aproximação ao método de Schnabel, foram realizadas experiências de marcação e

recaptura para estimar a densidade do *P. latipes* numa zona da praia de Faro. A estimativa da área de atração ao isco em que não houve nenhuma sobreposição entre armadilhas também foi calculada no mesmo local. A amostragem de campo foi realizada na zona de rebentação entre-marés com recurso à Sardinha (*Sardina pilchardus*) como isco para atrair os caranguejos às estacas de metal. Apenas alguns minutos foram necessários após a colocação do isco para que os caranguejos fossem apanhados à mão.

Finalmente, em colaboração com o IPMA (Instituto Português do Mar e da Atmosfera) foi realizado um estudo sobre a distribuição, abundância e biomassa da espécie ao longo da costa portuguesa, desde Vila Real de Santo Antonio até Matosinhos, entre três zonas de pesca (noroeste, sudoeste e áreas do sul). Para análise da abundância e biomassa, utilizou-se o software SURFER. Relativamente aos resultados, a temperatura durante todo o período de estudo, variou entre 13,4 °C e 21,5 °C e a salinidade entre 36,0 psu e 36,6 psu. A análise dos sedimentos da área de estudo sempre correspondeu-se com um valor superior a 98% areia, predominantemente de areia fina.

Um total de 899 indivíduos foram capturados durante as amostragens; o rácio entre fêmeas e machos foi de 1,56:1. A maior percentagem de fêmeas ovadas foi registrada entre Fevereiro e Abril, com decréscimos acentuados nos meses de Maio e Junho. O tamanho mínimo de fêmeas ovadas foi de 14,70 mm de comprimento de carapaça e 21,85 mm de comprimento máximo. Os valores de fecundidade observados foram de 35,334, 45,201 e 26,448 para os estágios I, II e III, respetivamente. Os modelos potencial e linear foram ajustados em função do tamanho dos indivíduos e para todos os estados de desenvolvimento dos ovos, escolheu-se o que tivesse a maior significância de r. O número de ovos por grama de peso total da fêmea, foi constante para todos os tamanhos dos indivíduos, refletindo a tendência horizontal. O número total de ovos por grama de fêmea estimado foi de 7711,1, 10004,0 e 4837,6 para os estágios I,II e III respectivamente.

Em relação ao tamanho dos indivíduos, os comprimentos mínimos e máximos da carapaça variaram entre 11,10 mm e 25,30 mm para machos, e 10,54 mm 21,85 para fêmeas. Relativamente à análise de frequências de distribuições de comprimento, ambos os sexos foram representados por 2 coortes que corespondem a diferentes classes de idade. Os parâmetros de crescimento de Von Bertalanffy estimados foram L_∞ = 34,83

mm; K = 0,52y-1; t_0 =-0,41 para os machos e L_∞= 27,16 mm; K = 0,74y-1; t_0 = - 0,39y para as fêmeas.

Uma densidade de 6 indivíduos por m^2 foi estimada com o método de marcação e recaptura. A distância mínima em que não houve nenhuma sobreposição entre as estacas iscadas foi de 10,6 m, com uma área de atração de 88,099 m^2/estaca iscada.

Portumnus latipes foi registado com amplamente distribuído ao longo da costa portuguesa. Durante as campanhas do IPMA, a espécie foi capturada principalmente com *Donax* spp., em fundos de areia. Indivíduos desta espécie foram capturados em profundidades que variaram entre os 3 m e os 28 m, no entanto foi raramente capturado em profundidades superiores à 12 m. As estações de 3 m de profundidade, principalmente na costa Sul de Portugal, foram as que obtiveram os maiores valores de abundância para a espécie. Em relação aos valores de biomassa, os valores mais elevados foram registados no Algarve central na área costeira altamente influenciada pela Ria Formosa. Em duas destas estações foram registados os maiores valores de biomassa (72,53g e 70,91g) e número total de indivíduos capturados (42 e 35 ind). Por outro lado, também foram registados elevados valores de biomassa e de abundância nas zonas perto da Ria de Aveiro e do estuário do Tejo.

Palavras-chave: Praia de areia, *Portumnus latipes*, Crescimento, Reprodução, Distribuição.

1. INTRODUCTION

1.1. General information on coastal evolution

Sandy beach ecosystems have suffered an intense alteration because of the high level of anthropogenic coastal development, one of the economic progress consequences. The first significant changes in sandy shores, linked to human activity, began at least two centuries ago (Nordstrom, 2000), and are expected to be intensified over the next few decades (Brown et al., 2008). The increase in human population, along with its tendency to occupy coastal areas (Roberts and Hawkins, 1999), have led to an accelerated destruction of natural habitats and consumption of natural resources that have caused a great impact on ecosystems worldwide; these damages are specifically targeted to the shorelines throughout the world, among which predominate sandy shores (McLachlan and Brown, 2006). Moreover, and giving a new dimension to the problem, there is global climate change, and particularly the sea level rise which caused worldwide changes of shorelines (Jones et al., 2007; Schlacher et al., 2008). This rising of sea level, will produce in the future an intense beach erosion affecting the ecosystems in this area. Related with the climate change there are other factors such as storm frequency and intensity, surges and precipitation that are expected to modify the shoreline in the future (Zacharioudaki and Reeve, 2011).

1.2. Sandy beach description

Around the world, in all latitudes, coasts and climates, there are beaches. All of them with different morphologies, sizes, exposure range and oceanographic conditions like temperature, salinity and streams (Rodil and Lastra, 2004). Sandy beaches are the most dynamic soft bottom habitat and can be found both in temperate and tropical climates (Davies, 1972). The open sandy beaches are defined by their morphodynamics, and described in terms of wave exposure among the characteristics of the sediments and tidal ranges.

The sandy beaches have been traditionally considered, by many biologists, as marine deserts, and as such, they had not been studied or taken care of until Remane (1933) began with his studies of the German coast. In contrast to what was thought, many sandy areas are very productive and commercially exploited. In this sense, the work of Pearse et al (1942) was also pioneering and it represents the first qualitative attempt to evaluate a whole sandy beach system. Sandy beach ecology has advanced considerably since those studies (Rodil and Lastra, 2004). Since then, the biological research on beaches has evolved from the initial largely taxonomic, quantitative and qualitative overviews of the most important species, to today's holistic systems approach (McLachlan and Erasmus, 1983). The fact that beaches are found in many places with different conditions and factors, allows a high diversity regarding biotic characteristics (Rodil and Lastra, 2004). All these factors are considered when a sandy beach is studied, due to this environment being controlled mainly by physical conditions. Previous studies analyzed micro and mesotidal areas, showing that there is a relationship between community structure and wave interaction and beach morphodynamics in the macroifauna in the intertidal zone (McLachlan et al., 1981; Defeo et al., 1992; McLachlan et al., 1993; McLachlan et al., 1996). On the other hand, beaches also show some abiotic and biotic relationships with the surf zone (McLachlan, 1990) and with the dunes that maintain the beaches.

Regarding the morphology of the beaches, they can be classified as reflective or dissipative depending to their characteristics (Ciavola et al., 1998). Dissipative beaches are characterized by having finer sediments and extensive surf zones, while reflective beaches, are narrow, steep, coarse-grained and no surf zones are present (McLachlan and Turner, 1994). The beach where the study was carried out corresponds to a reflective beach. However, on the one hand, the mesotidal zone corresponds with a very wide beach of dissipative type with a shallow slope. On the other hand, the high intertidal zone has a greater slope that is characteristic of a reflective beach (Anfuso and Ruiz, 2004).

1.3. Faunal components and ecosystem properties in Sandy beaches

Although exposed sandy beaches have a uniform appearance and biological poverty in the intertidal zones, they nevertheless englobe a marine fauna and flora with great ecological diversity (Rodil et al., 2006). In sandy beaches abiotic and physical factors are very important as they are the main forces that control macroinfaunal communities (Rodil and Lastra, 2004). In this unstable environment, the main fauna is composed by meiofauna and macrofauna, which is adapted and used as bioindicator (Bayed, 2003) and have their own strategies in response to physical factors such as beach slope, wave action and granulometry (McLachlan and Erasmus, 1983; 1990; McLachlan et al. 1993) as well as biological factors such as food availability and organic matter (Defeo et al., 2009). Sandy beach ecosystems contain a diverse and abundant fauna such as Crustacea, Polychaeta and Bivalvia, ranked among the most common macroinfaunal *taxa* (Brown and McLachlan, 1990), while Nematoda, Harpacticoidea, Plathelmintha and Oligochaeta dominate meiofaunal groups (McLachlan, 1980). In reflective beaches such as the study area the effects of biological interactions must be taken into account, since these are affected by physical factors (Defeo and McLachlan, 2005). Thus, macroinfaunal changes are related to changes in physical characteristics occurring along a gradient of beach morphodynamic types (Brazeiro, 2001). Many organisms that live in the intertidal zone have developed morphological and behavioral modifications such as high speed and ability to be buried in sediments with different grain size and to orient in surging swash. This is because the exposed sandy beaches are composed of unconsolidated sediments and are affected by the movement of the waves, producing a difficult habitat for life of intertidal organisms (Dugan et al., 2000).

This study will be conducted in a sandy beach intertidal area so it is necessary to consider that these areas provide habitats for a diversity of fauna dominated by crustaceans, molluscs and polychaete and includes predators, scavenger and deposit feeders. The composition and abundance of invertebrate assemblages are controlled primarily by the physical environment, intertidal swash and sand conditions being harshest on reflective beaches (Defeo et al., 2009).

1.4. Species Biology

This study was focused on a species of Decapod. The Decapods or Decapoda are an order of the phylum Arthropoda subphylum Crustacea. Decapoda is one of the largest Crustaceans groups which includes many familiar groups such as crayfish, crabs, lobsters, prawns and shrimp including more than 15,000 known species. It is challenging to cover all the existing forms in a single description, although there are common features to easily distinguish them from other Crustacea. The Latin root *Crustacea*, means “crust or shell” (Source: EOL), therefore, the most typical feature is the presence of a sheet called the carapace that covers the head, thorax and laterally the gill cavity (Ingle, 1996).

Also Crustacea are characterized by a segmented body and jointed limbs, although other more specific features such as eyes, larvae stage, labrum, etc. Crustaceans are very important in the ecology of ocean such as in the marine food web, since they are the primary herbivores feeding on phytoplankton and are important members in benthic communities (Source: EOL). As the name Decapoda implies, all decapods have ten appendices, in the form of five pairs of thoracic appendages in each segment, but in some groups these may be reduced or missing. In many decapods such as crabs, however, one pair of legs has enlarged pincers (Falciai and Minervini, 1995).

1.4.1. Biology *Portumnus latipes* (Pennant, 1777)

The studied species was *Portumnus latipes* (Pennant, 1777). The taxonomic classification of the species is the following (source: Marine Species):

- Kingdom Animalia
- Phylum Arthropoda
- Subphylum Crustacea
- Class Malacostraca
- Subclass Eumalacostraca
- Superorder Eucarida
- Order Decapoda
- Suborder Pleocyemata
- Infraorder Brachyura
- Family Portunidae
- Subfamily Carcininae
- Genus *Portumnus*
- Species *latipes*

Pennant's swimming crab (*Portumnus latipes*) is a typical organism of the foreshore of sandy beaches (see *Plymouth Marine Fauna*, 1931; cited in Lebour, 1944) and surf zone (Figure 1.1). Normally, this crab buries itself in the sand (Lebour, 1944) and for that reason is hidden during low tide and also when the habitat is drained (Türkay and Stecher, 2013). Samples of *P. latipes* have been reported from between the tide marks and beyond (i.e. in the surf zone) and 100-150 mm below the surface of sand. It probably swims just above the sand surface (Lebour, 1944). However, Chartosia et al. (2010) showed that when wave action is reduced, this species ascends to the mid-littoral zone to feed (Chartosia et al., 2010).

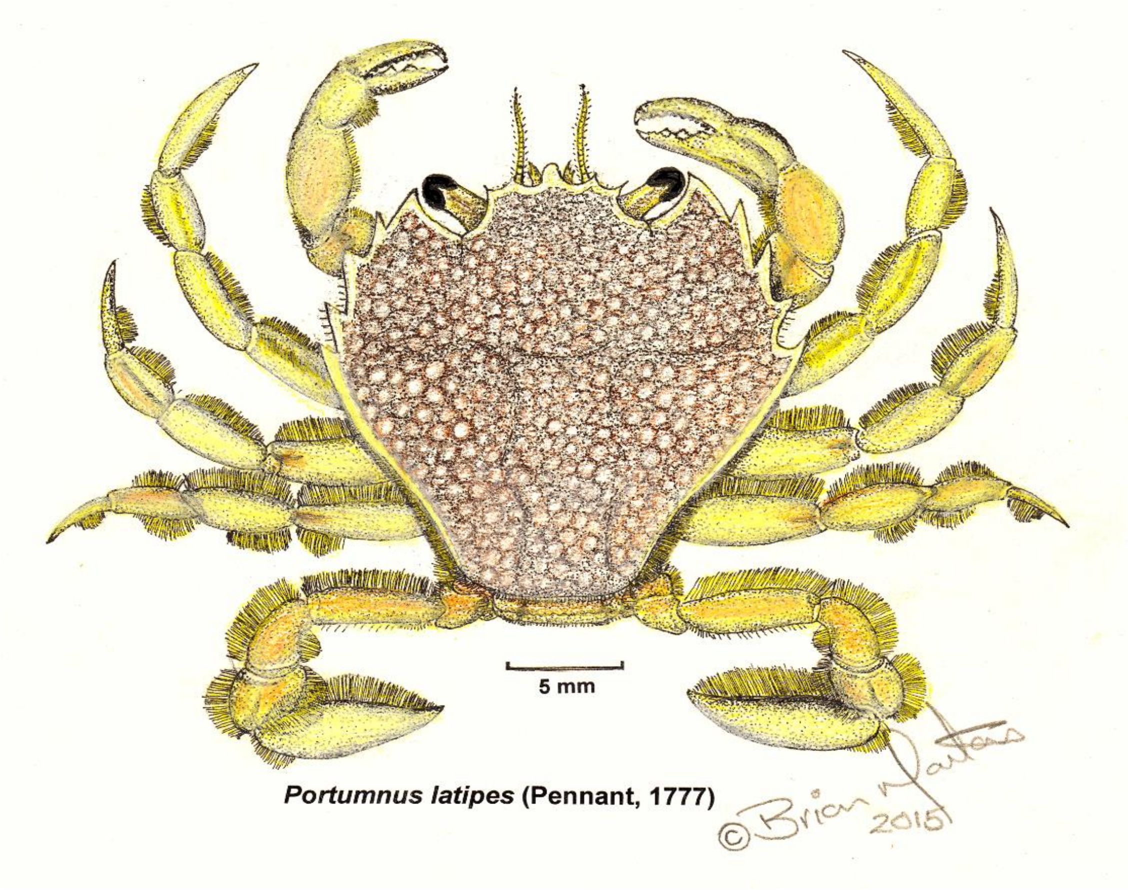

Figure 1.1: An individual of Pennant's swimming crab, Portumnus latipes (Drawn by Brian Morton).

This species of swimming crab has a reddish brown carapace, variegated with dark brown. It is also characterized by the white spot(s) often found in the center of the carapace sometimes called "fleur-de-lis" (Zariqueiey, 1968) (Figure 1.2). It is a good swimmer with back pereiopods that are flattened into paddles. The paddles are used for digging into the sand and, therefore, it can dig itself into wet sand rapidly (Source: EOL). Other characteristics of this species are a heart-shaped carapace, smooth dorsal surface, a slightly projected frontal region, sub-acute median and sub-median lobes and wide orbits. The antero-lateral margins of carapace with five teeth, the fourth often small and chelipeds slightly unequal and somewhat compressed (Source: Marine Species).

Figure 1.2. : Different types of ornamentation that can be found on the carapace of P.latipes called "fleur-de-lis".

Previous studies, such as Chartosia et al. (2010) reported that *P. latipes* feeds mainly on macro-invertebrates; it is therefore an omnivorous species although macroalgae also participated in its diet. In this study Chartosia et al. (2010) also found that during winter, spring, and autumn, the dominant prey were small crustaceans followed by polychaetes and macroalgae, while in summer the normal food items were polychaetes with crustaceans, with macroalgae as an accessory feeding source.

Existing information on the feeding habits of *Portunidae* crabs that live in shallow sandy sediments, corresponding with the characteristics possessed by Faro beach is rather limited (Hill, 1976 in Oliveira et al., 2006). This species has been reported in the Mediterranean from various localities, at depths of 2 to 4 m (García-Raso, 1984 in Chartosia et al. 2010) on sediments of fine sand. This species is especially common in temperate areas of the northeast Atlantic, including some areas in the Mediterranean Sea. With regard to this distribution it is possible observe that the area where it has been found more often is in the North Sea (Source: OBIS). On the other hand, it has more locations in the Southern Bight than farther north and east (Türkay and Stecher, 2013). The following map (Figure 1.3) shows the global distribution with the different locations where individuals of *P.latipes* have been found.

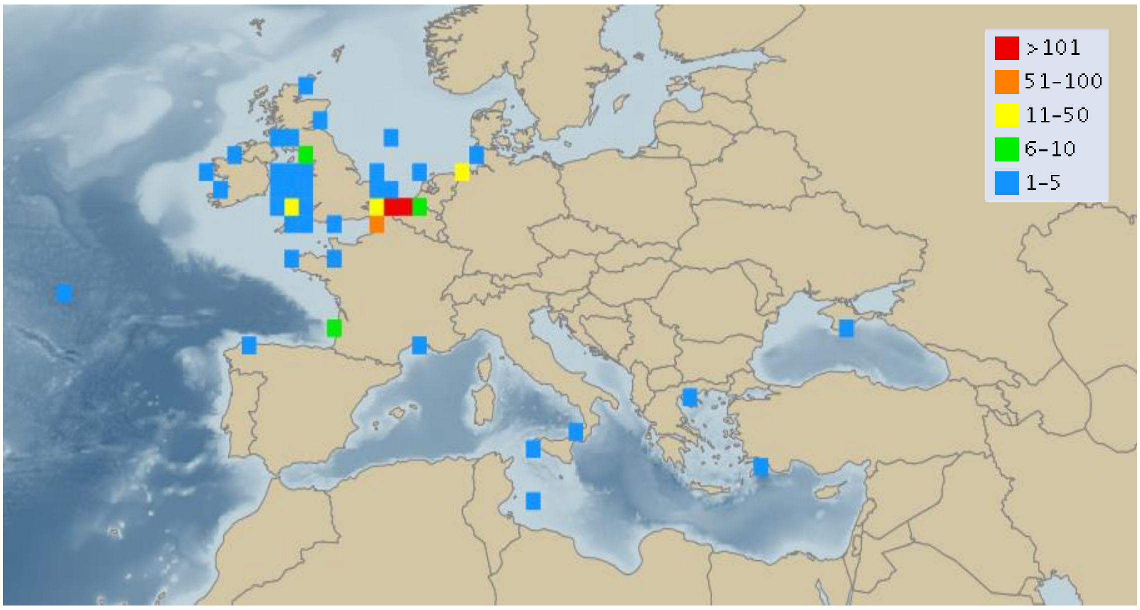

Figure 1.3: Spatial distribution of Portumnus latipes records (Source: OBIS). Belgium (8) Black Sea (2) France (1) Inner Seas off the West Coast of Scotland (1) Mediterranean Sea (1) Mediterranean Sea - Eastern Basin (2) North Atlantic Ocean (4) North Sea (7) United Kingdom (2) Africa and German Exclusive Economic Zone (no group). The number in parentheses indicates locations.

The study was sited in the coast of the Algarve, southern Portugal, where it was expected to capture specimens of *Portumnus latipes.* This area has an extension of 220 km, covering the area between Odeceixe and Vila Real de Santo Antonio, and is composed of two different types of torography. On the one hand, the western zone is characterized by a shoreline basically formed by cliffs while, on the other hand, the eastern part is composed of large sandy spits (Dias, 1988). This last area is where this study was to be conducted.

In this area, currents are relatively low, with the longshore currents and tides that flow parallel to the shoreline predominating, and extending seward to 30m bathymetry point (Magalhães, 2001). The Mediterranean water also has importance in this zone since its higher density and temperature make it sink below the cooler western Atlantic waters. This phenomenon is known as the “Mediterranean influence”, causing repercussions at the hydrological and biological levels (Monteiro-Marques, 1987).

1.5. Objectives

Portumnus latipes is a poorly known species that is found on sandy beaches in the wash zone at low tide. It may be quite abundant and an important prey item of fish such as sea bass (*Dicentrarchus labrax*), as it is often found in the stomachs of sea bass caught by anglers fishing from the beach (personal observation, K. Erzini). However, it is not sure if it corresponds to the species *P. latipes*. This is because there is no record in the Algarve area and more specifically from Faro beach. The study aims to contribute to a better understanding of the biology, ecology and dynamics of this species. As there is at least one other species of the same genus that may exist in the same area, the first objective is the correct identification of *P. latipes*. Distribution by depth in abundance and biomass, will be determined from bivalve dredge “Ganchorra” survey data from IPMA. Density will be estimated by mark-recapture of the crab in the intertidal zone. The distance at which the area of attraction of the bait not overlap occurs between bait will be also studied. Samples (bi-monthly) will be taken to the laboratory for biological studies (determination of sex, sex ratio, reproductive cycle, fecundity, size and weight). Data of temperature, salinity and sediment samples will be collected also in each sampling. Length frequency analysis will be used to study growth by identifying cohorts and modal progression analysis.

2. MATERIAL AND METHODS

2.1. Study area

This study was conducted in a sandy beach within the Ria Formosa ecosystem (Southern Portugal) (Figure 2.1). Ria Formosa is a system of barrier islands composed of five spits and two peninsulas separated by inlets. The maximum length of the Ria Formosa is 6 km from Faro to Cabo de Santa María and it has a total area of 11.000 hectares (Mendes et al., 1999). This study was performed more specifically, in the westernmost one of the spits and barrier islands particularly Ancão litoral (Faro beach) that form part of the Ría Formosa system (Anfuso and Ruiz, 2004) with orientation N 55ºW in the region of the leeward Algarve. Faro beach is an open and sandy beach with reflective to intermediate behaviour (Ferreira et al., 1997). This spit is considered a fragile ecosystem which varies over time between spit and barrier islands in this area (Ciavola et al., 1998). It is a 10 km long system that changes depending on the migration of the tidal inlet (Ciavola et al., 1998), and with a width ranging between 50 and 250 meters (Anfuso and Ruiz, 2004). This migration is usually produced southeastwards, meaning that this ecosystem is a dynamic environment, composed by a single dune ridge.

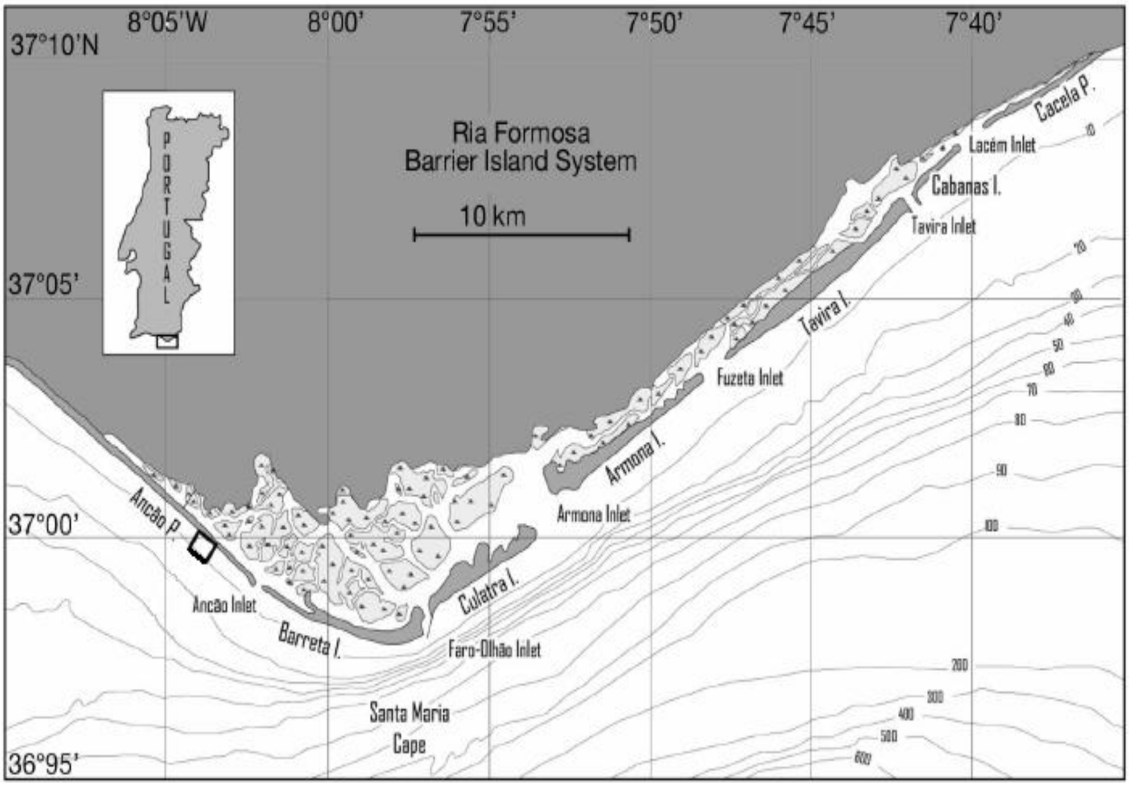

Figure 2.1: Study area where the samplings where carried out (Adapted from Dolbeth et al., 2007).

On the other hand, this spit has been quite exposed to anthropogenic activities, being destroyed by the construction of human activities during 1950s and 1960s. This fact explains periodic wash-over processes, with a mean shoreline retreat of 1 m yr^{-1} (González et al., 2002 in Anfuso and Ruiz, 2004).

Ancão spit presents a mesotidal range between 0.5 and 3.5 meters (during neap and spring tides respectively). Southwest winds attaining 60 km/hr are dominant in the area, so that the study area is directly affected by wave action. However, winds coming from the northwest and southeast are also present (Ciavola et al., 1997). Mean significant wave height is 0.9 m with a 5 s associated period. Values of wave height during storms are about 2–3 m approaching mainly from the west (51.5% of frequency) (Anfuso and Ruiz, 2004), although they can also approach the coast from the south and east (Pessanha and Pires, 1981; Pires and Pessanha, 1986).

2.2. Sampling

The sampling was conducted bi-monthly between February and June 2015 in Faro beach, Algarve coast. All samplings were done coinciding with the neap tides in the maximum low tide. Sampling was conducted on the following dates and the code used is shown in the following table (Table 2.1).

Table 2.1: Sampling dates and the corresponding identification code used.

DATE	CODE
06/02/2015	BG1
21/02/2015	BG2
07/03/2015	BG3
21/03/2015	BG4
18/04/2015	BG5
21/05/2015	BG6
01/06/2015	BG7
18/06/2015	BG8

Individuals were collected in the intertidal zone, using a manual ganchorra expecting to collect at least 100 specimens. Ganchorra is a metal structure with teeth at the front to drag in the sand and an attached net on the back to store the catch. This technique is used traditionally to catch different species of Genus *Donax* and the target species of this study *P.latipes* appears as by-catch (Figure 2.2). All captured specimens were stored in a plastic container with sea water in which they were transported to the laboratory for further analyses. In each sampling values of temperature and salinity were recorded with a sensor model (YSI oxygen, conductivity, salinity and temperature 85CE/10).

Figure 2.2: Technique of manual ganchorra used by the fishermen used to sample specimens of P.latipes.

2.2.1. Sediment analysis

Bi-monthly samples of sediment were taken in the low tide terrace area where the samplings to catch the target species was performed. Samples were taken always in the same area in Faro beach during the low tide. All samples were stored in environmental conditions in previously marked plastic containers. For the analysis, each sample was homogenized and divided in four approximately equal parts used to take subsamples composed for all the parts in order to minimize the errors (Figure 2.3, A).Subsamples of approximately 70-80 mg were taken from each sample and stored in plastic containers. Distilled water was introduced into the sample and samples were mixed three or four times for 2 minutes. Ceramic filter candles with porosity of less than one micron were used to filter and clean the sample and to eliminate much of the salt of the sample (Figure 2.3, B). Subsequently all the candles are interconnected to a vacuum pump to remove all the water in the sample. Then the samples were dried in the oven for 24h at 70ºC.

Figure 2.3: Process of sediment analysis. A: Homogenization and sample division. B: Vacuum system with ceramic filter candles.

The sediment samples were analysed for grain size using the sieving method since all sediments where coarse. Each sample was individually sieved using a series of sieves of decreasing size (4.00; 2.8; 2.00; 1.40; 1.00; 0.710; 0.500; 0.355; 0.250; 0.180; 0.125; 0.090; 0.063 mm) following Blott and Pye (2012). Sieves were placed in agitator mechanical shaker in which the sediment is separated as a function of grain size by motion (Figure 2.4, A). Subsequently the sediment retained at each sieve was carefully weighed to the nearest 0.01g to avoid the loss of any particles (Figure 2.4, B). Finally each subsample was stored in previously marked plastic bags (Figure 2.4, C).

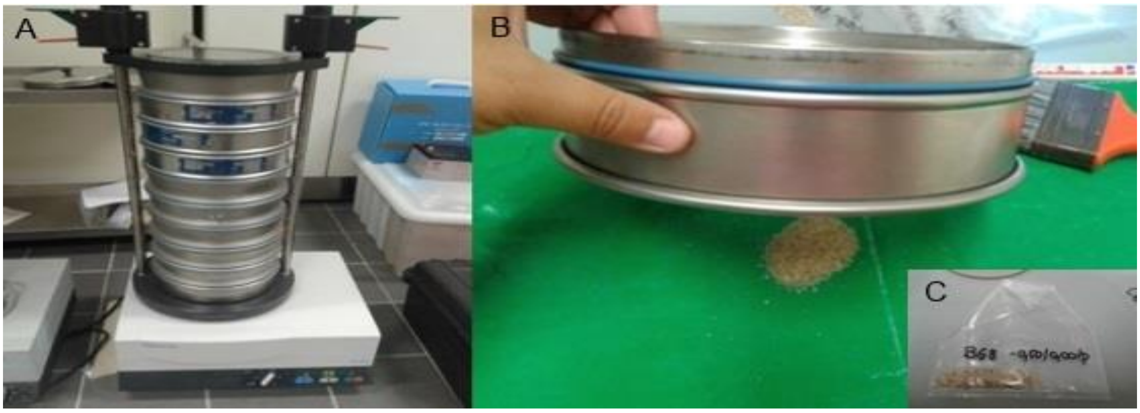

Figure 2.4: A: Sediment separation process depending on the size. B: Separation and weighing process of each subsample. C: Storage and marking of each subsample.

The computer program GRADISTAT (Blott and Pye, 2001) was used for the treatment of the data obtained in the grain size analysis. The program runs within the Microsoft Excel spreadsheet package, which allows statistical analysis of sediment samples.

2.3. Laboratory work

All the collected specimens were kept in seawater and taken back to the laboratory for further analysis (Türkay and Stecher, 2013). In the laboratory all individuals were properly marked and identified morphologically with a taxonomic key for Decapod Crustaceans. Standard measurements were taken: carapace width, the distance between the rostral tip and the tip of the dorsal spines (CW), and carapace length, from the tip of the median frontal tooth to the posterior terminal border of the carapace (CL) for each specimen sampled (Paula, 1988) (Figure 2.5). In parallel, sex was determined by examination of the shape of the abdomen. Crabs show marked sexual dimorphism; in most male crabs, this is narrow and triangular in form, while females have a broader, rounded abdomen (Figure 2.6). This is due to the fact that female crab brood fertilised eggs on their pleopods (Falciai and Minervini, 1995). Subsequently all individuals were weighed using a balance scale (precision 0.01 g). Finally, the stage of development of the eggs in berried females was recorded.

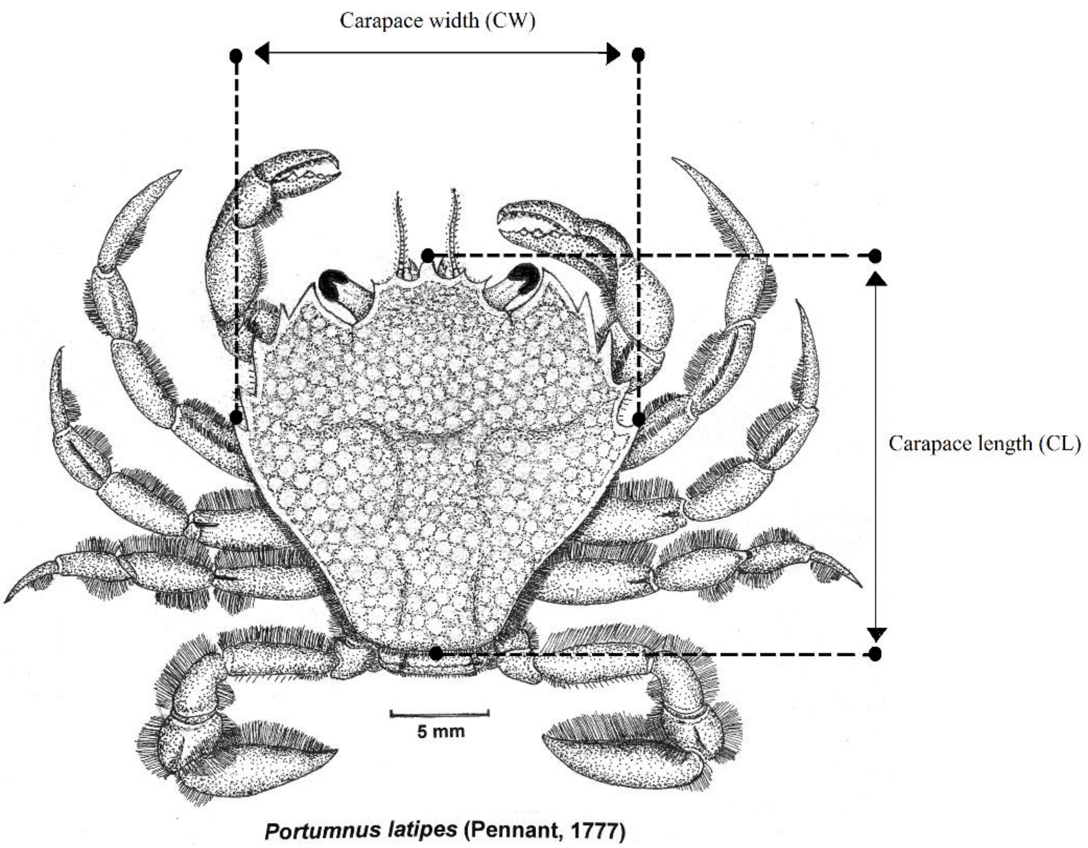

Figure 2.5: Specimen of Pennant's swimming crab, Portumnus latipes. Lines delimiting the measures taken during the study (Drawn by Brian Morton).

Figure 2.6: Specimens of P.latipes, female on the left and male on the right, showing the differences in abdomen shape.

2.4. Analysis and data processing

2.4.1. Sex ratio

The sex ratio for each sampling was calculated for all individuals, in order to be able to analyse the data taking into account the percentage of females present in each sample. The sex composition of a population was determined as the proportion of males to females in a given population and expressed as the number of males per 100 females. This ratio is also taken into account when comparing different types of sampling, providing information on the distribution between sexes. Besides that it is an important population characteristic.

2.4.2. Reproductive biology and Fecundity

The estimation of fecundity was performed by counting eggs. For that purpose three groups of berried females were established depending on the colour of eggs (I: yellowish, II: orange and III: grey) which indicates the eggs development stage, from the lowest to the highest respectively (Rodríguez-Domínguez et al., 2012). Twenty berried females for each group of coloration, including the widest range of sizes of individuals were selected (Kensler, 2015). The CW and CL were recorded using an electronic caliper with 0.01 mm precision. All the individuals were preserved in alcohol (96%) in previously marked individual plastic containers. The total eggs mass from each female was carefully separated from the pleopods by using a scalpel and tweezers in the petri dish (Da Silva et al., 2004). Subsequently, by mean of a stereoscopic microscope, the remains of pleopods and sand were removed from the egg mass (Figure 2.7).

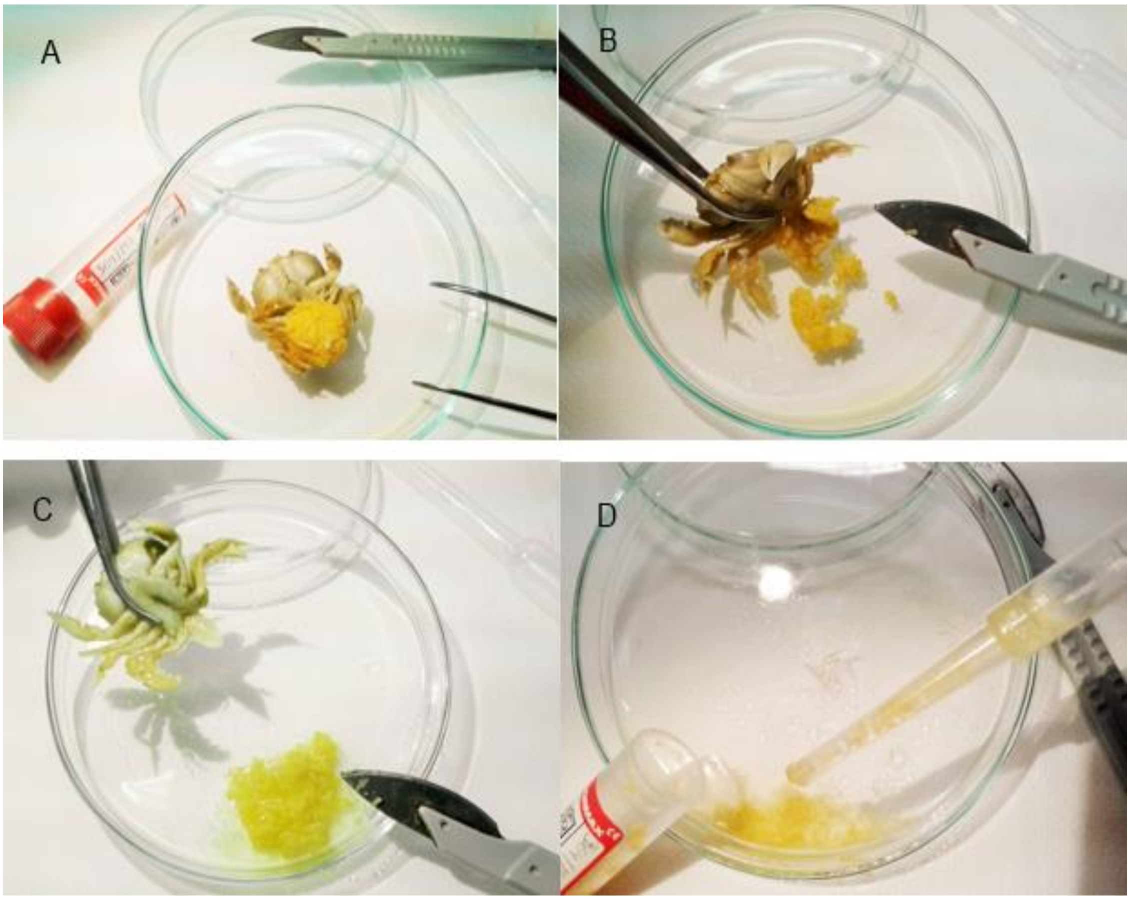

Figure 2.7: Representation of the separation process to obtain the eggs to study the fecundity (Stage II). A: Material required. B: Scraping eggs with scalpel. C: Addition of 96% alcohol and separation of the remains. D: Sample storage.

The samples were dried in the hood for about 10 minutes to evaporate any residual alcohol. A 5-10mg subsample was taken from the total egg mass of each female using a 0.0001 mg precision balance following a modification of Kensler (2015). Finally, all the eggs in each subsample were counted manually using the stereoscopic microscope obtaining the number of eggs in each subsample (Figure 2.8). To calculate the fecundity of the berried females, the total number of eggs for each female was calculated from the subsample egg count values and the weights of the subsample and the total egg mass. Power and linear models were fitted to the fecundity data as a function of CW and CL and the best model selected based on the r values and significance.

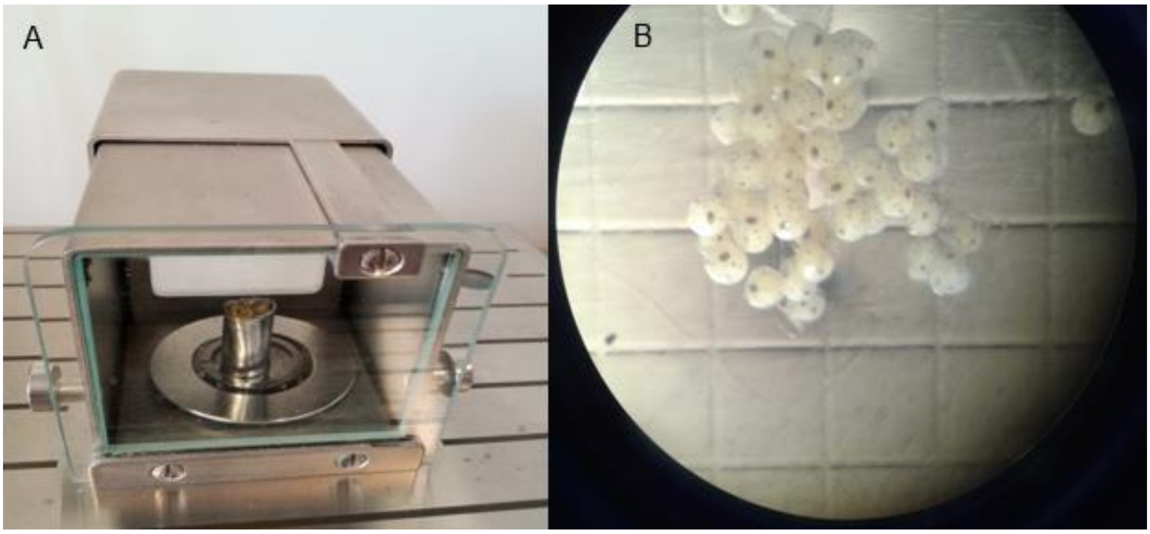

Figure 2.8: A: Method of weighing for each subsample, B: Stereoscopic microscope view of a subsample of eggs in Stage III.

2.4.3. Length frequency analysis

Length frequency data were collected in the ordinary sampling from February to June 2015. All length data were grouped in 1 mm size groups separately for males and females. For the length frequency analysis, the LFDA package was used (Hoggarth et al., 2006). LFDA provides a variety of methods for estimating growth parameters from length frequency distributions (Hoggarth et al., 2006). A module is provided that allows conversion of length frequencies to age frequencies using the estimated growth curves. Version 5.0 of LFDA was used to estimate the parameters (L_∞, K and t_0) of the non-seasonal von Bertalanffy growth curve of *P.latipes* (Formula 2.1).

$$L_t = L_\infty(1 - e^{-K(t-t_0)})$$

Formula 2.1: Von Bertalanffy equation.

Where L_t is the length at age t of the species; L_∞ is the asymptotic length at which growth is zero; K is the growth coefficient; t is the age of the individual and t_0 the hypothetical age at which the individuals would have zero length (Jayabalan et al., 2011).

For the estimations of the growth parameters the ELEFAN method (Electronic Length Frequency Analysis) developed by Dr Daniel Pauly and reviewed in Pauly (1987) was used.

2.5. Field work experiments

2.5.1. Capture techniques in field work

Field work experiments were performed for area of attraction and mark-recapture studies. The sampling was conducted in both cases in Faro beach, Algarve coast. All samplings were done coinciding with the neap tides in the maximum low tide. Individuals were collected in the intertidal zone. For the capture of the individuals a metal stake with length 35 cm and width of 0.9 cm was used. The metal stake was introduced in the sand with a piece of *Sardina pilchardus* (Walbaum, 1792) attached as bait (Figure 2.9). After 15-20 minutes metal stakes were checked searching for *P. Latipes* attracted to the bait and collecting the crabs by hand. The capture of the specimens has to be fast because as Lebour (1944) observed, they can burrow deeper or even run out along the sandy beach. All captured specimens were stored alive inside a plastic container with sea water.

Figure 2.9: Representation of the sampling methodology applied in the field work, with baited stakes in the intertidal zone. Top left hand: metal stake with attached sardine bait; lower right hand: searching for crabs attracted to the bait.

2.5.2. Estimation of abundance by mark-recapture method

In mark-recapture studies, it is very important to take into account that tag retention and visibility are reliable during all the period of the experiment. A particular difficulty in crustacean tagging is due to the loss of external tags through carapace shedding (Silva et al., 2014) during the experiment. For this experiment, some individuals were collected during the ordinary sampling and transported to an aquarium in the laboratory, simulating the environmental conditions of the species. Later, different methods for tagging were tested in order to select the most appropriate method. Firstly, tagging the carapace with waterproof ink to ensure that the mark is not lost was tested. Individuals were also marked with nail polish. According to the results, the last method tested was chosen for the experiment due to greater permanence.

Sampling for the collection of individuals, was made in the same way as explained in paragraph 2.5.1. The mark-recapture study was carried out during four consecutive days (19, 20, 21 and 24 May) in order to have enough data for the estimation of population size. The first day consists in the capture, marking and release of the individuals as close as possible to each corresponding metal stake (Linnane and Mercer, 1998), noting the exact position of the capture with GPS (Global Positioning System). A minimum of 40 individuals were tagged per day with nail polish, changing the mark colours in each day of the experiment (Figure 2.10, A). During the second, third and fourth day the same procedure was carried out, taking into account the individuals previously marked (Figure 2.10, B).

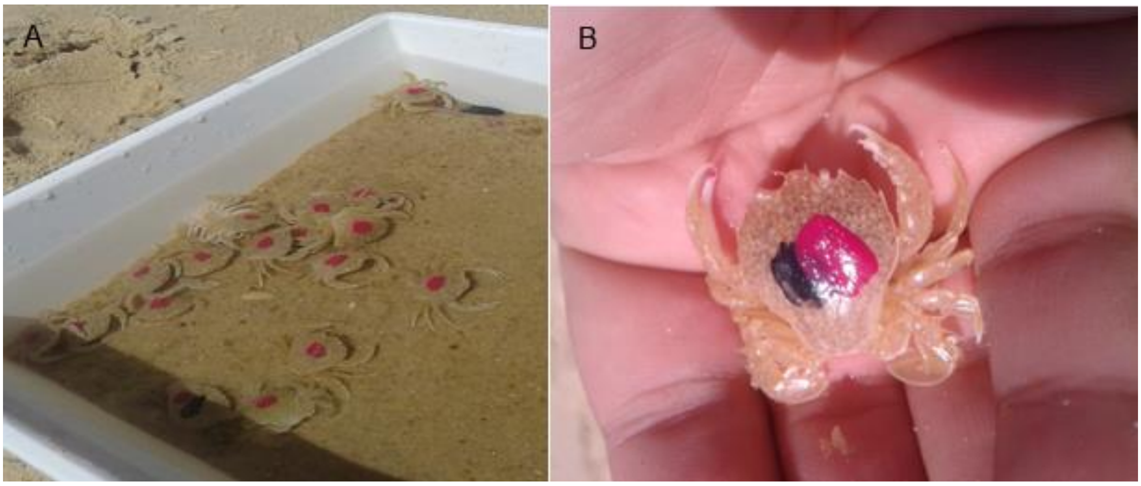

Figure 2.10: A: Marking method with nail polish for mark-recapture experiment. B: Individual recaptured and marked a second time with a different color.

Finally, for mark-recapture experiments it is possible to use the Petersen and Schnabel methods to estimate the abundance of the target population. The Petersen method is only used for one mark-recapture event. The method used in this study was the Schnabel method (Schnabel, 1938), which can be applied with more than 2 mark-recapture events and has no limit to the number of recaptures required. Both methods assume a closed population, which remains constant in size between sampling events, in this study on consecutive days. This method allows obtaining more accurate estimates than Petersen which tends to overestimate the population size (Olmos, 2013). This method differentiates between two types of individuals; marked individuals that have been captured in one or more prior samples, and unmarked individuals, which have never been captured before (Krebs, 1999; in Olmos, 2013). Since the percentage of marked individuals in the population was less than 10%, the Schnabel method used was (Formula 2.2).

$$\widehat{N} = \frac{\sum_{i=1}^{m} C_i M_i}{\sum_{i=1}^{m} R_i + 1}$$

Formula 2.2: Approach of Schnabel method

Where Mi = the total number of previously marked animals at time i, Ci = the number caught at time i, and Ri = the number of marked animals caught at time i.
Finally, as the number of recaptures was less than 50, the 95% confidence interval for the population was calculated from the Poisson distribution (Krebs, 1989).

2.5.3. Area of attraction experiment

Samples were collected in June 2015 with the method described in paragraph 2.5.1. The objective was to study the area of attraction of the target species *P. latipes* to the bait. For this experiment, metal stakes were placed in a horizontal line on the assumption that each metal stake had a fixed radius with circular influence area (Aedo and Arancibia, 2003) (Figure 2.11). Metal stakes were placed in different groups of four metal stakes with different distance between them (1m, 2m, 4m, 8m and 16m) (Figure 2.12). The different groups were separated by a distance of 30m as it should be far enough from each other to ensure independence (i.e. will not influence the catches of the nearest group of stakes) (Eggers et al, 1982). The catches in each replicate were recorded every 30 minutes, with five replicates per sampling day during three days.

The experiment was performed during approximately 2h per cycle of tide during the low tide and values of temperature and salinity were recorded in each sampling. The relationship between mean catch per unit effort (*cpue)* and distance between stakes was studied. The minimum distance at which areas of attraction of adjacent metal stakes did not overlap was estimated and the population density of *P.latipes* was estimated (Fogarty and Addison, 1997).

Figure 2.11: Representation of the methodology applied in the area of attraction experiment: group of stakes 1m apart. In the distance (top right hand) can be seen the next group of stakes (2m apart).

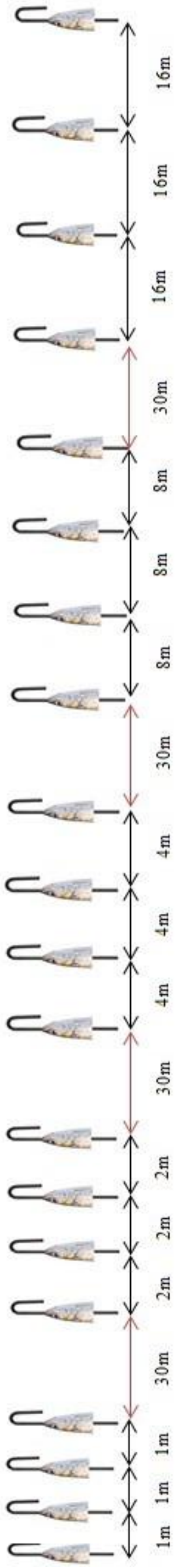

Figure 2.12: Representation of the experimental design applied in the study of area of attraction.

2.5.3.I. Estimation of *cpue* and the attraction area

The relationship between the average catch per trap and the distance between traps was studied by applying the following exponential function (Formula 2.3) following Aedo and Arancibia (2003):

$$\overline{cpue}_s = a(1 - e^{-bs})$$

Formula 2.3: Average $\overline{cpue}$ per trap at distance s.

Where $\overline{cpue}_s$ is the average catch per trap at the *s*th distance, *a* the estimator of the asymptotic catch per trap ($\overline{cpue}_\infty$), *b* the slope, that shows the rate at which ($\overline{cpue}_\infty$) is reached, and *s* the distance between traps. The parameters *a* and *b* were estimated by using the standard approach of least squares method with EXCEL SOLVER.

With this method it is assumed that $\overline{cpue}$ increases with the distance between traps, to reach $\overline{cpue}_\infty$, the maximum value that corresponds with the parameter *a*, which corresponds with a distance s_∞. At the distance s_∞ it can be considered where is no overlapping in the influence areas of adjacent traps (Aedo and Arancibia, 2003). To study the attraction area (A_{at}) (Formula 2.5), it is assumed that the area of attraction of each trap is approximately circular. The radius (r_{at}) was calculated such as (Formula 2.4):

$$r_{at} = \frac{1}{2} s_\infty$$

Formula 2.4: Formula radius of attraction area

$$A_{at} = \pi r_{at}^2$$

Formula 2.5: Formula of attraction area

Where s_∞ is the distance between traps, with 98% of the estimated $\overline{cpue}_\infty$ attained (sensu McQuinn et al., 1988), r_{at} the radius of the influence area, and π is equal to 3.1416.

2.6. Distribution of *P.latipes* along the Portuguese Coast

This part of the study was performed with the collaboration of IPMA (Portuguese Institute for the Ocean and Atmosphere). The institute has been carrying out bivalve monitoring surveys since 1983 in order to evaluate the conservation status of the populations of the most important commercial species, namely: *Spisula solida*, *Donax* spp, *Chamelea gallina*, *Callista chione*, *Glycymerys glycymerys* and *Ensis siliqua*.

In the present study, surveys were undertaken along the three fishing areas (northwest, southwest and south areas) on board the research vessel “NI DIPLODUS”. In the south coast the survey was conducted from 25 May to 3 June 2015 and covered all the area between Vila Real de Santo António and Olhos d’ Água (37º 9’ 40”N, 7º 23’ 55”W and 37º 4’ 59”N, 8º 11’ 13”W). The coast was subdivided into 108 transects perpendicular to the coastline, with a distance of ½ nautical mile between each other. Each transect was established between 3 and 15 m depth, comprising 8 sampling stations distanced 1.8 m from each other, In each transect 2-4 stations were sampled. In total, there were sampled 264 stations (Figure 2.13 and 2.14) were sampled.

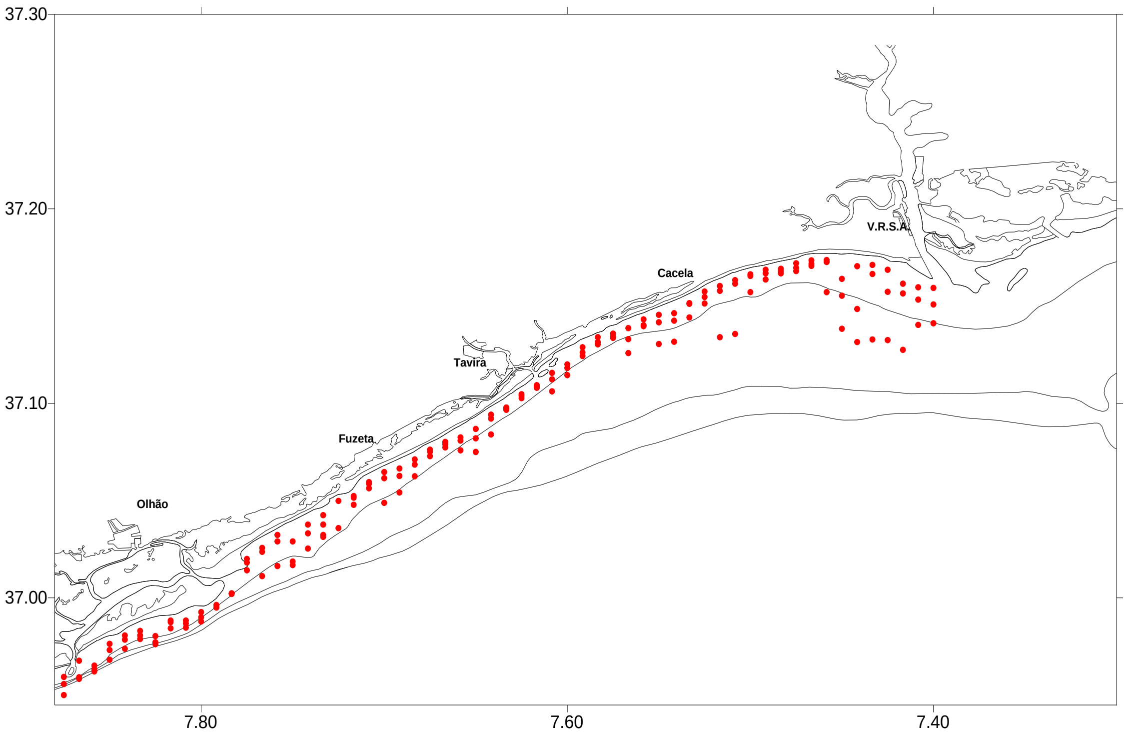

Figure 2.13: Sampling area in the south of Portugal and different sampling locations represented with red points (●). Bathymetric lines on the map correspond to 10m, 20m and 30m.

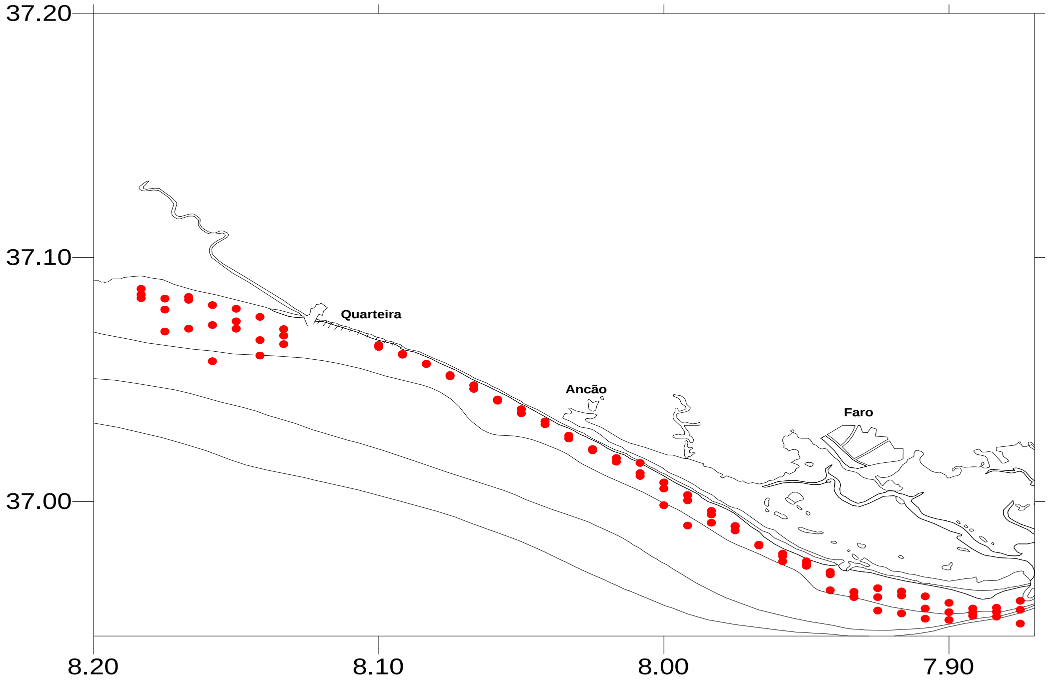

Figure 2.14: Sampling area in the south of Portugal and different sampling locations represented with red points (●).Bathymetric lines on the map correspond to 10m, 20m and 30m.

The second survey was conducted along the southwest coast between 10 to 16 of June 2015. This fishing area is divided into two zones, between Costa da Caparica and Rio de Prata beach (Zone A: 09º15'29''W, 38º39'00''N and 09º11'74''W, 38º28'00''N) and between Cabo Espichel and Sines (Zona B: 09º10'00''W, 38º25'36''N and 08º 51' 02''W, 37º 59'00''N) (Figure 2.15). In this fishing area, the transects are 1 mile apart and the stations are located between 3 and 25m depth. Samples were collect in 187 stations, 44 in zone A and 143 in zone B.

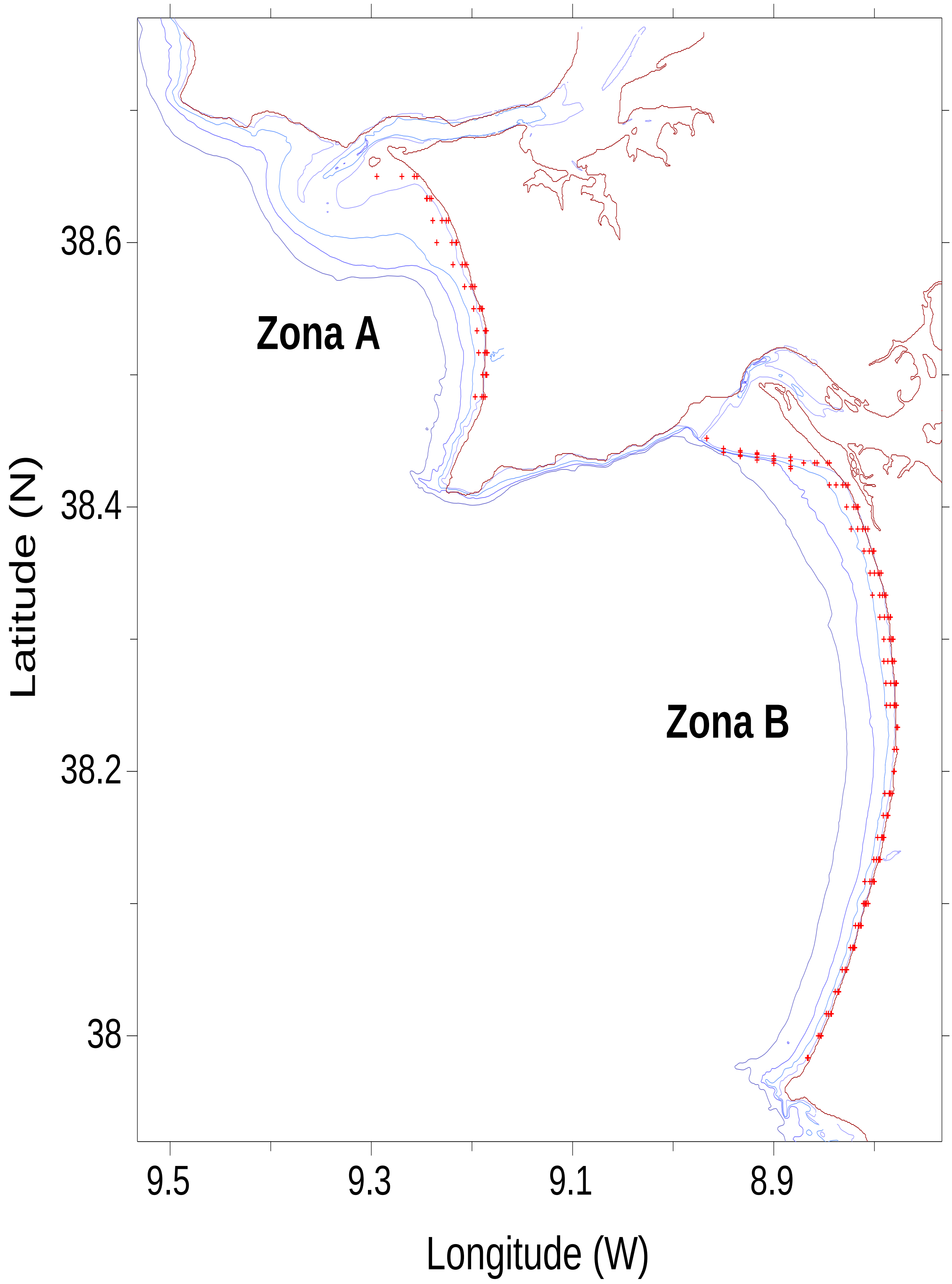

Figure 2.15: Sampling area in the western coast south of Portugal and different sampling locations represented with red points (●).Bathymetric lines on the map correspond to 10m, 20m and 30m.

The last survey was performed from June 23 to July 2 2015 in the northwest between Matosinhos (41º.10'.00" N) and Tocha (40º.20'.00" N) (Figure 2.16). In this area the transect are also distanced 1 mile to each other. Sampling took place in 230 stations ranging between 8 to 34 m depth.

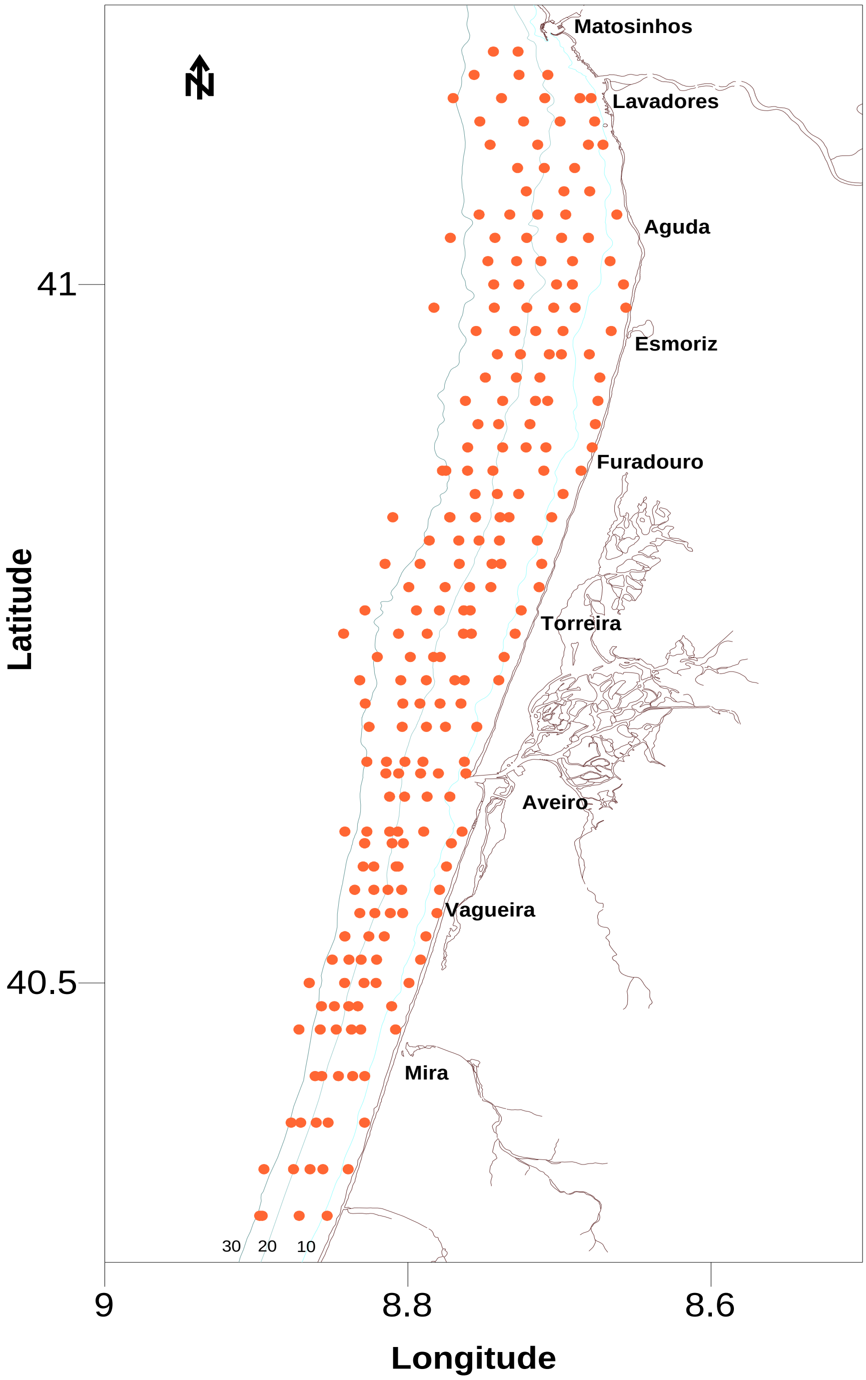

Figure 2.16: Sampling area in the North west coast of Portugal and different sampling locations represented with orange points ( ).Bathymetric lines on the map correspond to 10m, 20m and 30m.

The dredges used during sampling were identical to those used by the commercial dredge fleet.

The basic structure of the Portuguese clam and razor dredge is a small, heavy semicircular iron structure, with a net bag and a toothed lower bar at the mouth. Welded to this iron structure are three metal shafts forming a kind of hen's foot where the towing cable is attached (Gaspar et al., 1999) the main characteristics of the two dredges used in sampling are summarised in Table 2.2.

Table 2.2: Main characteristics of the dredges used during sampling.

CHARACTERISTICS	**GANCHORRA**	
	"AMÊIJOA"	**"LONGUEIRÃO"**
Hoop		
Diameter (cm)	64	63
Height (cm)	45	50
Tooth bar		
Tooth spacing (cm)	2.5	1.5
Teeth wide (cm)	1.6	1.4
Teeth length (cm)	17	30
Net bag		
Size (cm)	200	200
Net mesh (mm)	40	35

In each haul, both a clam dredge (port side, 20-mm teeth) and a razor-clam dredge (starboard side, 35-mm teeth) were used simultaneously (Figure 2.17 and Figure 2.18). Dredges were towed for 5 min at a mean speed of 1.5 knots. During the surveys, all bivalves presented in the catches were collected along with *P. latipes*. Once on board, the catch from each of the dredges was placed in a labelled plastic container. In the case of *P. latipes*, all individuals were preserved in 96% alcohol. Finally all specimens were weighed and measured in the lab following the procedures adopted in other parts of this study. Finally, an analysis of the abundance and biomass of the target species along the coast of Portugal was performed using the software SURFER.

Figure 2.17: Ganchorra dredges used during sampling.

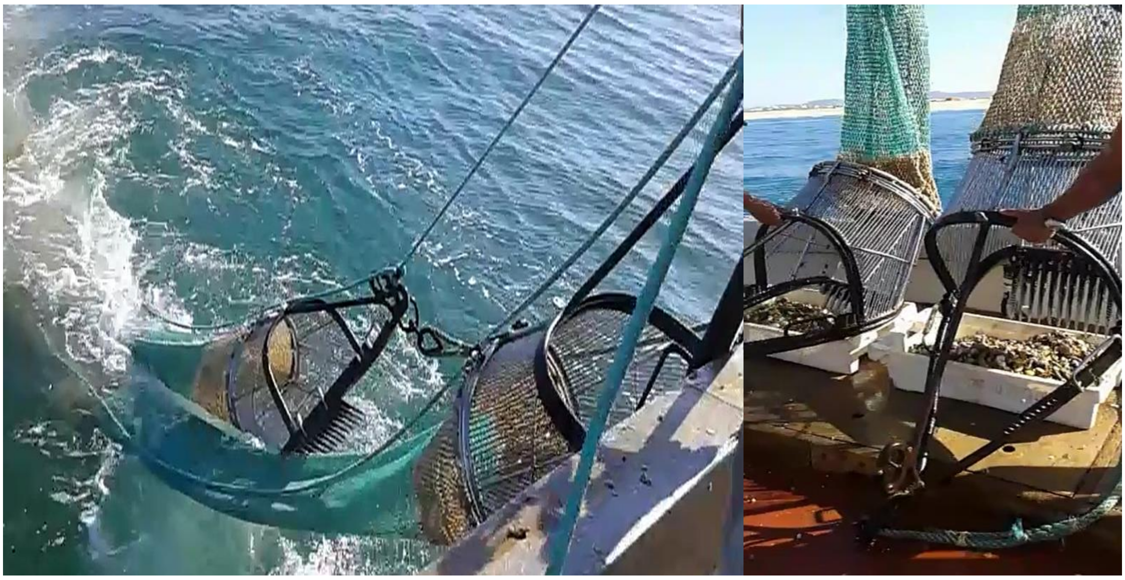

Figure 2.18: Sampling method: dredges being hauled on board and the catch put in boxes.

3. RESULTS

3.1. Environmental parameters

The temperature record during the study in the intertidal zone during neap tides is shown in Figure 3.1. Temperature varied between 13.4ºC and 21.5ºC between February and June 2015. Values of temperature were lower than 16ºC before April. These lower temperatures made it impossible to perform the experiments using metal stakes due to the inactivity of the target species. However from April on an increase in temperature was recorded, reaching a maximum of 21.5ºC in the last samplings. Temperature values from the Portuguese hydrographic institute were also recorded in parallel (ANNEX 1).

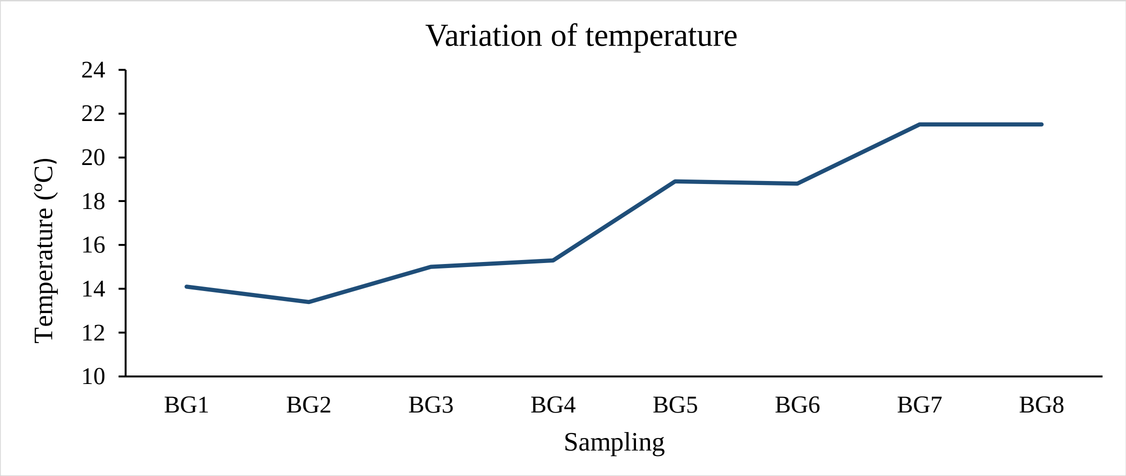

Figure 3.1: Temperature data recorded in samplings between February and June 2015 in Faro beach.

The salinity record had a similar pattern as temperature with an increase from April. Salinity varied between 36.0psu and 36.6psu in the last sampling as shown in Figure 3.2.

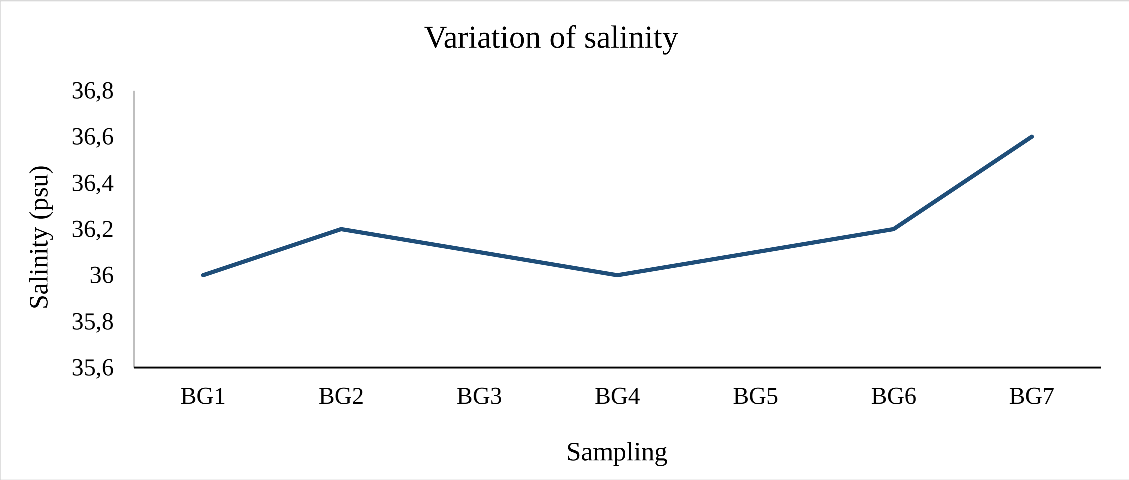

Figure 3.2: Salinity data recorded in samplings between February and June 2015 in Faro beach.

3.2. Sediment analysis

The highest percentage of all samples, always superior to 98%, were sand as shown in the following table (Table 3.1).

Table 3.1: Percentage of each sample between gravel, sand and mud.

	BG1	BG2	BG3	BG4	BG5	BG6	BG7	BG8
% GRAVEL:	1.2%	0.2%	0.0%	0.0%	0.6%	0.0%	0.3%	0.8%
% SAND:	98.8%	99.8%	100.0%	100.0%	99.4%	100.0%	99.7%	99.2%
% MUD:	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

All the samples when plotted in ternary triangle fell in the sand line (Figure 3.3). All the samples was the same pattern corresponding to sand with a minimum variation in the samples that appeared in the form of small quantities of gravel.

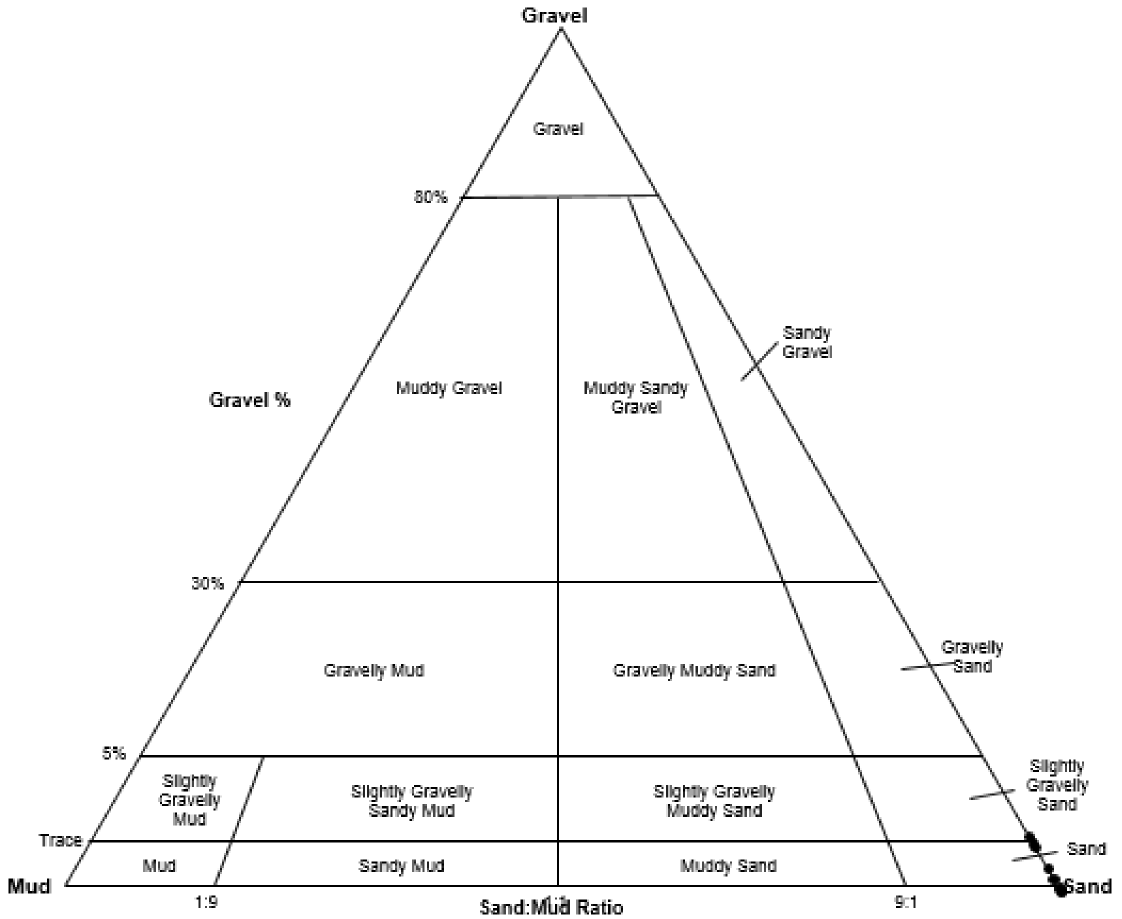

Figure 3.3: Ternary triangle which represents the ratios of sand:mud and sand:gravel present in the samples

Subsequently, an analysis of the samples was performed according to the different classification of sand as a function of the grain size. The predominant sediment was fine sand and medium sand, with the higher percentages of the subsample corresponding to sieves of 0.355-0.250 and 0.180-0.125 mm respectively (Figure 3.4). In the results an oscillation every 15 days between each sampling was observed. In the first sampling (BG1) the medium sand predominated, fine sand in the second (BG2) and consecutively. Other types of sand varied in the different samplings in lower percentages, with coarse sand predominating.

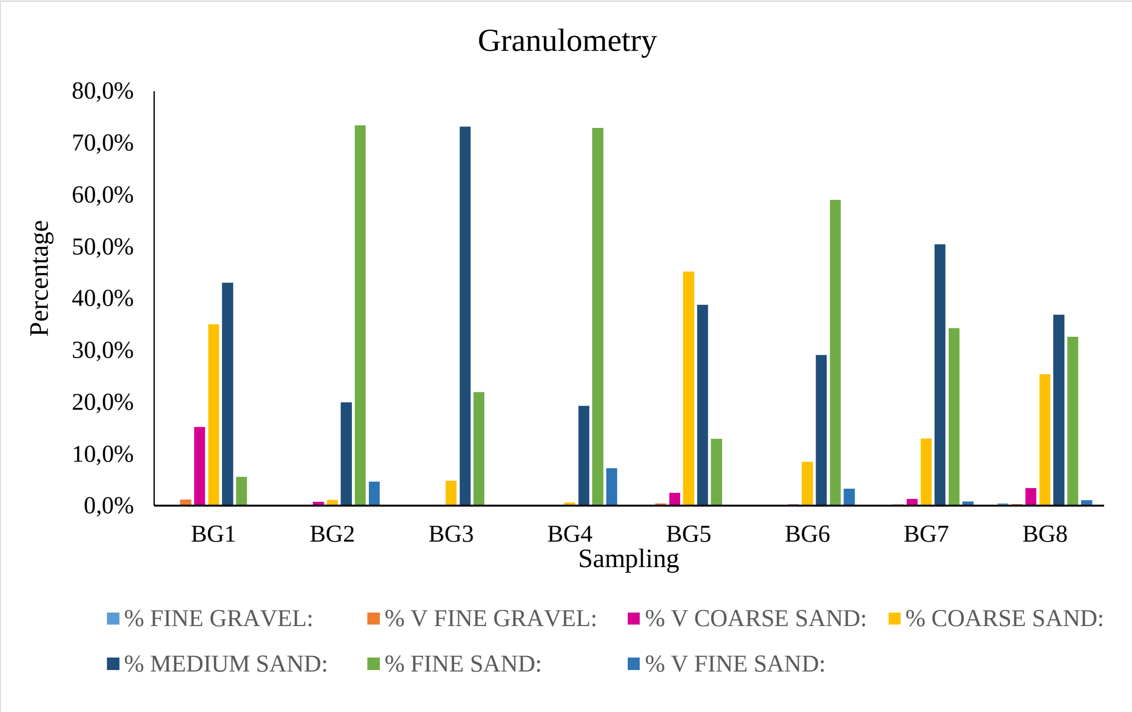

Figure 3.4: Percentage of sand in the samples as a function of the grain size according to Blott and Pye (2012).

3.3. Analysis and data processing

3.3.1. Sex ratio

A total of 899 individuals were sampled, of which 539 were females, 345 males and 15 of indeterminate sex (ANNEX 2). Sex-ratio obtained as a proportion of females was (1.56:1). A higher percentage of females than males was found in all samples except two, as shown Figure 3.5. All the values per sample were expressed as a percentage because the same number of individuals were not obtained in all samples.

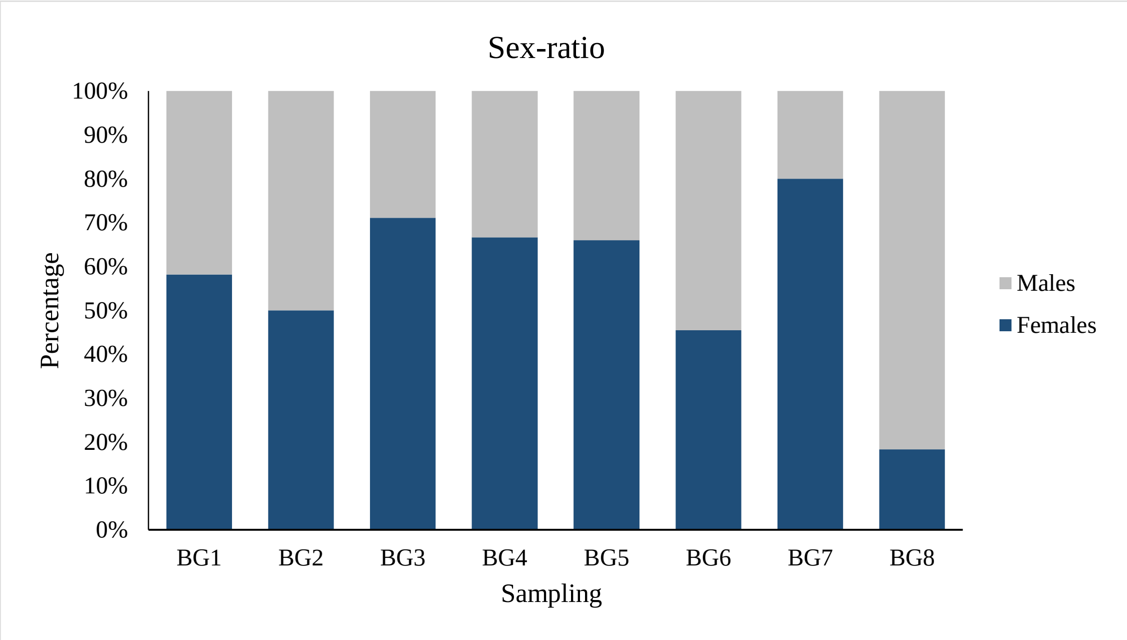

Figure 3.5. Percentage of females based on the total number of individuals in each sample (from February to June 2015).

3.3.2. Reproductive biology

3.3.2.I. Reproductive cycle

The results obtained provide some information about the reproductive cycle of *P. latipes* between February and June. During the first three months of sampling, a high percentage of females with eggs was observed. Later, during the three samplings in May and June a large decrease was observed in the percentage of berried females (Figure 3.6). Minimum berried female was carapace length (CL) 14.70 mm and carapace width (CW) 14.38 mm; maximum berried female recorded was with CL 21.85 mm and CW 21.42 mm.

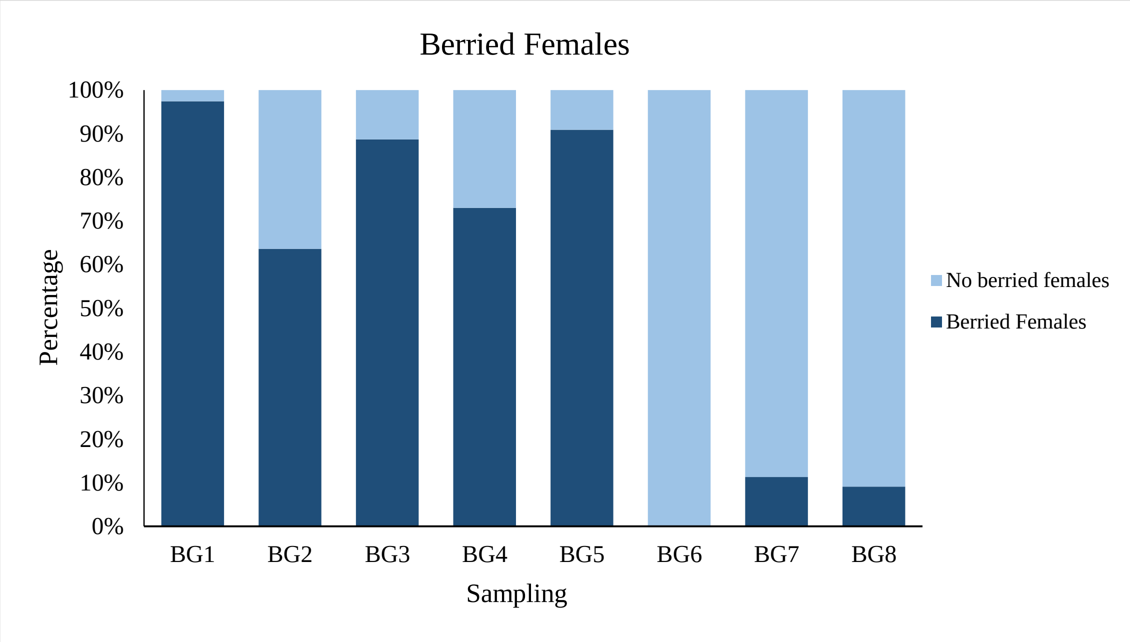

Figure 3.6. Percentage of berried females during the period of study.

3.3.2.II.. Fecundity

The fecundity differed for the different states of egg development, with a decrease in fecundity with egg development (orange > yellowish > grey). Analysis of different states were made as a function of the length and width. Significant positive relationships were found between fecundity and CW and CL. The carapace length ranged from 15,43mm to 21,37mm (Stage I), 15,91mm to 21,85mm (Stage II) and 15,32mm to 20,51mm (Stage III). On the other hand, the carapace width ranged from 15,20mm to 20,65mm, 15,41mm to 21,42mm and 15,34mm to 20,07mm respectively for the Stage I, II and III eggs. The minimum and maximum values observed in the total number of eggs were 8.880 to 35.334, 12.533 to 45.201 and 4.536 to 26.448 respectively for the different stages of egg development (ANNEX 3).

Table 3.2 shows the estimated parameters of the fitted power and linear models and the significance of r for models applied to the fecundity – CW and fecundity – CL data for the three egg development stages.

Table 3.2: Parameters of the power and linear models fitted to the fecundity-CW and fecundity-CL data for the three egg development stages and associated r values.

Model	Coloration	Parameters				
Carapace Length		a	b	R^2	r	Significance
Power	Yellowish	7.984	2.648	0.502	0.709	p<0.001
Linear	Yellowish	-30231	2656	0.449	0.67	p<0.01
Power	Orange	11.448	2.616	0.379	0.6156	p<0.01
Linear	Orange	-42265	3646.7	0.38	0.6164	p<0.01
Power	Grey	2.909	2.819	0.224	0.473	p<0.05
Linear	Grey	-29132	2230.1	0.342	0.585	p<0.01
Carapace Width		a	b	R^2	r	Significance
Power	Yellowish	3.327	2.98	0.51	0.714	p<0.001
Linear	Yellowish	-35760	3049	0.46	0.678	p<0.01
Power	Orange	29.193	2.321	0.33	0.574	p<0.01
Linear	Orange	-35096	3368.6	0.335	0.579	p<0.01
Power	Grey	0.415	3.53	0.344	0.587	p<0.01
Linear	Grey	-35107	2641.6	0.453	0.673	p<0.01

The models with the best fit (highest values of r) are given in Figures 3.7 and 3.10 for Stage I, Figures 3.8 and 3.11 Stage II and Figures 3.9 and 3.12 for Stage III. In all cases a positive trend was observed between the total number of eggs and the carapace length or width.

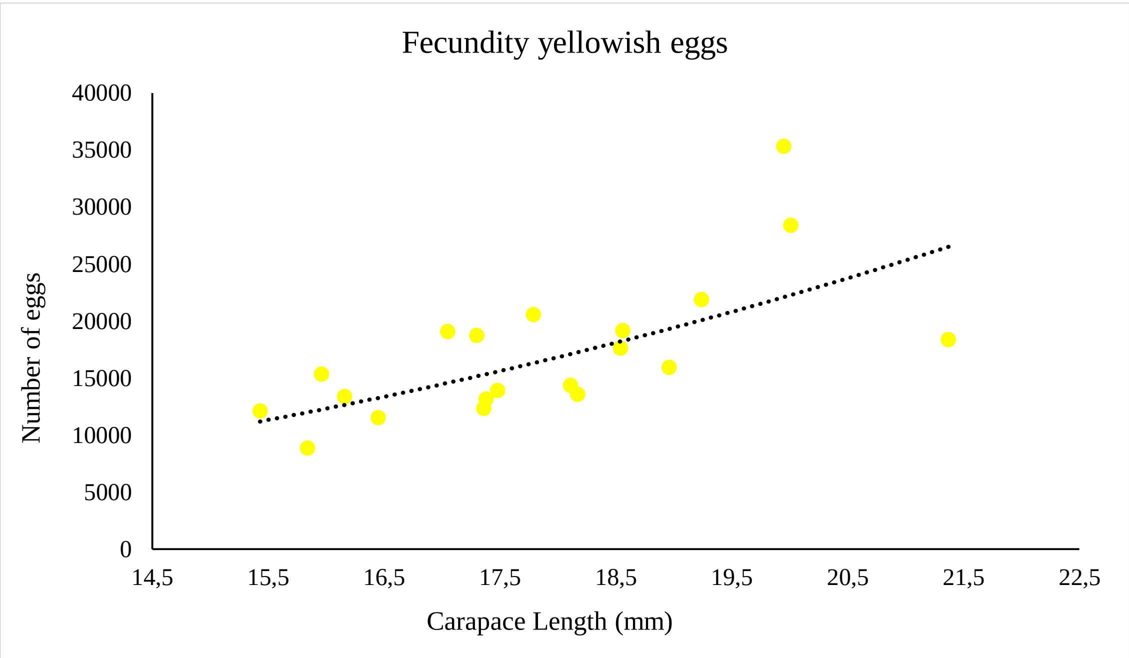

Figure 3.7: Representation of power model between the number of eggs and carapace length for females with yellowish eggs colour (Stage I) (N=20).

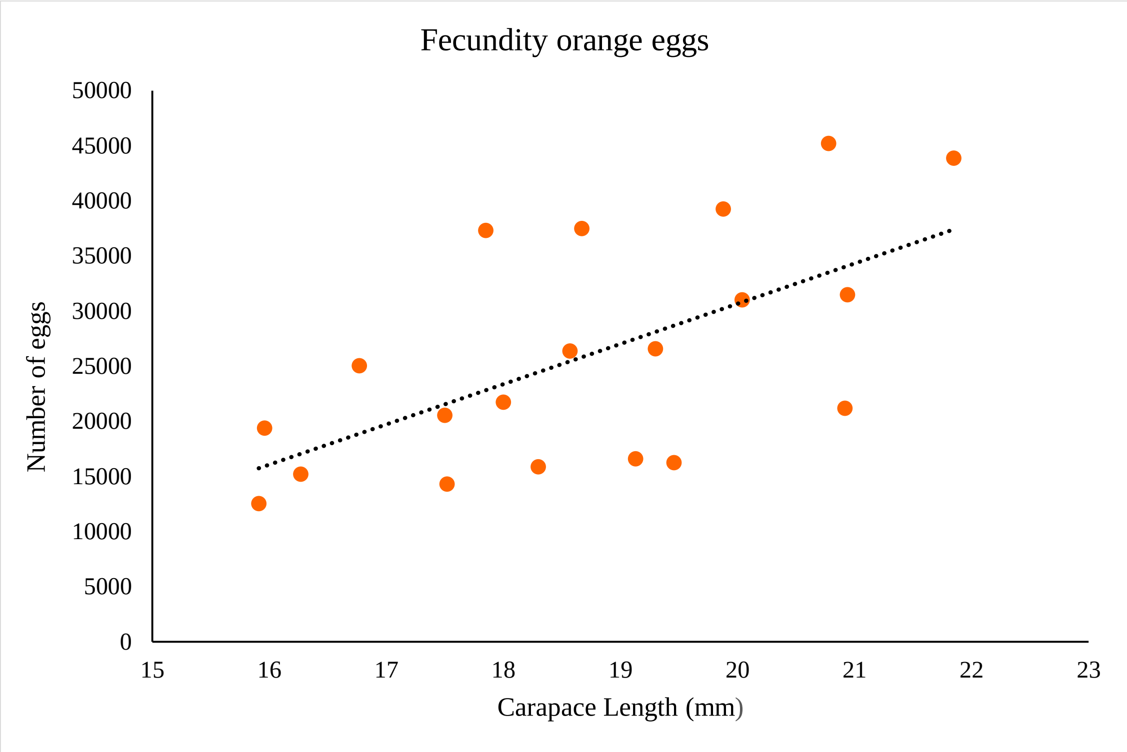

Figure 3.8: Representation of linear model between the number of eggs and carapace length for females with orange eggs colour (Stage II) (N=20).

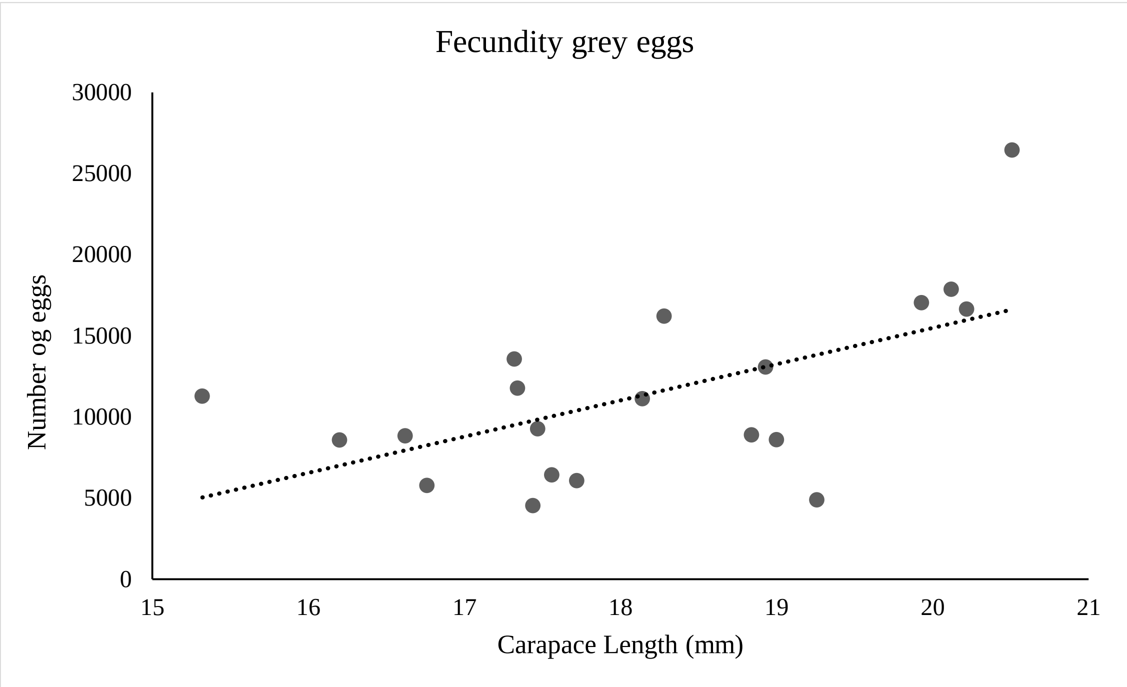

Figure 3.9: Representation of linear model between the number of eggs and carapace length for females with grey eggs colour (Stage III) (N=20).

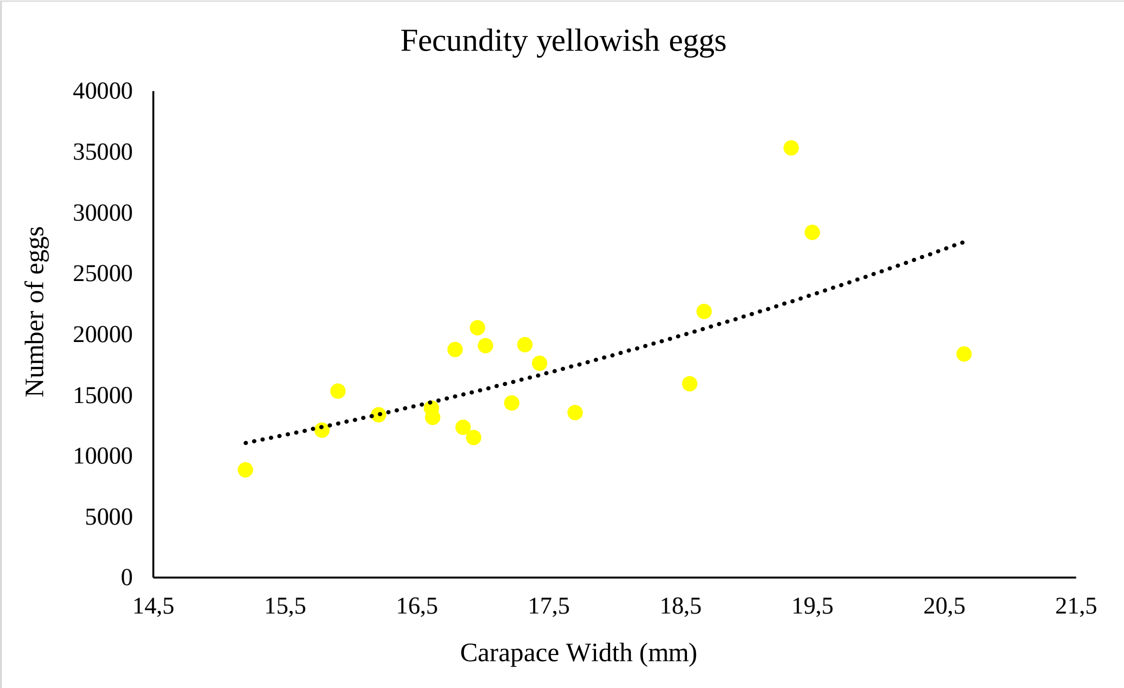

Figure 3.10: Representation of power model between the number of eggs and carapace width for females with yellowish eggs colour (Stage I) (N=20).

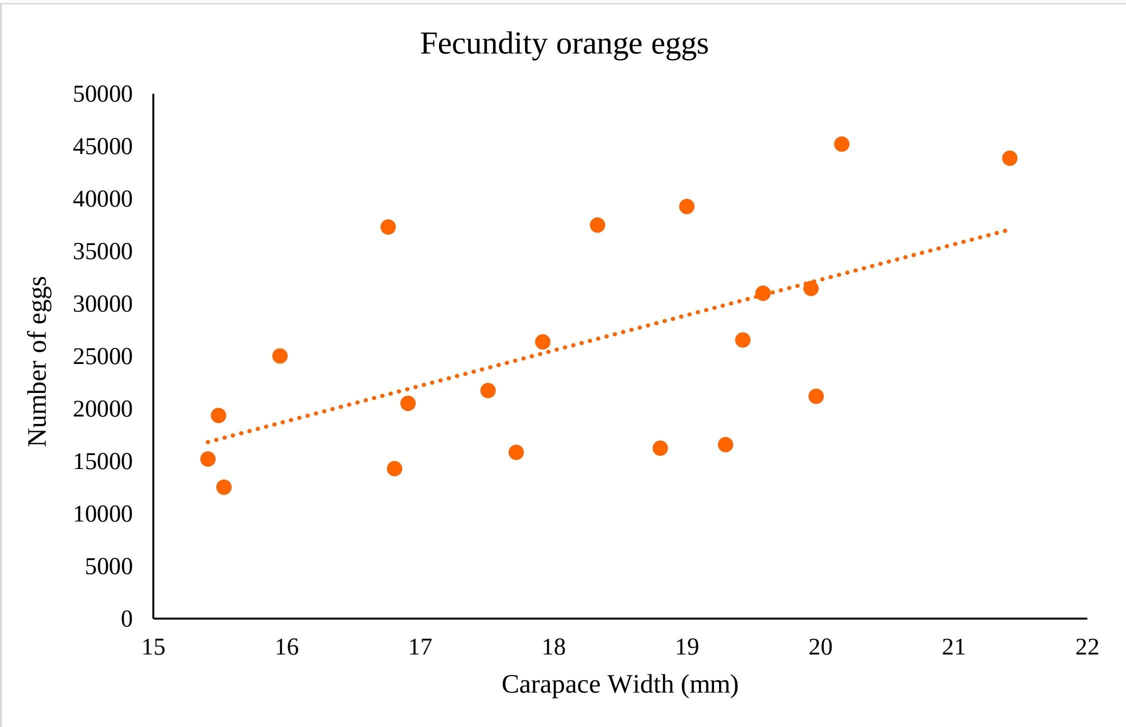

Figure 3.11: Representation of linear model between the number of eggs and carapace width for females with orange eggs colour (Stage II) (N=20).

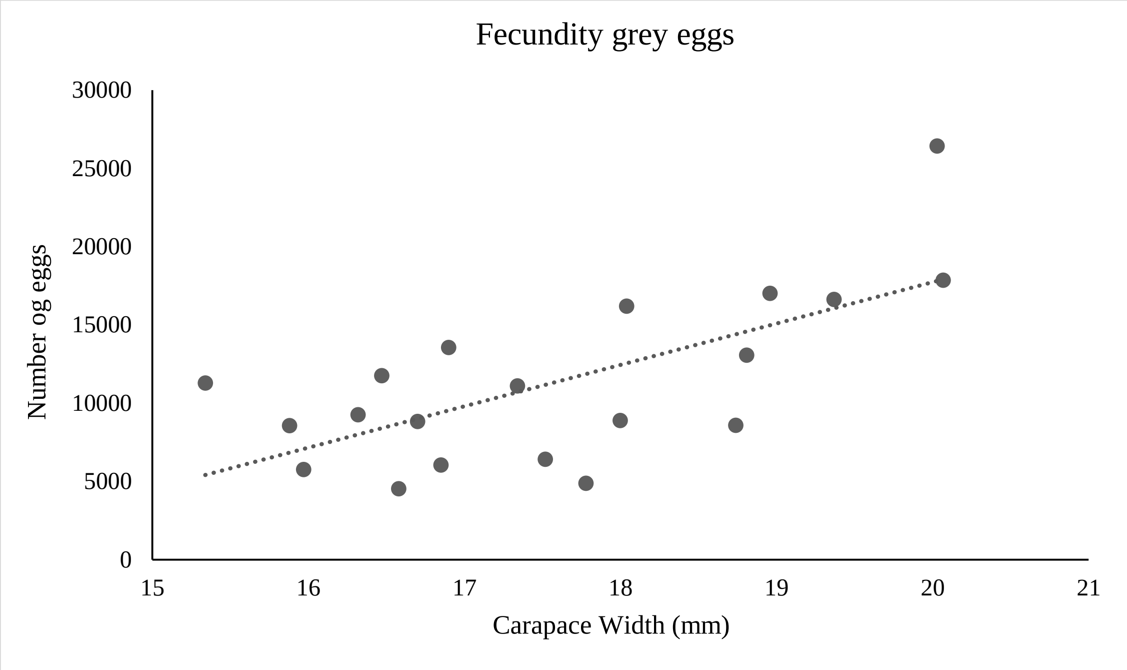

Figure 3.12: Representation of linear model between the number of eggs and carapace width for females with grey eggs colour (Stage III) (N=20).

The highest number of eggs was observed in the orange colored eggs stage of development with orange coloration eggs. On the other hand, the smallest values were obtained in grey colored eggs, coinciding with the last development state of the eggs.

3.2.2.III. Number of eggs per 1 gram of sample.

Despite the variation in the total number of eggs with respect to the carapace measurements, the number of eggs per gram of female was constant across all sizes (ANNEX 4). Linear regressions of the number of eggs per gram of female against CL gave non-significant ($p > 0.05$) r values of 0.341; 0.189 and 0.110 for yellowish, orange and grey eggs respectively, reflecting a horizontal trend (Figure 3.13). The mean total fecundity values obtained for each stage of development were 7711.1, 10004.0 and 4837.6 eggs per gram of female respectively for stages I, II and III eggs. With increasing size, individuals have proportionally greater numbers of eggs. Egg size did not vary between individuals, but it differs between the stages of development. Differences between the first two stages with respect to the last one were observed, in which the total number of eggs was lower for the same amount of sample (1g). In this case, the total number of eggs is lower due to a higher density of eggs produced by a further development of the eggs.

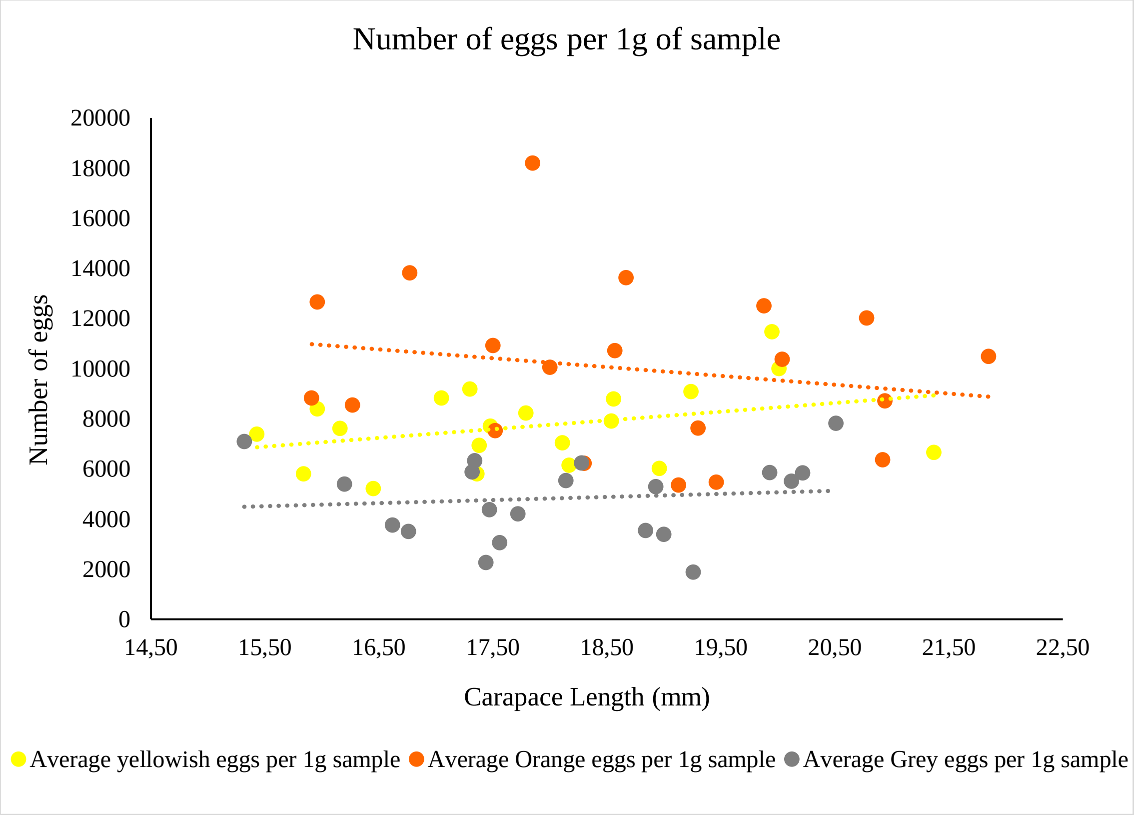

Figure 3.13: Representation of linear model for the different stages I, II and III for the fecundity per gram of sample.

3.3.3. Length frequency analysis

The length frequency distributions for males and females are given in figures 3.14 and 3.15. In general, males were found in larger size classes than females, 18-20mm and 16-18mm respectively. The maximum length in males was 25,30mm and the minimum 11,10mm in all length frequency data. For females the maximum length was 21,85mm and the minimum 10.54 mm.

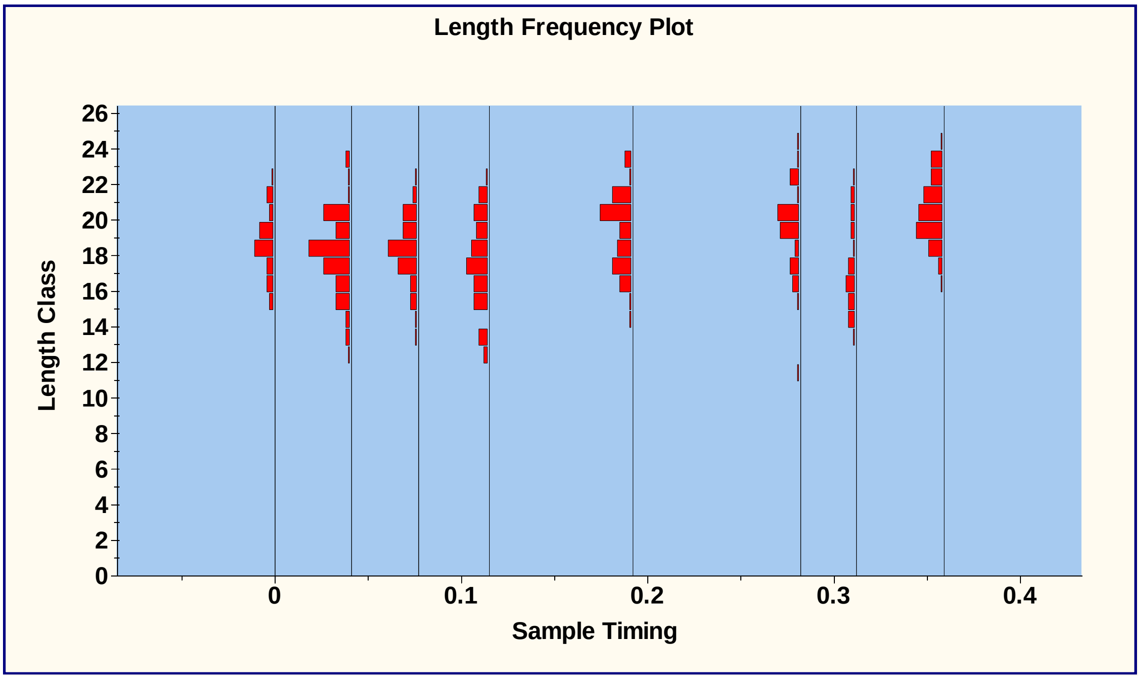

Figure 3.14: Sample length frequency histograms of P.latipes males from February to June 2015.

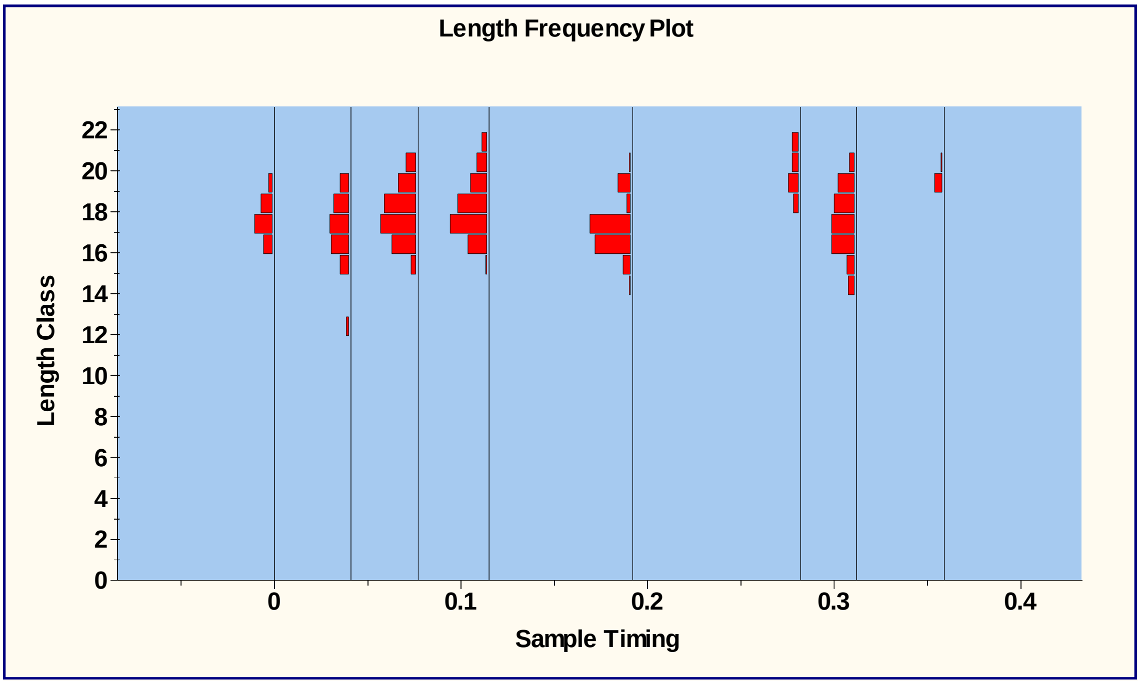

Figure 3.15: Sample length frequency histograms of P.latipes females from February to June 2015.

The growth curves were calculated using ELEFAN implemented in the LFDA package. The estimated von Bertalanffy growth parameters for males of *P.latipes* were L_∞= 34.83mm; K= 0.52y^{-1}; t_0= -0.41, while for females the estimated parameters were

L_∞= 27,16mm; K= 0.74y^{-1}; t_0= -0.39y. The von Bertalanffy equations for males and females are shows below (Equation 3.1 and 3.2):

$$L_t = 34.83(1 - e^{-0.52(t+0.41)})$$

Equation 3.1: Von Bertalanffy equation for males of P.latipes.

$$L_t = 27.16(1 - e^{-0.74(t+0.39)})$$

Equation 3.2: Von Bertalanffy equation for females of P.latipes.

Parameters obtained in the equation of von Bertalanffy differ between both sexes. It can be observed that females had a higher growth rate than males, but males attain a larger asymptotic maximum size. Von Bertalanffy plot are represented for the different cohorts in Figure 3.16 for males and Figure 3.17 for females.

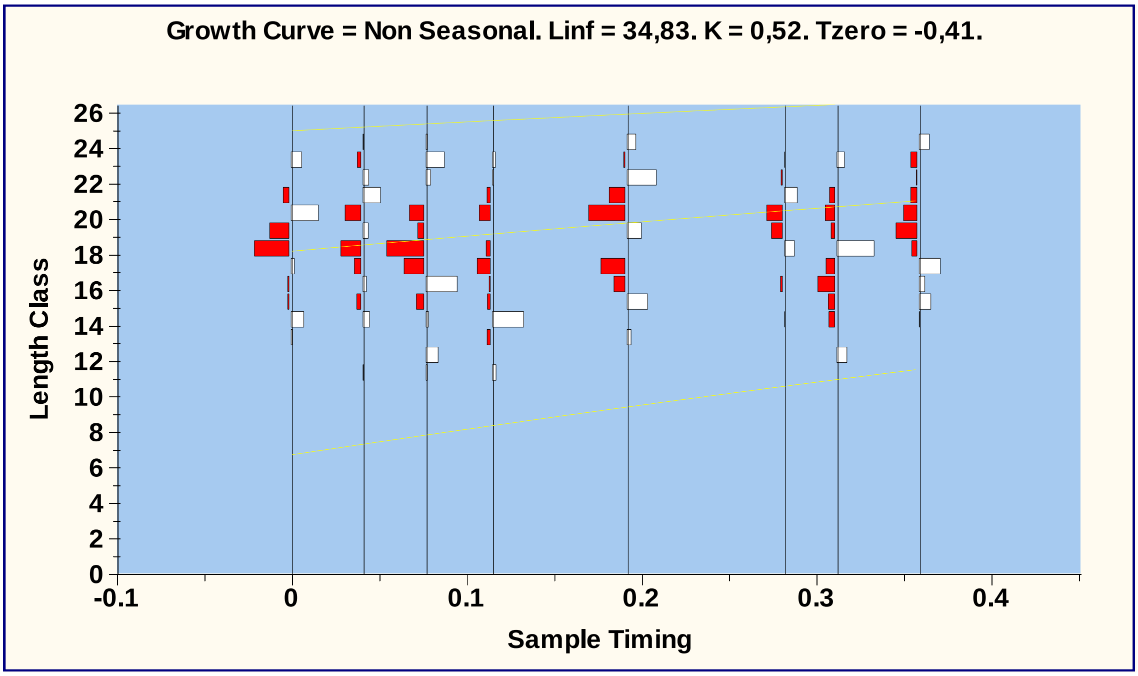

Figure 3.16: Von Bertalanffy growth curve fitted by ELEFAN for males of P.latipes.

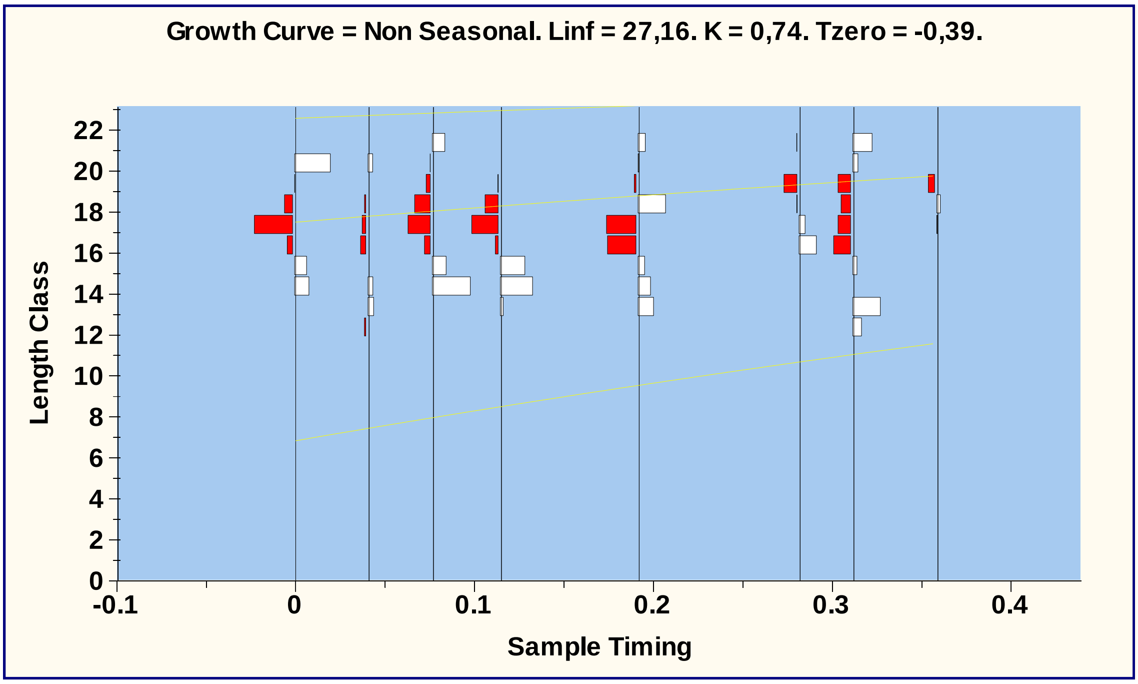

Figure 3.17: Von Bertalanffy growth curve fitted by ELEFAN for females of P.latipes.

From the plots it can be observed that in both sexes there are two, possibly three cohorts corresponding to different age classes. In both sexes the minimum length of the first cohort was approximately 7mm. The ELEFAN contour plots, an intermediate step during the Length frequency analysis, for males and females are shown in ANNEX 5.

3.4. Field work experiments

3.4.1. Mark-recapture experiment

The experiment was performed in the same place with a constant area of 720m^2 (60 meter long by 12 meters wide). During the four days in which the experiment was performed, the amplitude of the low tide varied between 0.5 – 1m. The table below show the results obtained in the mark-recapture experiment (Table 3.3).

Table 3.3: Results of the catch obtained in the mark-recapture experiment.

	Catch	Recapture	Marked	Previously marked
19/05/2015	41	0	41	0
20/05/2015	59	2	57	41
21/05/2015	66	0	66	98
22/05/2015	76	2	74	164
Total	242	4	238	303

The result obtained with the Schnabel method was $\widehat{N} = 4270.2$, with 95% confidence interval of [1753.39; 7188.89]. In relation with the area studied, the result was approximately 6 individuals per m^2.

3.4.2. Area of attraction experiment

During the three sampling days the water temperature was 21.5ºC, 21.7ºC and 21.5ºC and salinity was 36.6 and 36.2 PSU for the two first days (salinity was not recorded in the third day). ANNEX 6 shows the different distances between stakes during the three sampling days along with the catches. The mean catch obtained for each distance is given in the table below (Table 3.4).

Table 3.4: Results obtained in the area of attraction experiment and the mean for each distance between the traps.

Distance	Catch 05/06/2015	Catch 08/06/2015	Catch 18/06/2015	Mean
1	4	1	3	2.7
2	2	3	7	4.0
4	6	6	14	8.7
8	8	10	19	12.3
16	4	3	20	9.0

An exponential model between mean *cpue* and the distance between traps was fitted (Figure 3.18).

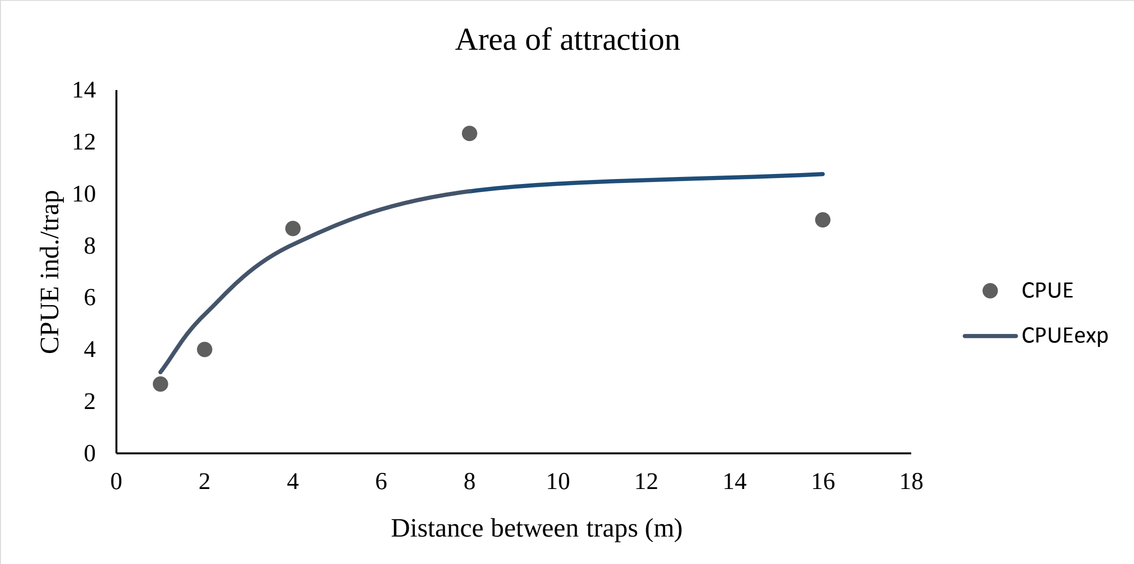

Figure 3.18: Plot of observed (grey spot) and expected (line) mean cpue as a function of distance betweem traps.

A value of $\overline{cpue}_{\infty}$ equal to 10.515 individuals per trap was obtained for the distance between traps of s_{∞} of 10.591m. At this distance between traps supposedly there is no overlapping between the attraction area of the different traps (Figure 3.19). The radius obtained of the attraction area was 5.296, corresponding to an attraction area of 88.099 m^2/trap. All the parameters obtained are shown in Table 3.5.

Table 3.5: Parameters obtained in the area of attraction experiment.

Parameters	**a**	**b**	S_{∞} **(m)**	r_{at} **(m)**	A_{at} **(m^2/trap)**
Estimate	10.807	0.341	10.591	5.296	88.099

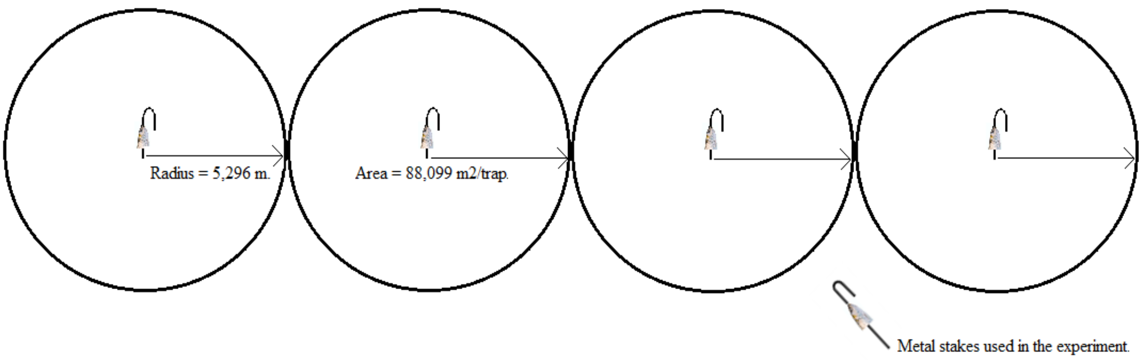

Figure 3.19: Representation of experimental design with the distance at which the greatest catch of the target species is obtained.

3.5. Distribution of *P.latipes* along the Portuguese coast

During the monitoring surveys the target species was found in different habitats. Most of the crabs were captured in samples with *Donax* species in the shallower waters with sandy bottom. Individuals of *P.latipes* were also found in samples with mud where the surface layer is composed of sand (Figure 3.20).

Figure 3.20: Different bottom types in which individuals of P.latipes were found. Left picture shows individuals caught in shallow waters with sand and in the right picture mud bottom.

Portumnus latipes is widely distributed along the entire Portuguese coast (ANNEX 7). The lowest depth from which individuals of *P.latipes* was recorded was 3 m during the survey carried out both in the south and southwest coast of Portugal. The species was rarely found at depths greater than 12 m, with a maximum of 28 m in the campaign along the north-west coast of Portugal. Highest abundances were recorded in stations around 3 m depth in two first campaigns. On the other hand in north-west coast, the abundance was similar at 8 m and 10 m with both depths dominating the catches obtained during the campaign.

In the south coast *P. latipes* were recorded in 17.04% of the stations sampled. A total of 309 individuals were captured at depths ranging between 3 to 6.6 m (Figure 3.21 and 3.22). In the windward area the catch was higher than in leeward. More specifically the highest catches were obtained in the areas influenced by the Ria Formosa. The greatest number of individuals captured was registered in front of Faro spit with 45 individuals.

On the other hand, between Vila Real de Santo António and Olhão, practically no catches were recorded.

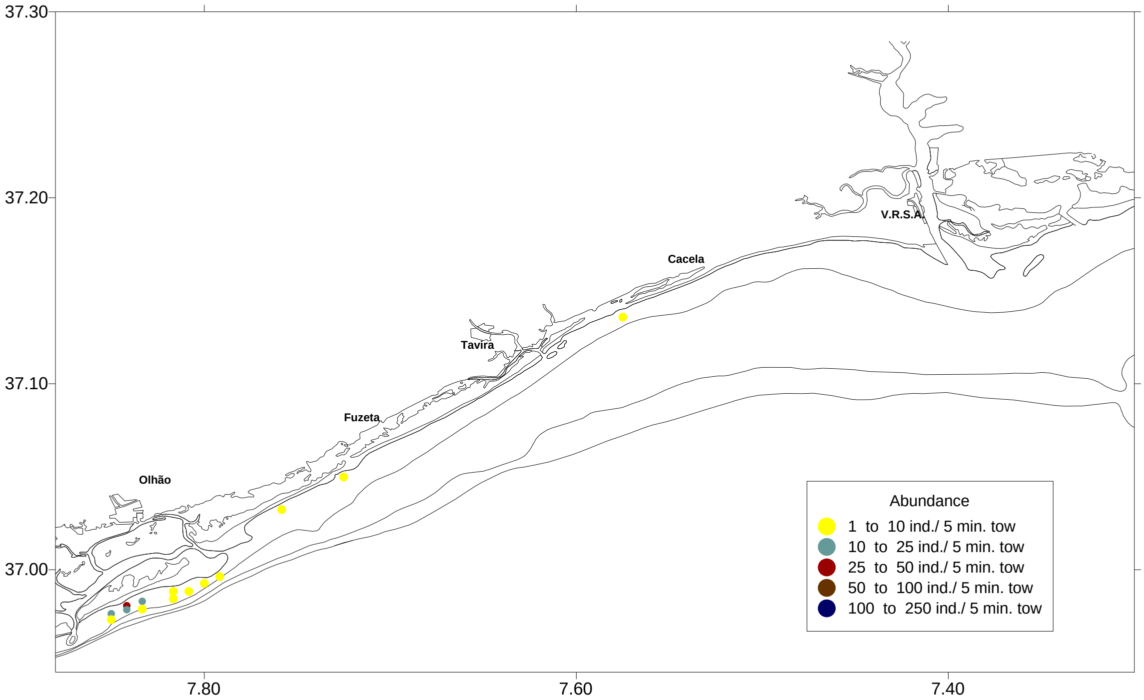

Figure 3.21: Number of individuals of P.latipes per 5 min tow from different sampling locations in the south of Portugal.

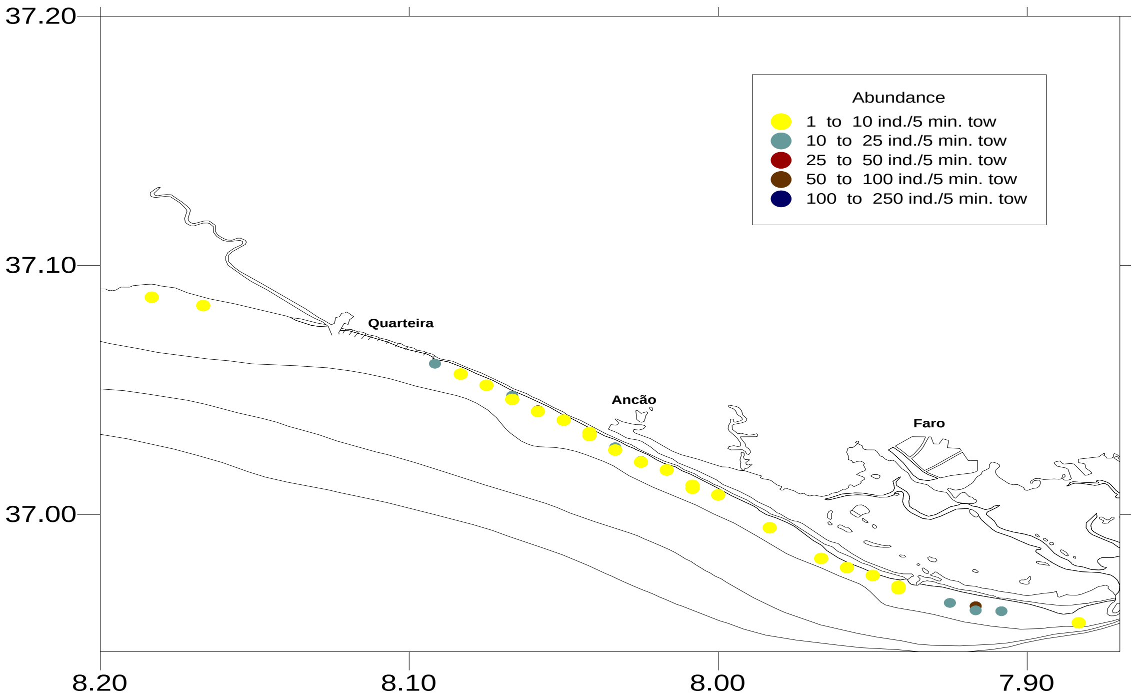

Figure 3.22: Number of individuals of P.latipes per 5 min tow from different sampling locations in the south of Portugal.

In the southwest coast between Sines and Costa da Caparica, a total of 820 *P. latipes* individuals were caught (Figure 3.23) at depths from 3 to 20 m. This species were recorded in 49.73% of the stations sampled, having the highest percentage of occurrence. Occurrence of *P .latipes* were distributed homogeneously in the stations nearest the coast. Higher catches were observed near Costa da Caparica in the area influenced by the Tejo estuary.

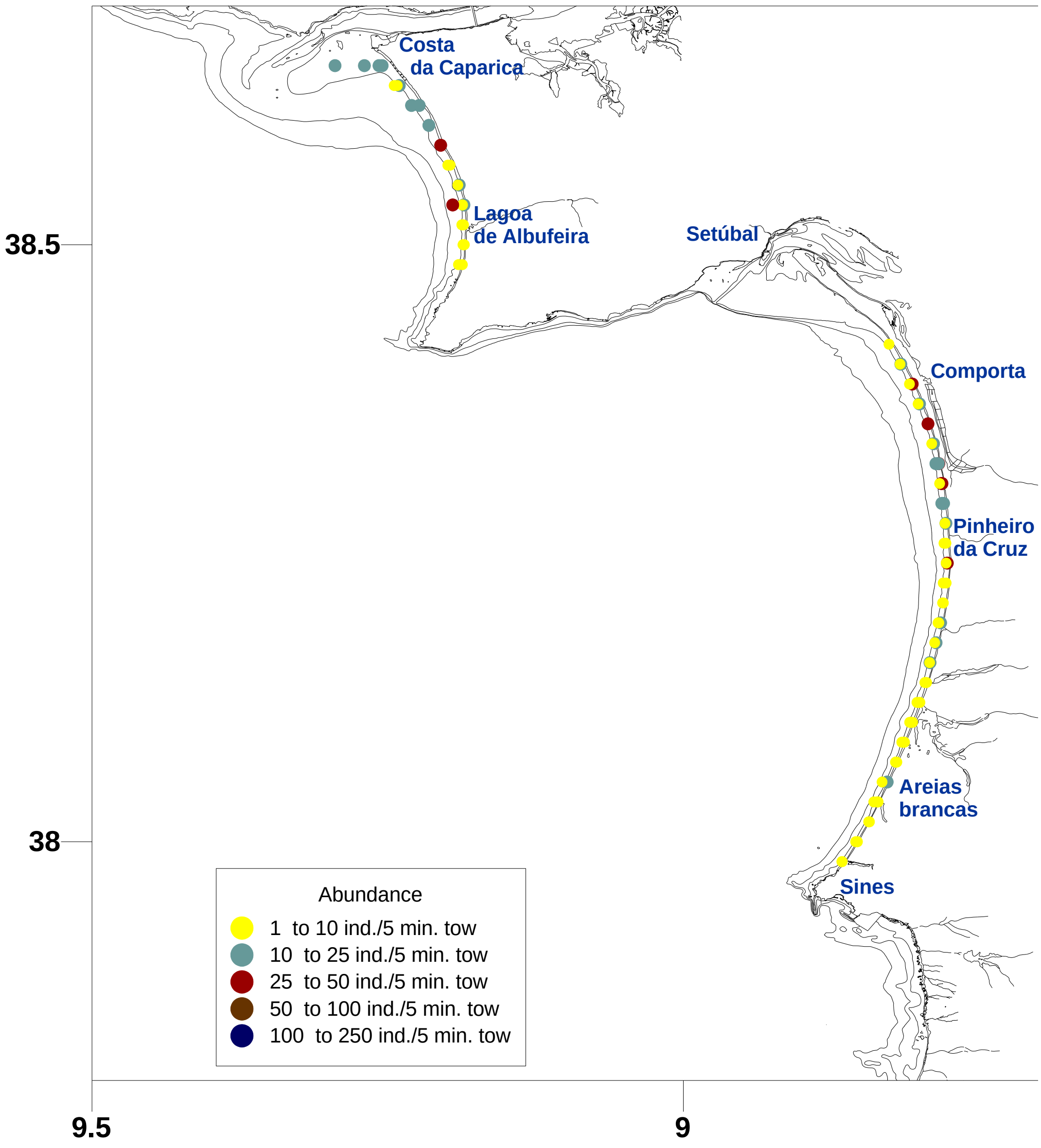

Figure 3.23: Number of individuals of P.latipes per 5 min tow from different sampling locations in the western coast of Portugal.

A total of 229 individuals of *P .latipes* were captured in the survey undertaken in the northwest coast of Portugal at depths ranging between 8 and 28 m. (Figure 3.24). This species occurred in 9.13% of the stations sampled. The highest abundance of registered off Aveiro.

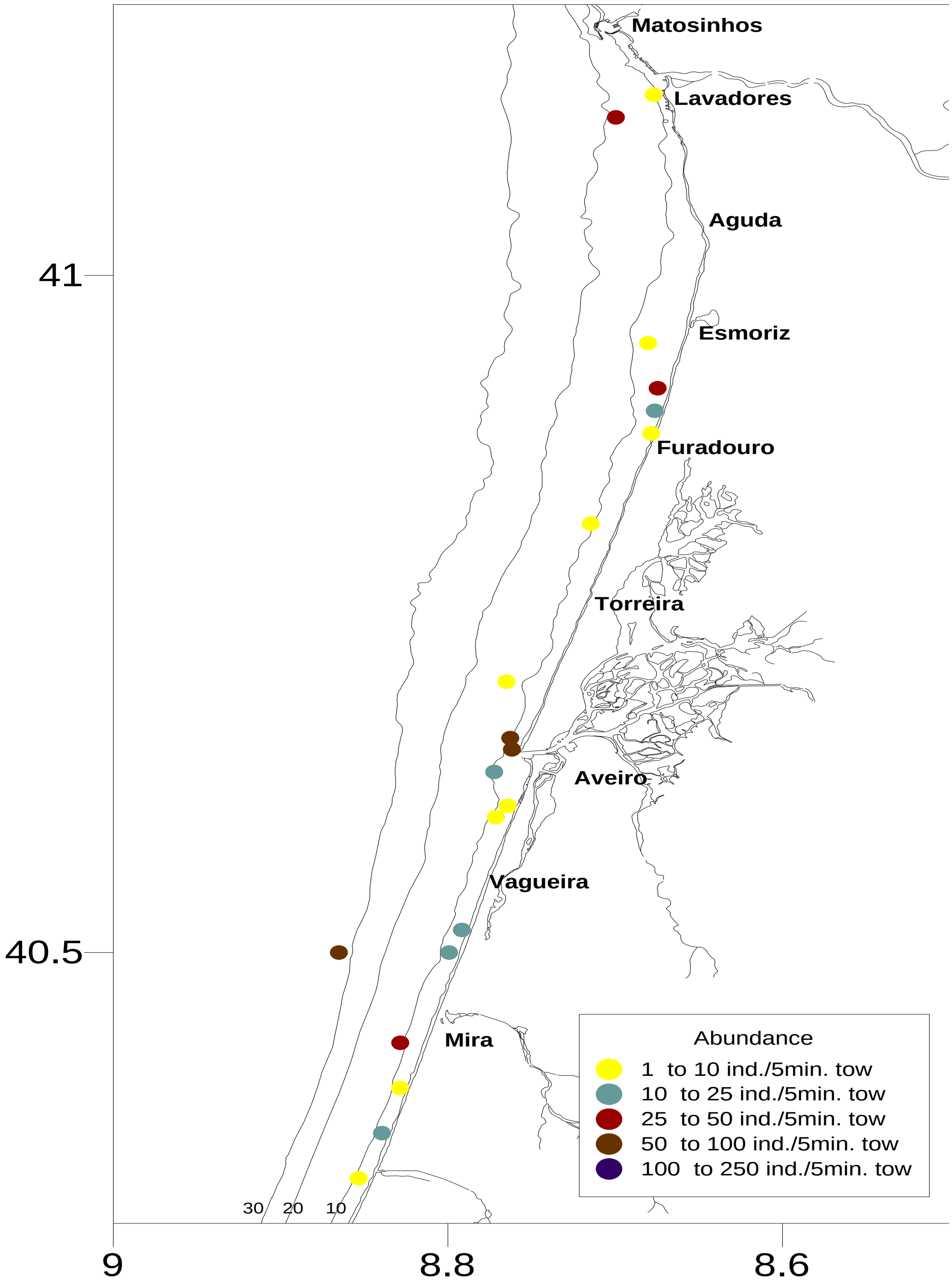

Figure 3.24: Number of individuals of P.latipes per 5 min tow from different sampling locations in the north western coast of Portugal.

With respect to biomass, the highest values per tow were recorded in the south coast of Portugal (Figure 3.25 and 3.26). The stations with highest values were located near the Ria Formosa, with 42 and 35 individuals for a total of 72.53g and 70.91g, respectively. In the southwest coast the values of biomass were higher than in the south coast with practically half of the station with values ranging from 10 to 25g/5 min. tow (Figure 3.27). However in the south coast most stations had values of 1 to 10 g/5min. tow. With respect to the analysis of biomass in the northwest coast, the highest values were observed off Aveiro (Figure 3.28).

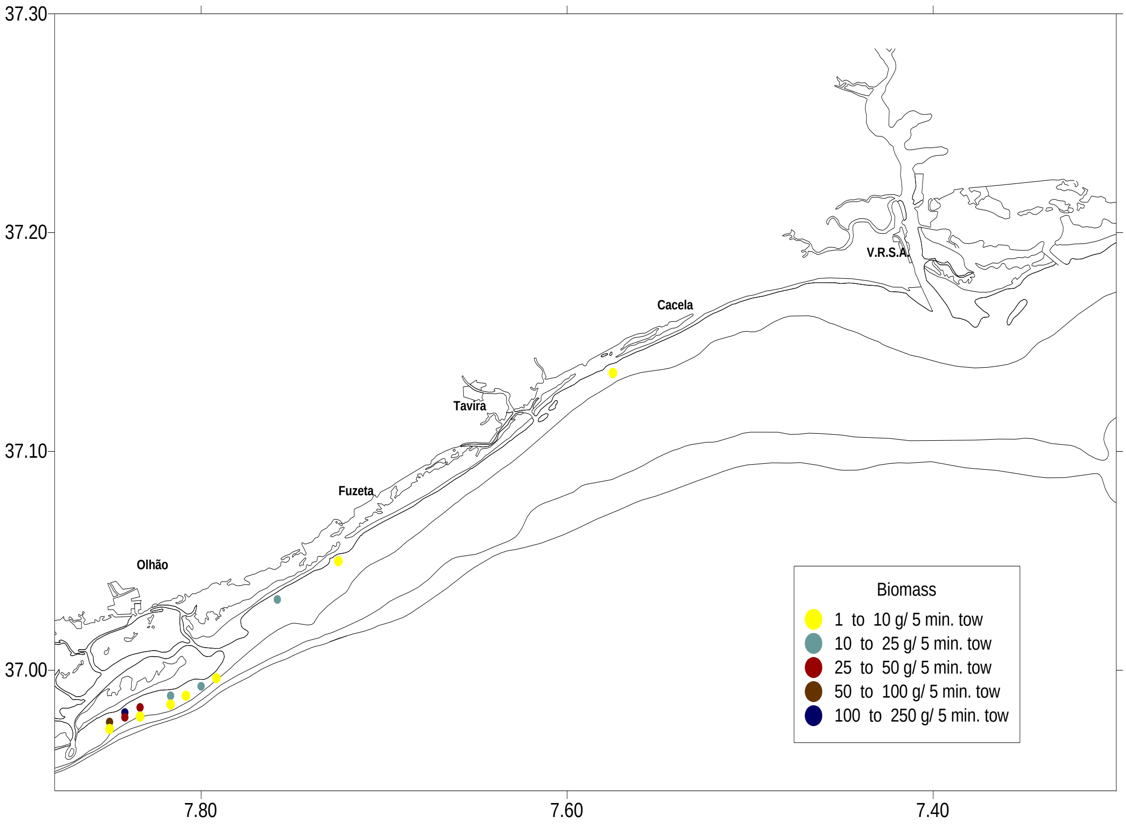

Figure 3.25: Biomass of P.latipes (g / 5 min tow) in the South of Portugal.

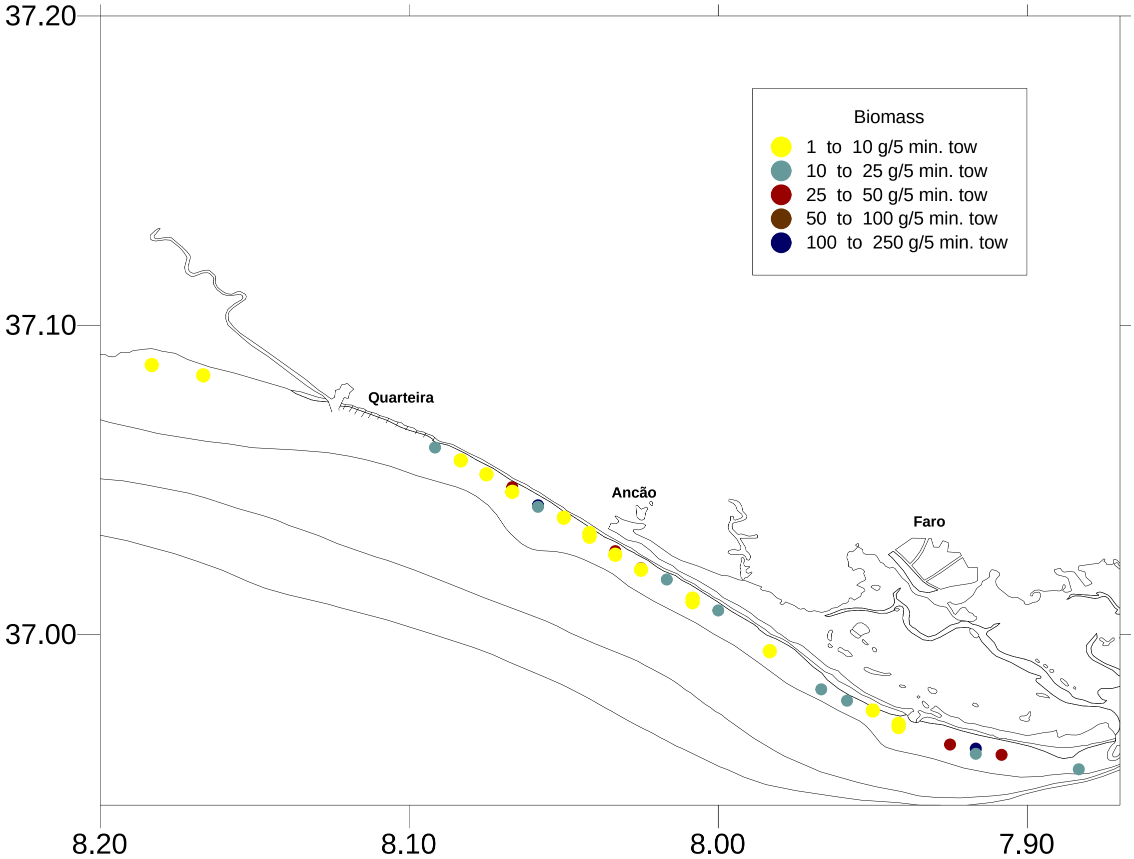

Figure 3.26: Biomass of P.latipes (g / 5 min tow) in the South of Portugal.

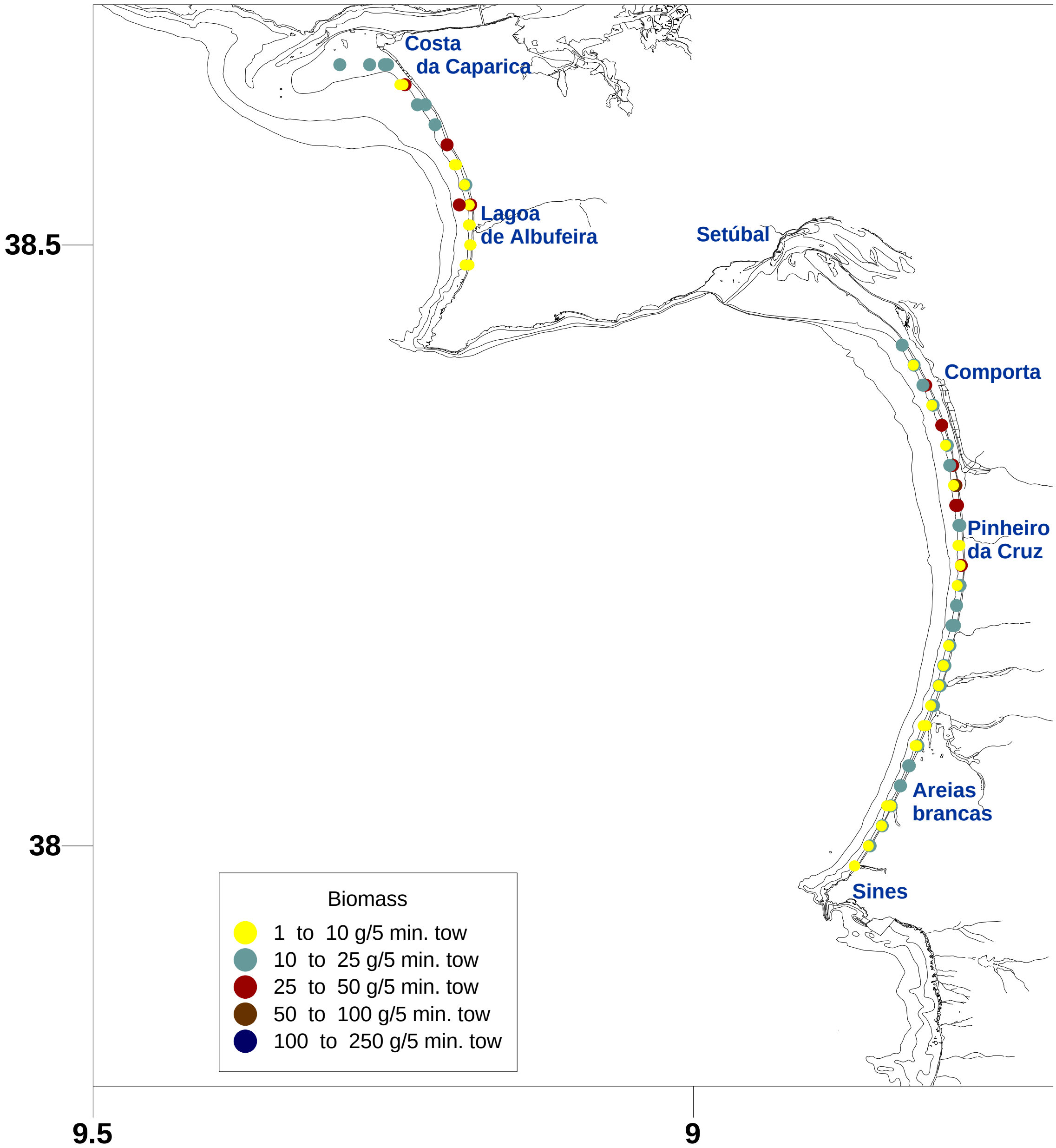

Figure 3.27: Biomass of P.latipes (g / 5 min tow) in the west coast of Portugal.

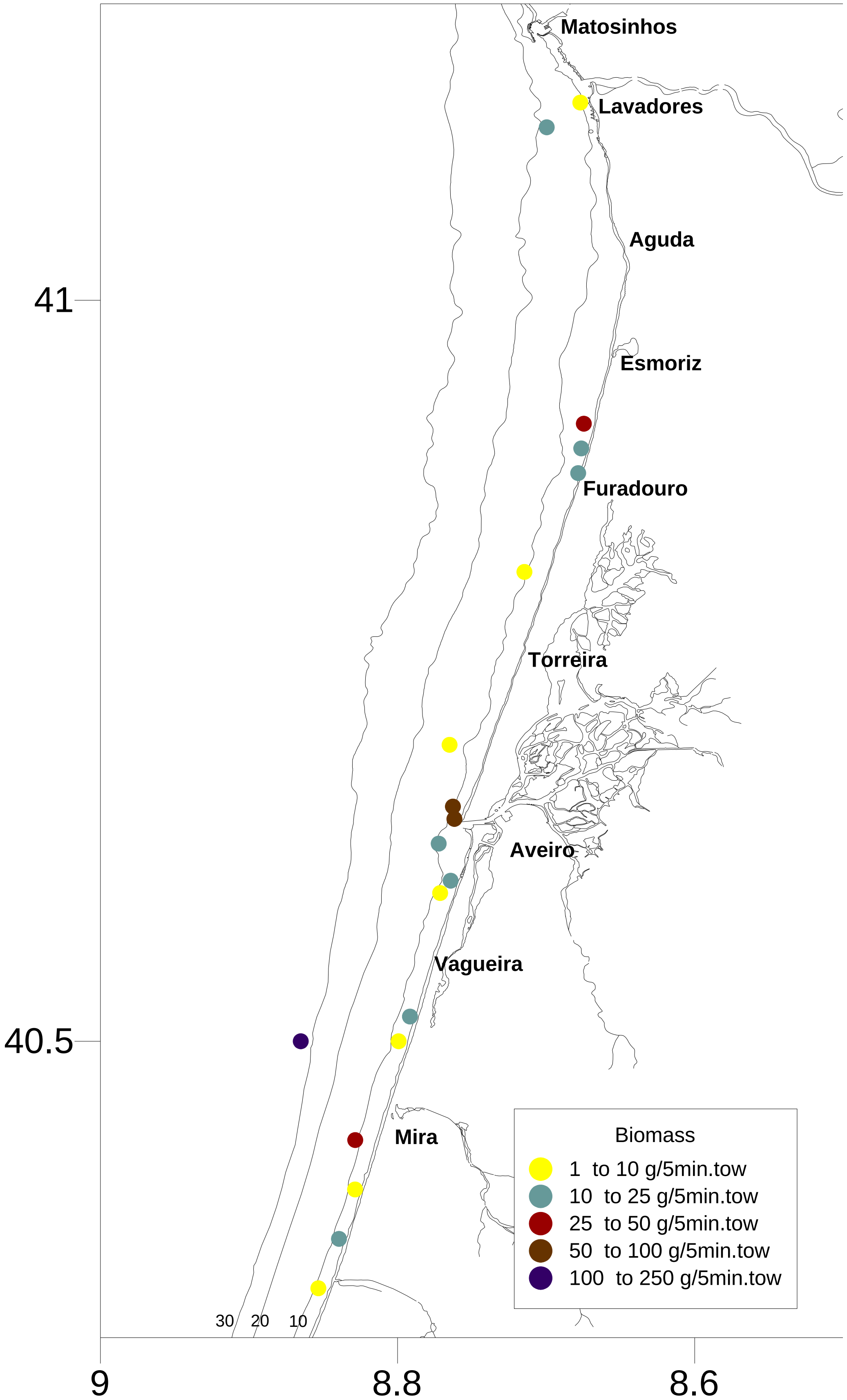

Figure 3.28: Biomass of P.latipes (g / 5 min tow) in the North west coast of Portugal.

4. DISCUSSION

4.1. Efficiency of sampling methods

According to the results of this study, the presence of Pennant's swimming crab is confirmed in the Portuguese Coast. During the study 3 different sampling methods were applied; manual ganchorra, baited metal stakes and dredges (Ganchorra pulled by a vessel). Sampling methods used in this study proved to be effective, providing adequate numbers of undamaged individuals for the biological studies. However, it should be noted that earlier trials in winter months resulted in few or no captures using metal stakes. This is probably due to low activity or feeding levels at lower temperatures (less than 13ºC), resulting in low attraction rates to the baited stakes. An alternative sampling method, such as a dredge for bivalves, would be required for the coldest months of the year.

Both, metal stakes and ganchorra methods were applied on sandy beach in the mesotidal zone that is highly affected by surf, while the dredges were used in the infralittoral zone, with all methods strongly affected by tidal currents. Although effective, each of them had certain limitations. Sampling using dredges from the research vessel allows sampling farther from the coast and at greater depths than the other two methods. However, with dredges from vessels it is not possible to sample at lower depths due to the draft of the vessel; in this study the shallowest stations were 3 m deep, while with the manual ganchorra sampling depth is limited by the height of the fisherman, varying between 0.5-1.5m sampling depth.

The main limitation of these techniques is the possible loss of smaller individuals due to the mesh of the net. Previous studies have reported individuals of *P.latipes* with 6 mm length using nets whose mesh size was 0.5 cm (Chartosia et al., 2010), whereas in this study the ganchorra net targeting bivalves that was used in the sampling during the IPMA surveys had a stretched mesh size of 4 cm, The manual ganchorra minimum mesh size was 3cm, according to "Direcção Geral das Pescas e Aquicultura", Jenuary 2005; [Artº 16º, nº 3, c) de Regulamento aprovado pela Portaria nº 1102-E/2000]. Among all the individuals caught in this study with ganchorra by hand, the smallest length corresponded to a 10.54 mm female and using dredge another female with 10.09 mm length. Therefore, it must be considered that with the net used for sampling with ganchorra the smallest specimens of the target species are underrepresented or not sampled at all.

Sampling using metal stakes is the most economical method but it is the least efficient method if a large number of individuals is required. Regarding the catches using metal stakes there was no specific size selectivity. However, the data obtained showed that catches normally correspond to medium to large individuals. The main limiting factor when the method used is metal stakes is the temperature of the seawater. In winter during the first samplings with stakes metal no individuals of crab were found. Subsequently when the sea temperature reached values above 18 ° C in spring, this method was tested again. In this case the method was effective for capture of specimens of *P.latipes*, suggesting a possible inactivity of individuals due to low temperatures. These results also correspond to the expectations of offshore migration of the species when environmental conditions are not optimal (Türkay and Stecher, 2013). In addition to temperature, the target species can be affected by storms because previous studies such as that of Chartosia et al. (2006) found that after a period with no individuals, after wave action is reduced for several days, individuals migrate to the intertidal zone to feed. Finally, the storms can also affect the species because they can modify the type of sediment, affecting the species which lives buried in the sand.

4.2. Reproductive biology of Pennant's swimming crab, *Portumnus latipes*

The sex ratio in this study was dominated by females 1.56:1. However, Türkay and Stecher (2013) recorded an even distribution of individuals of *P.latipes* between sexes. Abelló (1989) recorded a sex ratio of 1.23: 1 for *Liocarcinus depurator* (Linnaeus, 1758). Du Preez and McLachlan (1984) studied a portunid crab *Ovalipes punctatus* (De Haan, 1833) and suggested that biased sex ratios could be due to the different rates of mortality in adult individuals. In this case, greater mortality of males could be associated with greater exposure to predators if males spend less time buried in the sand than females.

Significant catches started to be made in February when the highest proportions of berried females were found. Previous studies of Decapod crustacean larvae by Fusté (1989) found large numbers of larvae of *P.latipes* between February and early May in the Ebro delta. Zoea of *P.latipes* were found in February off the coast of Castellón (Vives, 1966) and in March off the coast near Barcelona (Fusté, 1989). Thus, it can be concluded that the reproductive period probably starts in winter, with a peak in February-March. *P.*

latipes begin brooding in winter, as is the case for other small portunid species from the nearby Northwestern Mediterranean, *L.depurator* (Abelló, 1989) and *Liocarcinus arcuatus* (Leach, 1814) from Northwestern Spain (Muiño et al., 2000). The breeding season of *P. latipes* extends to the spring, with a marked decrease in the proportion of berried females by June, with water temperature above 20ºC. However, it is likely that the timing of reproductive period may vary from region to region, as found in previous studies on *L.depurator* by Allen (1967) and Christiansen (1969). On the other hand, supporting the reproductive cycle, a previous study on the diet of the target species noted that most feeding activity coincided with the winter and spring (Chartosia et al., 2010). This is because specimens need to obtain more resources throughout the reproductive process, decreasing feeding in summer and autumn (Chartosia et al., 2010).

The number of eggs produced by females was greater when increase the size of the individual. As in other portunid species (Abelló, 1989; Muiño et al., 2000), fecundity was high and highly variable for similar sized crabs. Fecundity values for similar size ranges of *L.arcuatus* and *L.depurator* are comparable (Abelló, 1989; Muiño et al., 2000).

The fecundity of the earliest stage eggs (yellowish color) was lower than that of the intermediate stage (orange color). This may be due to the fact that first stage eggs were still being produced. The decrease in numbers of late stage eggs (grey color) could be attributed to egg losses over time, since the crabs live in the turbulent surf zone and bury in the sand. Thus egg loss is expected to happen. A decrease in the number of eggs per brood with egg development has been reported for other portunid species such as *L.arcuatus* (Muiño et al., 2000).

4.3. Growth analysis

In this study, the largest sizes were found to be 25.30 mm and 21.85 mm for males and females respectively. These sizes are larger than those reported for this species by Chartosia et al., (2010) for males in the Northern Aegean Sea. Regarding the size of the females, no comparison is possible since the study did not present results separately for males and females. From the length frequency analysis it can be deduced that the population consists of at the most three age classes.

According to Sparre and Venema (1995), growth parameters vary among species or even within different populations of the same species. It could also change depending on the life cycle; even successive cohorts could have different growth parameters depending on the environmental conditions. As also found in this study, growth parameters normally depend on the sex of the individual. Regarding the growth parameters obtained from the von Bertalanffy growth curve, asymptotic length (L_∞) was found to be 34.83 mm for males, while for females it was 27.16 mm. Castillo *et al.*, (2011), in the case of *Callinectes danae* (Smith, 1869), a much larger species, also concluded that the asymptotic length was significantly higher for males than for females. These results confirm the theory that within the Brachyura, males attain larger sizes than females. This could be due to a bigger energetic investment carried out by the females during the reproductive process. Nevertheless, males continue growing after reaching sexual maturity (Sastry, 1983). This difference in size favours the reproductive biology of this species, since copulation occurs when the females changes the carapace (moults) and the bigger size of the male provides protection to the female from predators, while the exoskeleton is regenerated.

Exponential growth tends to be higher at the beginning during the early life stages of the organism, becoming lower with age, until they attain the maximum length. The von Bertalanffy growth parameters (K) indicate that *P. latipes* is a fast growing species, with relatively faster growth for females ($K = 0.74\ y^{-1}$) than for males ($K = 0.52\ y^{-1}$). In the light of these results, it can be concluded that in *P. latipes* females attain their maximum size faster, although it is lower than the maximum size of males. On the contrary, male present a slower but continued growth, attaining bigger sizes. However, Fernandez *et al.*, (2001) concluded that growth rate in males was greater than in females for individuals of *L.depurator*. Also Sukumaran and Neelakantan (1997) recorded faster growth for males in individuals of *Portunus sanguinolentus* (Herbst, 1783) and *Portunus pelagicus* (Linnaeus, 1758). This growth parameter is also useful in order to characterize the potential vulnerability of these populations against an excessive mortality (Musick and Frazer, 1999).

4.4. Estimation of the density of *P.latipes* in Faro beach

This mark-recapture study was carried out based on the assumptions of a closed population for a given area of intertidal zone. The validation of the assumptions of mark-recapture methods are critical to obtaining unbiased estimates of population size. A population can be said to be closed when the population is constant, that is, when there is no additions or losses from birth and death. To assume a closed population, it is also necessary to consider that there is no immigration or emigration (Seber, 1982). Since the time interval between the mark-recapture sampling in this study was 1 day, over four consecutive days, immigration and emigration were probably minimal, corresponding to a constant population size, and the assumption of a closed population can be considered valid. Regarding the size of the population, it is considered to be the catchable population, which can be or not the entire population.

On the other hand, it was also necessary to consider that the marks would not be lost between sampling periods and would not affect the probability of capture (Krebs, 1989). Due to the importance of the loss of the marks, before the experiment was carried out in the study area, several marking techniques were tested in the laboratory. Nail polish was the most effective marking method as it has a longer duration and more visibility compared with the other methods tested. During the four days of the study the loss of nail polish marks is considered extremely unlikely. However, we must take into account that the habitat of individuals of *P.latipes* is very dynamic as they live buried in the sand. These factors may affect the erosion of the mark or loss, but still with a very low probability. Another important factor could be moulting. It is possible that some individuals could have moulted during the period of the experiment and therefore the mark would be lost. Large crustaceans can be marked through the soft body parts at joints so that the mark is not lost when moulting take place. However, given the small size of *P. latipes*, such methods were not possible.

Furthermore, the marking method applied did not affect the probability of capture (Krebs, 1989) because individuals were captured by attraction to a bait and the marks did not affect the mobility of individuals the crabs. During the replicates of the experiment in each sampling day, individuals remained stored in conditions as close as possible to their natural habitat, with very low alteration produced in them while the experiment was carried out. However, it should be noted that this species lives buried in the sand and its coloration helps to camouflage the crabs with the sand surface. Having a mark of another color on the dorsal surface may have made individuals more visible to predators.

Due to capture method applied throughout the experiment, catchability of individuals always occurs randomly (Krebs, 1989). Since the crabs are attracted by a bait and caught with the hand, there is no determining factor when they are captured. The experiment always was performed in the same area with constant effort. Uniform mixing there was of marked and unmarked Individuals and All of Them Were Equally catchable. All these factors provided adequate estimates of population size (Krebs 1989).

In the present study it was found that the density of the species in the intertidal zone corresponded to 6 individuals per m^2 in the month of May. It should be noted that these results were obtained when the sea water temperature reached 18 ° C. If this experiment is carried out at another time of year with lower values of temperature, density results would be practically zero or null due to the reduced feeding and activity, resulting in low or no catches. Although there are no density estimates of similar sand living species of crabs, relatively similar densities of other crabs have been reported. For example, Drummond-Davis et al. (1982) reported a density of rock crabs (*Cancer irroratus*), a much larger species, of 2 crabs per meter in a Nova Scotia kelp bed.

4.5. Area of attraction of the baited stakes

In the present survey the minimum distance at which attraction area (A_{at}) of adjacent traps did not overlap was estimated. Results shows how there is an asymptotic increase in catches of *P.latipes* as the distance between traps increases. Eggers et al. (1982) performed a study with traps for prickly sculpin (*Cottus asper*) and fish hooks for halibut (*Hippoglossus stenolepis*) and sablefish (*Anoplopoma fimbria*). For all of them catches also increased asymptotically with increasing distance between traps and hooks, allowing the determination of the areas of attraction.

Both, Eggers et al. (1982) and Aedo and Arancibia (2003), showed that maximum catches corresponded to the distance S_∞, between traps at which there is no overlapping. In the case *P. latipes* the distance at which there is no overlapping was 10.6 m. In the Aedo and Arancibia (2003) study the S_∞ corresponded to 109 m but the species and capture methods differed from the present study.

The attraction experiments results can be useful for future studies, allowing improved sampling design for population dynamics and other studies. Nevertheless, we must also take into account biotic and abiotic factor that can affect the catches, especially seawater temperature and the intensity and direction of the waves which influences the bait odour plume and consequently the area of attraction and the catch rates.

4.6. Distribution of *P.latipes* along the Portuguese coast

The present records of *P.latipes* show the existence of individuals along the whole Portuguese coast. The highest catches are associated with fine sand environments, according to the sediment analysis performed in the present study where the minimum value obtained of sand with respect to the total sample was always higher than 98%, with fine sand predominating. We can therefore confirm that *P.latipes* is present in sandy beaches sediment assemblages along the coast of Portugal. In concordance with these results, Chartosia et al. (2006) also recorded individuals of *P.latipes* in sampling stations where more than 70% of the sediment was fine sand along the Greek coast.

The main catches of the target species during surveys correspond with samples dominated by *Donax spp.*, Chartosia et al. (2006) also recorded individuals of *P.latipes* with catches of *Donacilla cornea* (Poli, 1795), *Donax trunculus* (Linnaeus, 1758) and other species of crab *Portumnus lysianassa* (Herbst, 1796).

Although the highest values of catches in abundance and biomass were from shallow waters near shore, the species was also recorded at greater depths offshore. The greatest abundance was found at approximately 3m depths, probably due to a connection with surf zone. In the survey along the northwest coast there were records of the species up to 28 m deep, although they were not common at depths greater than 12 m. Previous studies (Adema, 1991), have reported the target species from depths greater than 30 m, although these are rare occurrences.

On the other hand, both abundance and biomass could be affected by the sampling, due to seasonal migration of the species. Türkay and Stecher, (2013), observed how occurrence of *P.latipes* changed depending on temperature and even observed variations in abundance associated with the 1990 regime shift along the German North sea coast.

Higher values of abundance were recorded in areas under the Ria Formosa influence, since it is a highly productive shallow coastal lagoon and an important habitat for a large number of species (Lin et al., 1999 in Gamito and Erzini, 1990). It is directly connected to the sea by 6 channels (Falcao and Vale, 1990), for this reason it has a significant influence on the adjacent coast (Monteiro, 1989). These conditions may produce optimal habitat for the species, encouraging their development in that area. On the other hand, high values of abundance were also recorded in the areas with Ria de Aveiro and Tejo estuary influence, both influenced by input of freshwater. The area of the Ria de Aveiro has input of freshwater from two rivers, Antuã and Vouga; separated from the sea by a sand bar and very affected by anthropogenic activity (Dias et al., 2003). It is possible that habitats with these conditions may be suitable for the reproductive biology of the species. Fusté (1989) also recorded the presence of zoea of *P.latipes* in the area of the delta of the Ebro river, which is also influenced by freshwater discharge.

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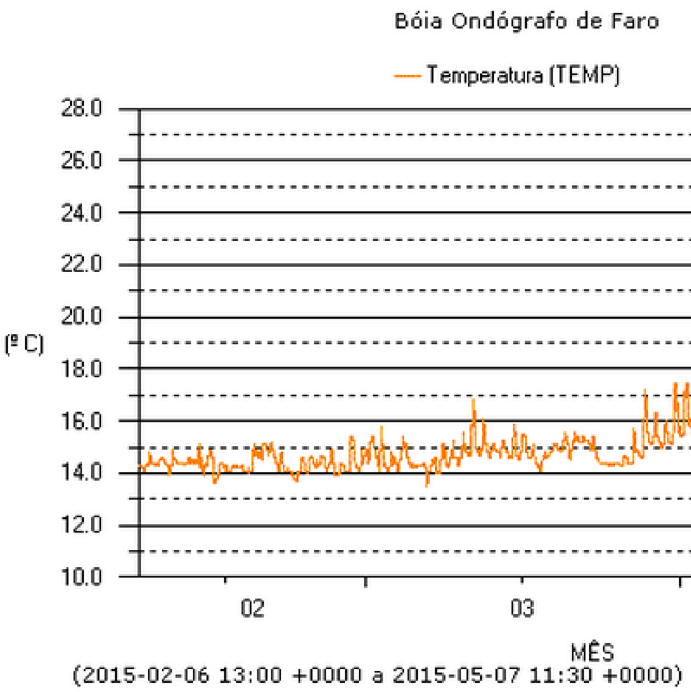
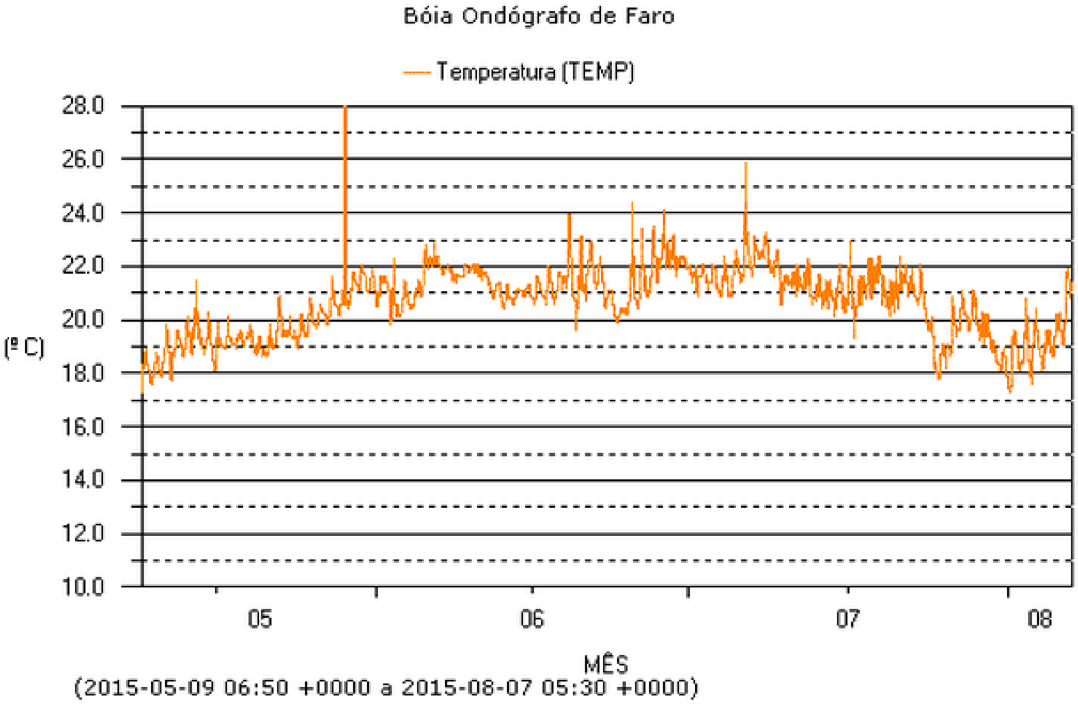
ANNEXES

ANNEX 1

DATA RECORD OF TEMPERATURE FROM "INSTITUTO HIDROGRÁFICO PORTUGAL".





ANNEX 2

DATA RECORD OF *PORTUMNUS LATIPES* OF FIRST SAMPLING.

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
	Faro Beach	Ganchorra	BG0/1	F	17.47	16.32	2.12
06/02/2015	Faro Beach	Ganchorra	BG1/1	F	18.53	17.82	2.05
06/02/2015	Faro Beach	Ganchorra	BG1/2	F	17.14	16.19	1.92
06/02/2015	Faro Beach	Ganchorra	BG1/3	F	18.22	17.15	2.72
06/02/2015	Faro Beach	Ganchorra	BG1/4	F	16.62	16.7	2.35
06/02/2015	Faro Beach	Ganchorra	BG1/5	F	17.48	16.61	1.81
06/02/2015	Faro Beach	Ganchorra	BG1/6	F	18.56	17.32	2.42
06/02/2015	Faro Beach	Ganchorra	BG1/7	F	17.01	16.81	2.65
06/02/2015	Faro Beach	Ganchorra	BG1/8	F	18.55	18.8	2.1
06/02/2015	Faro Beach	Ganchorra	BG1/9	F	17.79	17.54	2.26
06/02/2015	Faro Beach	Ganchorra	BG1/10	F	17.48	17.87	2.59
06/02/2015	Faro Beach	Ganchorra	BG1/11	F	19.26	17.78	2.59
06/02/2015	Faro Beach	Ganchorra	BG1/12	F	18,00	17.56	2.46
06/02/2015	Faro Beach	Ganchorra	BG1/13	F	17.32	16.9	2.31
06/02/2015	Faro Beach	Ganchorra	BG1/14	F	16.16	16.21	1.76
06/02/2015	Faro Beach	Ganchorra	BG1/15	F	18.23	18.23	2.31
06/02/2015	Faro Beach	Ganchorra	BG1/16	F	16.59	17.19	2.18
06/02/2015	Faro Beach	Ganchorra	BG1/17	F	19.46	18.8	2.97
06/02/2015	Faro Beach	Ganchorra	BG1/18	F	19.77	19.47	3.28
06/02/2015	Faro Beach	Ganchorra	BG1/19	F	17.79	16.96	2.5
06/02/2015	Faro Beach	Ganchorra	BG1/20	F	16.45	16.93	2.21
06/02/2015	Faro Beach	Ganchorra	BG1/21	F	17.36	16.85	2.13
06/02/2015	Faro Beach	Ganchorra	BG1/22	F	21.33	20.96	3.97
06/02/2015	Faro Beach	Ganchorra	BG1/23	F	17.52	16.81	1.9
06/02/2015	Faro Beach	Ganchorra	BG1/24	F	18.28	18.04	2.6
06/02/2015	Faro Beach	Ganchorra	BG1/25	F	16.15	16.09	1.69
06/02/2015	Faro Beach	Ganchorra	BG1/26	F	16.83	16.45	2.05
06/02/2015	Faro Beach	Ganchorra	BG1/27	F	18.11	17.22	2.04
06/02/2015	Faro Beach	Ganchorra	BG1/28	F	15.43	15.78	1.64
06/02/2015	Faro Beach	Ganchorra	BG1/29	F	17.38	16.62	1.9
06/02/2015	Faro Beach	Ganchorra	BG1/30	F	19.9	19.05	2.78
06/02/2015	Faro Beach	Ganchorra	BG1/31	F	17.3	16.56	2.16
06/02/2015	Faro Beach	Ganchorra	BG1/32	F	17.47	17,00	1.91
06/02/2015	Faro Beach	Ganchorra	BG1/33	F	16.65	16.61	1.73
06/02/2015	Faro Beach	Ganchorra	BG1/34	F	17.47	17.25	2.19
06/02/2015	Faro Beach	Ganchorra	BG1/35	F	18.31	18.3	2.58
06/02/2015	Faro Beach	Ganchorra	BG1/36	F	17.61	17.96	2.28
06/02/2015	Faro Beach	Ganchorra	BG1/37	F	17.71	18.32	2.42
06/02/2015	Faro Beach	Ganchorra	BG1/38	F	16.72	16.47	1.68
06/02/2015	Faro Beach	Ganchorra	BG1/39	M	19.4	16.67	2.2
06/02/2015	Faro Beach	Ganchorra	BG1/40	M	20.13	17.56	2.23
06/02/2015	Faro Beach	Ganchorra	BG1/41	M	21.64	20.07	3.28
06/02/2015	Faro Beach	Ganchorra	BG1/42	F	18.38	17.62	1.71
06/02/2015	Faro Beach	Ganchorra	BG1/43	M	18.16	16.77	1.98
06/02/2015	Faro Beach	Ganchorra	BG1/44	M	19.73	18.31	2.49
06/02/2015	Faro Beach	Ganchorra	BG1/45	M	18.91	18.64	2.27
06/02/2015	Faro Beach	Ganchorra	BG1/46	M	18.88	17.71	2.2
06/02/2015	Faro Beach	Ganchorra	BG1/47	M	21.4	19.44	3.09
06/02/2015	Faro Beach	Ganchorra	BG1/48	M	18.05	17.76	2.45
06/02/2015	Faro Beach	Ganchorra	BG1/49	M	17.22	16.29	1.68
06/02/2015	Faro Beach	Ganchorra	BG1/50	M	18,00	17.39	2.01

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
06/02/2015	Faro Beach	Ganchorra	BG1/51	M	19.76	18.1	2.24
06/02/2015	Faro Beach	Ganchorra	BG1/52	M	19.27	17.19	2.13
06/02/2015	Faro Beach	Ganchorra	BG1/53	M	16.85	15.89	1.78
06/02/2015	Faro Beach	Ganchorra	BG1/54	M	17.55	16.35	2,00
06/02/2015	Faro Beach	Ganchorra	BG1/55	M	18.31	17.01	2.03
06/02/2015	Faro Beach	Ganchorra	BG1/56	M	19.21	17.67	2.21
06/02/2015	Faro Beach	Ganchorra	BG1/57	M	16.72	16.29	2.03
06/02/2015	Faro Beach	Ganchorra	BG1/58	M	22.55	20.51	3.69
06/02/2015	Faro Beach	Ganchorra	BG1/59	M	19.81	18.35	2.59
06/02/2015	Faro Beach	Ganchorra	BG1/60	M	16.45	15.43	1.5
06/02/2015	Faro Beach	Ganchorra	BG1/61	M	18.18	16.74	2.07
06/02/2015	Faro Beach	Ganchorra	BG1/62	M	21.5	21.07	3.66
06/02/2015	Faro Beach	Ganchorra	BG1/63	M	20.1	19.81	2.93
06/02/2015	Faro Beach	Ganchorra	BG1/64	M	15.02	14.79	1.43
06/02/2015	Faro Beach	Ganchorra	BG1/65	M	18.09	17.79	2.51
06/02/2015	Faro Beach	Ganchorra	BG1/66	M	17.18	16.21	1.73
06/02/2015	Faro Beach	Ganchorra	BG1/67	M	15.87	15.04	1.29

DATA RECORD OF *PORTUMNUS LATIPES* OF SECOND SAMPLING.

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
21/02/2015	Faro Beach	Ganchorra	BG2/1	M	20.24	18.63	2.09
21/02/2015	Faro Beach	Ganchorra	BG2/2	?	19.23	19.22	2.06
21/02/2015	Faro Beach	Ganchorra	BG2/3	?	17.44	16.97	1.54
21/02/2015	Faro Beach	Ganchorra	BG2/4	M	16.86	16.71	1.31
21/02/2015	Faro Beach	Ganchorra	BG2/5	M	17.24	17.52	1.64
21/02/2015	Faro Beach	Ganchorra	BG2/6	F	17.11	17.22	1.71
21/02/2015	Faro Beach	Ganchorra	BG2/7	M?	19.34	21.78	2.81
21/02/2015	Faro Beach	Ganchorra	BG2/8	M?	17.28	16.62	1.55
21/02/2015	Faro Beach	Ganchorra	BG2/9	M	17.75	16.01	1.69
21/02/2015	Faro Beach	Ganchorra	BG2/10	F	18.77	17.7	2.28
21/02/2015	Faro Beach	Ganchorra	BG2/11	F	16.89	16.41	1.87
21/02/2015	Faro Beach	Ganchorra	BG2/12	F	17.43	17.16	1.59
21/02/2015	Faro Beach	Ganchorra	BG2/13	F	16.47	16.09	1.53
21/02/2015	Faro Beach	Ganchorra	BG2/14	M	20.83	19.51	2.77
21/02/2015	Faro Beach	Ganchorra	BG2/15	F	17.39	17.19	1.55
21/02/2015	Faro Beach	Ganchorra	BG2/16	M	17.9	17.05	1.65
21/02/2015	Faro Beach	Ganchorra	BG2/17	F	17.59	17.42	1.85
21/02/2015	Faro Beach	Ganchorra	BG2/18	F	18.25	17.38	2.23
21/02/2015	Faro Beach	Ganchorra	BG2/19	M	16.12	15.82	1.73
21/02/2015	Faro Beach	Ganchorra	BG2/20	M	17.03	16.01	1.75
22/02/2015	Faro Beach	Ganchorra	BG2/21	M	18.18	17.79	2.19
22/02/2015	Faro Beach	Ganchorra	BG2/22	M	20.07	19.59	2.89
22/02/2015	Faro Beach	Ganchorra	BG2/23	M	20.63	19.98	3.11
22/02/2015	Faro Beach	Ganchorra	BG2/24	F	16.33	16.44	1.5
22/02/2015	Faro Beach	Ganchorra	BG2/25	M	17.25	16.23	1.67
22/02/2015	Faro Beach	Ganchorra	BG2/26	M	20.26	18.97	2.75
22/02/2015	Faro Beach	Ganchorra	BG2/27	M	20.03	18.89	2.59
22/02/2015	Faro Beach	Ganchorra	BG2/28	M	20.09	19.33	2.85
22/02/2015	Faro Beach	Ganchorra	BG2/29	F	19.1	18.7	2.1
22/02/2015	Faro Beach	Ganchorra	BG2/30	M	16.07	15.47	1.21
22/02/2015	Faro Beach	Ganchorra	BG2/31	M	18.14	17.46	1.94
22/02/2015	Faro Beach	Ganchorra	BG2/32	F	18.08	17.98	2.02
22/02/2015	Faro Beach	Ganchorra	BG2/33	M	14.01	13.28	0.81
22/02/2015	Faro Beach	Ganchorra	BG2/34	F	17.86	17.99	2.17
22/02/2015	Faro Beach	Ganchorra	BG2/35	M	18.77	18.1	2.04
22/02/2015	Faro Beach	Ganchorra	BG2/36	F	16.36	15.89	1.6
22/02/2015	Faro Beach	Ganchorra	BG2/37	M?	16.83	16.27	1.41
22/02/2015	Faro Beach	Ganchorra	BG2/38	M	13.41	12.83	0.84
22/02/2015	Faro Beach	Ganchorra	BG2/39	F	18.54	17.43	2.23
22/02/2015	Faro Beach	Ganchorra	BG2/40	M	17.98	17.1	1.92
22/02/2015	Faro Beach	Ganchorra	BG2/41	F	15.38	14.92	1.26
22/02/2015	Faro Beach	Ganchorra	BG2/42	F	19.18	19.31	2.41
22/02/2015	Faro Beach	Ganchorra	BG2/43	M	16.9	16.5	1.66
22/02/2015	Faro Beach	Ganchorra	BG2/44	M	18.76	17.96	2.17
22/02/2015	Faro Beach	Ganchorra	BG2/45	M	15.56	14.94	1.29
22/02/2015	Faro Beach	Ganchorra	BG2/46	M	18.12	17.31	1.94
22/02/2015	Faro Beach	Ganchorra	BG2/47	M	12.19	11.61	0.56
22/02/2015	Faro Beach	Ganchorra	BG2/48	M	17.55	16.86	1.84
22/02/2015	Faro Beach	Ganchorra	BG2/49	M	18.48	17.02	1.8
22/02/2015	Faro Beach	Ganchorra	BG2/50	F	16.22	15.82	1.55

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
22/02/2015	Faro Beach	Ganchorra	BG2/51	F	18.19	18.07	2.04
22/02/2015	Faro Beach	Ganchorra	BG2/52	M	19.38	19.02	2.53
22/02/2015	Faro Beach	Ganchorra	BG2/53	F	18.84	18.3	2.39
22/02/2015	Faro Beach	Ganchorra	BG2/54	M	19.9	18.51	2.6
22/02/2015	Faro Beach	Ganchorra	BG2/55	M	18.45	18.16	2.24
22/02/2015	Faro Beach	Ganchorra	BG2/56	F	17.77	17.09	2.37
22/02/2015	Faro Beach	Ganchorra	BG2/57	M	18.63	17.9	2.28
22/02/2015	Faro Beach	Ganchorra	BG2/58	M	19.04	18.69	2.37
22/02/2015	Faro Beach	Ganchorra	BG2/59	M	19.26	18.79	2.62
22/02/2015	Faro Beach	Ganchorra	BG2/60	M	17.85	16.83	1.8
22/02/2015	Faro Beach	Ganchorra	BG2/61	M	23.6	23.52	4.56
22/02/2015	Faro Beach	Ganchorra	BG2/62	M	18.22	17.47	1.86
22/02/2015	Faro Beach	Ganchorra	BG2/63	M	16.21	15.85	1.6
22/02/2015	Faro Beach	Ganchorra	BG2/64	M	20.5	19.32	2.9
22/02/2015	Faro Beach	Ganchorra	BG2/65	F	17.31	17.75	1.9
22/02/2015	Faro Beach	Ganchorra	BG2/66	F	18.18	18,00	2.38
22/02/2015	Faro Beach	Ganchorra	BG2/67	M	18.99	18.41	2.38
22/02/2015	Faro Beach	Ganchorra	BG2/68	F	19.38	18.3	2.71
22/02/2015	Faro Beach	Ganchorra	BG2/69	F	16.82	16.55	2.03
22/02/2015	Faro Beach	Ganchorra	BG2/70	M	17,00	16.37	1.6
22/02/2015	Faro Beach	Ganchorra	BG2/71	M	20.71	20.16	2.92
22/02/2015	Faro Beach	Ganchorra	BG2/72	F	19.79	18.84	2.72
22/02/2015	Faro Beach	Ganchorra	BG2/73	F	17.41	16.89	2.33
22/02/2015	Faro Beach	Ganchorra	BG2/74	F	19.3	19.42	3.48
22/02/2015	Faro Beach	Ganchorra	BG2/75	M	17.02	16.38	1.84
22/02/2015	Faro Beach	Ganchorra	BG2/76	M	17.96	17.16	2.22
22/02/2015	Faro Beach	Ganchorra	BG2/77	M	13.05	12.37	0.75
22/02/2015	Faro Beach	Ganchorra	BG2/78	F	16.23	15.63	1.68
22/02/2015	Faro Beach	Ganchorra	BG2/79	M	14.56	14.55	1.14
22/02/2015	Faro Beach	Ganchorra	BG2/80	F	17.3	16.79	2.04
22/02/2015	Faro Beach	Ganchorra	BG2/81	F	17.56	17.12	2.05
22/02/2015	Faro Beach	Ganchorra	BG2/82	M	19.71	19,00	2.77
22/02/2015	Faro Beach	Ganchorra	BG2/83	M	18.88	18.37	2.55
22/02/2015	Faro Beach	Ganchorra	BG2/84	F	18.55	18.47	2.43
22/02/2015	Faro Beach	Ganchorra	BG2/85	F	12.78	12.08	0.88
22/02/2015	Faro Beach	Ganchorra	BG2/86	F	16.28	16.33	1.96
22/02/2015	Faro Beach	Ganchorra	BG2/87	F	15.32	15.34	1.59
22/02/2015	Faro Beach	Ganchorra	BG2/88	M	15.75	14.8	1.34
22/02/2015	Faro Beach	Ganchorra	BG2/89	F	15.95	15.66	1.54
22/02/2015	Faro Beach	Ganchorra	BG2/90	M	20.6	19.3	3.01
22/02/2015	Faro Beach	Ganchorra	BG2/91	F	18.59	18.18	2.66
22/02/2015	Faro Beach	Ganchorra	BG2/92	M	21.56	20.57	3.69
22/02/2015	Faro Beach	Ganchorra	BG2/93	M	15.06	14.99	1.17
22/02/2015	Faro Beach	Ganchorra	BG2/94	F?	10.54	9.97	0.38
22/02/2015	Faro Beach	Ganchorra	BG2/95	F	18.01	17.6	2.06
22/02/2015	Faro Beach	Ganchorra	BG2/96	M	16.76	16.13	1.49
22/02/2015	Faro Beach	Ganchorra	BG2/97	F	17.12	16.24	1.64
22/02/2015	Faro Beach	Ganchorra	BG2/98	M	18.4	17.45	1.75
22/02/2015	Faro Beach	Ganchorra	BG2/99	F	16.93	16.32	1.82
22/02/2015	Faro Beach	Ganchorra	BG2/100	M	18.27	17.65	2.19

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
22/02/2015	Faro Beach	Ganchorra	BG2/101	F	19.56	19.27	2.37
22/02/2015	Faro Beach	Ganchorra	BG2/102	F	16.8	16.42	1.51
22/02/2015	Faro Beach	Ganchorra	BG2/103	M	23.17	21.48	4.08
22/02/2015	Faro Beach	Ganchorra	BG2/104	F	17.05	17.02	2.16
22/02/2015	Faro Beach	Ganchorra	BG2/105	F	12.22	11.78	0.55
22/02/2015	Faro Beach	Ganchorra	BG2/106	F	16.89	16.24	1.66
22/02/2015	Faro Beach	Ganchorra	BG2/107	F	18.17	17.7	2.21
22/02/2015	Faro Beach	Ganchorra	BG2/108	F	17.32	16.93	2.07
22/02/2015	Faro Beach	Ganchorra	BG2/109	M	20.22	18.7	2.43
22/02/2015	Faro Beach	Ganchorra	BG2/110	F	21.37	20.65	2.76
22/02/2015	Faro Beach	Ganchorra	BG2/111	F	19.01	18.22	2.23
22/02/2015	Faro Beach	Ganchorra	BG2/112	?	10.21	9.86	0.36
22/02/2015	Faro Beach	Ganchorra	BG2/113	M	18.47	17.78	1.91
22/02/2015	Faro Beach	Ganchorra	BG2/114	M	15.89	15.13	1.28
22/02/2015	Faro Beach	Ganchorra	BG2/115	F	16.53	16.24	1.47
22/02/2015	Faro Beach	Ganchorra	BG2/116	F	20.65		2.81
22/02/2015	Faro Beach	Ganchorra	BG2/117	?	17.31	16.62	1.55
22/02/2015	Faro Beach	Ganchorra	BG2/118	F	15.69	15.69	1.43
22/02/2015	Faro Beach	Ganchorra	BG2/119	F	16.86	16.42	1.68
22/02/2015	Faro Beach	Ganchorra	BG2/120	F	15.85	15.56	1.48
22/02/2015	Faro Beach	Ganchorra	BG2/121	F	16.38	15.64	1.44
22/02/2015	Faro Beach	Ganchorra	BG2/122	F	15.2	14.58	1.11
22/02/2015	Faro Beach	Ganchorra	BG2/123	F	18.9	18.02	1.95
22/02/2015	Faro Beach	Ganchorra	BG2/124	F	12.29	11.64	0.55
22/02/2015	Faro Beach	Ganchorra	BG2/125	F	17.42	16.43	1.44
22/02/2015	Faro Beach	Ganchorra	BG2/126	M	18.9	18.53	2.12
22/02/2015	Faro Beach	Ganchorra	BG2/127	M	19.16	18,00	2.4
22/02/2015	Faro Beach	Ganchorra	BG2/128	F	19.13	19.29	3.1
22/02/2015	Faro Beach	Ganchorra	BG2/129	M	15.95	15.16	1.45
22/02/2015	Faro Beach	Ganchorra	BG2/130	M	15.97	14.97	1.36
22/02/2015	Faro Beach	Ganchorra	BG2/131	F	17.44	16.58	2,00
22/02/2015	Faro Beach	Ganchorra	BG2/132	F	15.96	15.9	1.83
22/02/2015	Faro Beach	Ganchorra	BG2/133	F	14.81	14.45	1.13
22/02/2015	Faro Beach	Ganchorra	BG2/134	?	21.62	20.46	2.69
22/02/2015	Faro Beach	Ganchorra	BG2/135	F	18.98	18.58	2.1
22/02/2015	Faro Beach	Ganchorra	BG2/136	M	22.39	21.58	3.8
22/02/2015	Faro Beach	Ganchorra	BG2/137	F	16.89	16.82	1.78
22/02/2015	Faro Beach	Ganchorra	BG2/138	M	18.03	17.29	1.9
22/02/2015	Faro Beach	Ganchorra	BG2/139	F	15.92	15.32	1.26
22/02/2015	Faro Beach	Ganchorra	BG2/140	M	18.8	17.81	2.25
22/02/2015	Faro Beach	Ganchorra	BG2/141	F	17.16	16.19	1.44

DATA RECORD OF *PORTUMNUS LATIPES* OF THIRD SAMPLING.

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
07/03/2015	Faro Beach	Ganchorra	BG3/1	F	17.04	16.98	1.89
07/03/2015	Faro Beach	Ganchorra	BG3/2	F	20.92	19.97	3.33
07/03/2015	Faro Beach	Ganchorra	BG3/3	F	16.95	16.11	1.9
07/03/2015	Faro Beach	Ganchorra	BG3/4	F	19.18	18.82	2.67
07/03/2015	Faro Beach	Ganchorra	BG3/5	F	17.7	17.07	1.81
07/03/2015	Faro Beach	Ganchorra	BG3/6	F	18.59	18.73	2.7
07/03/2015	Faro Beach	Ganchorra	BG3/7	F	18.2	18.08	2.34
07/03/2015	Faro Beach	Ganchorra	BG3/8	F	16.82	16.1	1.76
07/03/2015	Faro Beach	Ganchorra	BG3/9	F	19.05	18.27	2.35
07/03/2015	Faro Beach	Ganchorra	BG3/10	F	19.85	19.25	2.92
07/03/2015	Faro Beach	Ganchorra	BG3/11	F	17.5	17.03	2.06
07/03/2015	Faro Beach	Ganchorra	BG3/12	F	16.62	16.05	1.66
07/03/2015	Faro Beach	Ganchorra	BG3/13	F	19.95	19.34	3.08
07/03/2015	Faro Beach	Ganchorra	BG3/14	F	17.95	17.14	2.19
07/03/2015	Faro Beach	Ganchorra	BG3/15	F	18.45	17.61	2.52
07/03/2015	Faro Beach	Ganchorra	BG3/16	F	18.88	18.62	2.71
07/03/2015	Faro Beach	Ganchorra	BG3/17	F	16.98	16.25	1.67
07/03/2015	Faro Beach	Ganchorra	BG3/18	F	17.9	17.2	1.98
07/03/2015	Faro Beach	Ganchorra	BG3/19	F	17.06	15.88	1.76
07/03/2015	Faro Beach	Ganchorra	BG3/20	F	18.92	18.38	2.58
07/03/2015	Faro Beach	Ganchorra	BG3/21	F	18.3	17.72	2.55
07/03/2015	Faro Beach	Ganchorra	BG3/22	F	17.4	16.66	2.09
07/03/2015	Faro Beach	Ganchorra	BG3/23	F	20.94	19.93	3.61
07/03/2015	Faro Beach	Ganchorra	BG3/24	F	19.25	18.54	2.83
07/03/2015	Faro Beach	Ganchorra	BG3/25	F	18.48	17.73	2.38
07/03/2015	Faro Beach	Ganchorra	BG3/26	F	18.22	18.1	2.56
07/03/2015	Faro Beach	Ganchorra	BG3/27	F	16.27	15.41	1.78
07/03/2015	Faro Beach	Ganchorra	BG3/28	F	17.91	16.78	2.27
07/03/2015	Faro Beach	Ganchorra	BG3/29	F	20.24	19.65	3.27
07/03/2015	Faro Beach	Ganchorra	BG3/30	F	18.67	18.33	2.75
07/03/2015	Faro Beach	Ganchorra	BG3/31	F	16.65	16.18	1.91
07/03/2015	Faro Beach	Ganchorra	BG3/32	F	15.84	15.2	1.53
07/03/2015	Faro Beach	Ganchorra	BG3/33	F	17.55	16.8	1.96
07/03/2015	Faro Beach	Ganchorra	BG3/34	F	17.16	16.48	2.06
07/03/2015	Faro Beach	Ganchorra	BG3/35	F	17.94	16.98	2.1
07/03/2015	Faro Beach	Ganchorra	BG3/36	F	16.07	15.84	1.52
07/03/2015	Faro Beach	Ganchorra	BG3/37	F	19.59	19.31	2.06
07/03/2015	Faro Beach	Ganchorra	BG3/38	F	17.66	17.15	2.19
07/03/2015	Faro Beach	Ganchorra	BG3/39	F	16.76	15.8	1.7
07/03/2015	Faro Beach	Ganchorra	BG3/40	F	16.96	16.11	1.91
07/03/2015	Faro Beach	Ganchorra	BG3/41	F	18.79	17.77	2.37
07/03/2015	Faro Beach	Ganchorra	BG3/42	F	18.55	18.32	2.38
07/03/2015	Faro Beach	Ganchorra	BG3/43	F	17.96	17.13	2.18
07/03/2015	Faro Beach	Ganchorra	BG3/44	F	16.62	15.85	1.66
07/03/2015	Faro Beach	Ganchorra	BG3/45	M	19.41	18.72	2.68
07/03/2015	Faro Beach	Ganchorra	BG3/46	M	18.56	17.56	1.97
07/03/2015	Faro Beach	Ganchorra	BG3/47	M	18.41	17.52	1.93
07/03/2015	Faro Beach	Ganchorra	BG3/48	M	20.7	19.5	2.93
07/03/2015	Faro Beach	Ganchorra	BG3/49	M	18.82	17.71	2.02
07/03/2015	Faro Beach	Ganchorra	BG3/50	M	18.76	18.7	2.08

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
07/03/2015	Faro Beach	Ganchorra	BG3/51	M	18.03	16.96	1.85
07/03/2015	Faro Beach	Ganchorra	BG3/52	F	19.65	20.09	2.42
07/03/2015	Faro Beach	Ganchorra	BG3/53	?	15.78	15.21	1.18
07/03/2015	Faro Beach	Ganchorra	BG3/54	M	13.2	12.57	0.75
07/03/2015	Faro Beach	Ganchorra	BG3/55	M	18.97	17.97	2.15
07/03/2015	Faro Beach	Ganchorra	BG3/56	M	19.53	18.39	2.41
07/03/2015	Faro Beach	Ganchorra	BG3/57	M	17.8	17.08	1.88
07/03/2015	Faro Beach	Ganchorra	BG3/58	M	19.3	18.18	2.28
07/03/2015	Faro Beach	Ganchorra	BG3/59	M	16.32	15.41	1.43
07/03/2015	Faro Beach	Ganchorra	BG3/60	M	14.46	13.52	0.91
07/03/2015	Faro Beach	Ganchorra	BG3/61	M	15.96	15.5	1.3
07/03/2015	Faro Beach	Ganchorra	BG3/62	F	18.46	18.14	2.09
07/03/2015	Faro Beach	Ganchorra	BG3/63	F	15.43	15.31	1.23
08/03/2015	Faro Beach	Ganchorra	BG3/64	F	19.93	18.96	2.91
08/03/2015	Faro Beach	Ganchorra	BG3/65	F	19,00	18.74	2.54
08/03/2015	Faro Beach	Ganchorra	BG3/66	F	16.76	15.97	1.65
08/03/2015	Faro Beach	Ganchorra	BG3/67	F	20.22	19.37	2.85
08/03/2015	Faro Beach	Ganchorra	BG3/68	F	17.56	17.52	2.1
08/03/2015	Faro Beach	Ganchorra	BG3/69	F	17.72	16.85	1.44
08/03/2015	Faro Beach	Ganchorra	BG3/70	F	18.84	18,00	2.51
08/03/2015	Faro Beach	Ganchorra	BG3/71	F	20.04	19.57	2.99
08/03/2015	Faro Beach	Ganchorra	BG3/72	F	15.91	15.53	1.42
08/03/2015	Faro Beach	Ganchorra	BG3/73	F	17.5	16.91	1.88
08/03/2015	Faro Beach	Ganchorra	BG3/74	F	15.96	15.49	1.53
08/03/2015	Faro Beach	Ganchorra	BG3/75	F	18.14	17.34	2.01
08/03/2015	Faro Beach	Ganchorra	BG3/76	F	20.12	20.07	3.24
08/03/2015	Faro Beach	Ganchorra	BG3/77	F	16.2	15.88	1.59
08/03/2015	Faro Beach	Ganchorra	BG3/78	F	18.93	18.81	2.47
08/03/2015	Faro Beach	Ganchorra	BG3/79	F	17.34	16.47	1.86
08/03/2015	Faro Beach	Ganchorra	BG3/80	F	17.19	17,00	1.94
08/03/2015	Faro Beach	Ganchorra	BG3/81	M	18.76	17.32	2.17
08/03/2015	Faro Beach	Ganchorra	BG3/82	M	17.91	17.43	1.89
08/03/2015	Faro Beach	Ganchorra	BG3/83	M	20.07	19.24	2.77
08/03/2015	Faro Beach	Ganchorra	BG3/84	M	17.3	16.09	1.56
08/03/2015	Faro Beach	Ganchorra	BG3/85	F	17.31	17,00	1.99
08/03/2015	Faro Beach	Ganchorra	BG3/86	F	16.51	16.23	1.59
08/03/2015	Faro Beach	Ganchorra	BG3/87	F	18.17	18.52	2.66
08/03/2015	Faro Beach	Ganchorra	BG3/88	M	19.54	18.67	2.62
08/03/2015	Faro Beach	Ganchorra	BG3/89	F	18.63	18.02	2.42
08/03/2015	Faro Beach	Ganchorra	BG3/90	F	18.35	18.07	2.07
08/03/2015	Faro Beach	Ganchorra	BG3/91	F	17.64	16.55	2.42
08/03/2015	Faro Beach	Ganchorra	BG3/92	F	17.88	17.29	2.32
08/03/2015	Faro Beach	Ganchorra	BG3/93	F	17.42	16.21	1.99
08/03/2015	Faro Beach	Ganchorra	BG3/94	F	16.12	15.78	1.48
08/03/2015	Faro Beach	Ganchorra	BG3/95	F	17.6	17.29	1.88
08/03/2015	Faro Beach	Ganchorra	BG3/96	F	18.54	17.71	2.26
08/03/2015	Faro Beach	Ganchorra	BG3/97	F	18.14	17.84	1.96
08/03/2015	Faro Beach	Ganchorra	BG3/98	M	18.4	17.52	1.89
08/03/2015	Faro Beach	Ganchorra	BG3/99	F	19.02	18.89	2.8
08/03/2015	Faro Beach	Ganchorra	BG3/100	F	19.51	19.6	2.83

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
08/03/2015	Faro Beach	Ganchorra	BG3/101	F	18,00	17.51	2.16
08/03/2015	Faro Beach	Ganchorra	BG3/102	F	20.01	19.5	2.84
08/03/2015	Faro Beach	Ganchorra	BG3/103	M	18.87	18.07	2.25
08/03/2015	Faro Beach	Ganchorra	BG3/104	M	19.59	18.79	2.54
08/03/2015	Faro Beach	Ganchorra	BG3/105	F	13.36	13.05	0.78
08/03/2015	Faro Beach	Ganchorra	BG3/106	M	20.56	19.04	2.74
08/03/2015	Faro Beach	Ganchorra	BG3/107	F	17.25	17.54	2.26
08/03/2015	Faro Beach	Ganchorra	BG3/108	F	16.45	16.06	1.37
08/03/2015	Faro Beach	Ganchorra	BG3/109	M	17.45	16.16	1.63
08/03/2015	Faro Beach	Ganchorra	BG3/110	F	16.85	16.91	2.06
08/03/2015	Faro Beach	Ganchorra	BG3/111	M	15.35	15.09	1.26
08/03/2015	Faro Beach	Ganchorra	BG3/112	F	18.27	17.55	2.57
08/03/2015	Faro Beach	Ganchorra	BG3/113	F	16.54	15.7	2.74
08/03/2015	Faro Beach	Ganchorra	BG3/114	M	20.04	19.57	2.87
08/03/2015	Faro Beach	Ganchorra	BG3/115	M	16.47	15.93	1.59
08/03/2015	Faro Beach	Ganchorra	BG3/116	F	15.42	15.16	1.29
08/03/2015	Faro Beach	Ganchorra	BG3/117	M	20.39	19.04	2.63
08/03/2015	Faro Beach	Ganchorra	BG3/118	M	22.68	21.72	3.82
08/03/2015	Faro Beach	Ganchorra	BG3/119	M	17.82	16.75	1.85
08/03/2015	Faro Beach	Ganchorra	BG3/120	M	16.11	15.24	1.31
08/03/2015	Faro Beach	Ganchorra	BG3/121	M	17.94	17.51	2.11
08/03/2015	Faro Beach	Ganchorra	BG3/122	F	18.87	18.36	2.81
08/03/2015	Faro Beach	Ganchorra	BG3/123	F	21.14	20.87	3.46
08/03/2015	Faro Beach	Ganchorra	BG3/124	F	19.58	19.39	2.78
08/03/2015	Faro Beach	Ganchorra	BG3/125	F	17.49	16.67	1.9
08/03/2015	Faro Beach	Ganchorra	BG3/126	F	20.39	20.29	3.53
08/03/2015	Faro Beach	Ganchorra	BG3/127	M	15.85	15.18	1.22
08/03/2015	Faro Beach	Ganchorra	BG3/128	F	18.96	18.57	2.65
08/03/2015	Faro Beach	Ganchorra	BG3/129	M	18.56	18.03	2.25
08/03/2015	Faro Beach	Ganchorra	BG3/130	F	16.8	16.29	1.85
08/03/2015	Faro Beach	Ganchorra	BG3/131	M	18.53	17.45	2.27
08/03/2015	Faro Beach	Ganchorra	BG3/132	M	18.72	17.9	2.27
08/03/2015	Faro Beach	Ganchorra	BG3/133	F	16.21	15.49	1.7
08/03/2015	Faro Beach	Ganchorra	BG3/134	F	17.04	16.35	1.54
08/03/2015	Faro Beach	Ganchorra	BG3/135	F	17.45	17.28	2.05
08/03/2015	Faro Beach	Ganchorra	BG3/136	F	16.54	15.66	1.85
08/03/2015	Faro Beach	Ganchorra	BG3/137	M	21.34	20.12	3.31
08/03/2015	Faro Beach	Ganchorra	BG3/138	F	20.01	19.46	3.45
08/03/2015	Faro Beach	Ganchorra	BG3/139	F	19.39	19.5	3.12
08/03/2015	Faro Beach	Ganchorra	BG3/140	F	18.18	17.24	2.17
08/03/2015	Faro Beach	Ganchorra	BG3/141	F	17.6	16.98	1.78
08/03/2015	Faro Beach	Ganchorra	BG3/142	M	20.57	19.91	3.26
08/03/2015	Faro Beach	Ganchorra	BG3/143	F	19.73	19.88	3.34
08/03/2015	Faro Beach	Ganchorra	BG3/144	F	18.04	17.59	2.31
08/03/2015	Faro Beach	Ganchorra	BG3/145	F	17.85	16.76	2.05
08/03/2015	Faro Beach	Ganchorra	BG3/146	F	19.49	19.21	3,00
08/03/2015	Faro Beach	Ganchorra	BG3/147	M	17.41	16.58	1.76
08/03/2015	Faro Beach	Ganchorra	BG3/148	M	19.74	18.53	2.67
08/03/2015	Faro Beach	Ganchorra	BG3/149	M	17.73	16.41	1.67
08/03/2015	Faro Beach	Ganchorra	BG3/150	M	21.89	20.24	3.35

DATA RECORD OF *PORTUMNUS LATIPES* OF FOURTH SAMPLING.

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
21/03/2015	Faro Beach	Ganchorra	BG4/1	M	21.43	19.82	3.07
21/03/2015	Faro Beach	Ganchorra	BG4/2	F	19.53	18.98	2.86
21/03/2015	Faro Beach	Ganchorra	BG4/3	M	15.34	14.98	1.32
21/03/2015	Faro Beach	Ganchorra	BG4/4	F	19.21	17.95	2.49
21/03/2015	Faro Beach	Ganchorra	BG4/5	F	17.12	16.61	2.04
21/03/2015	Faro Beach	Ganchorra	BG4/6	F	15.62	14.98	1.56
21/03/2015	Faro Beach	Ganchorra	BG4/7	F	18.06	17.19	2.24
21/03/2015	Faro Beach	Ganchorra	BG4/8	F	18.25	17.24	1.67
21/03/2015	Faro Beach	Ganchorra	BG4/9	F	19.3	18.41	2.22
21/03/2015	Faro Beach	Ganchorra	BG4/10	M	18.04	17.12	1.84
21/03/2015	Faro Beach	Ganchorra	BG4/11	M	19.92	18.43	2.38
21/03/2015	Faro Beach	Ganchorra	BG4/12	F	17.45	16.58	1.68
21/03/2015	Faro Beach	Ganchorra	BG4/13	M	12.06	11.42	0.55
21/03/2015	Faro Beach	Ganchorra	BG4/14	F	17.78	17.07	1.85
21/03/2015	Faro Beach	Ganchorra	BG4/15	F	17.13	16.48	2.03
21/03/2015	Faro Beach	Ganchorra	BG4/16	F	20.55	19.97	3.42
21/03/2015	Faro Beach	Ganchorra	BG4/17	F	18.6	17.75	2.48
21/03/2015	Faro Beach	Ganchorra	BG4/18	M	21.44	20.25	3.7
21/03/2015	Faro Beach	Ganchorra	BG4/19	F	19.21	18.52	2.76
21/03/2015	Faro Beach	Ganchorra	BG4/20	M	18.8	17.41	2.1
21/03/2015	Faro Beach	Ganchorra	BG4/21	F	20.54	20.22	3.27
21/03/2015	Faro Beach	Ganchorra	BG4/22	F	17.55	16.88	2.17
21/03/2015	Faro Beach	Ganchorra	BG4/23	M	18.45	17.52	2.04
21/03/2015	Faro Beach	Ganchorra	BG4/24	M	16.77	15.72	1.6
21/03/2015	Faro Beach	Ganchorra	BG4/25	F	17.76	16.94	2.2
21/03/2015	Faro Beach	Ganchorra	BG4/26	F	16.94	16.67	1.52
21/03/2015	Faro Beach	Ganchorra	BG4/27	F	16.15	15.62	1.71
21/03/2015	Faro Beach	Ganchorra	BG4/28	M	17.49	16.93	1.86
21/03/2015	Faro Beach	Ganchorra	BG4/29	M	19.71	19.21	2.7
21/03/2015	Faro Beach	Ganchorra	BG4/30	F	20.27	19.58	3.28
21/03/2015	Faro Beach	Ganchorra	BG4/31	M	20.76	19.66	2.95
21/03/2015	Faro Beach	Ganchorra	BG4/32	M	12.56	11.41	0.56
21/03/2015	Faro Beach	Ganchorra	BG4/33	M	17.07	15.83	1.52
21/03/2015	Faro Beach	Ganchorra	BG4/34	F	17.33	16.72	2.08
21/03/2015	Faro Beach	Ganchorra	BG4/35	F	17,00	16.22	1.74
21/03/2015	Faro Beach	Ganchorra	BG4/36	F	16.77	15.95	1.81
21/03/2015	Faro Beach	Ganchorra	BG4/37	M	19.06	17.95	2.34
21/03/2015	Faro Beach	Ganchorra	BG4/38	M	17.88	16.8	1.8
21/03/2015	Faro Beach	Ganchorra	BG4/39	F	17.77	17.04	2.28
21/03/2015	Faro Beach	Ganchorra	BG4/40	M	13.27	12.45	0.65
21/03/2015	Faro Beach	Ganchorra	BG4/41	F	20.12	18.89	3.41
21/03/2015	Faro Beach	Ganchorra	BG4/42	F	19.91	20.09	2.35
21/03/2015	Faro Beach	Ganchorra	BG4/43	F	17.06	15.97	1.9
21/03/2015	Faro Beach	Ganchorra	BG4/44	M	13.38	12.32	0.73
21/03/2015	Faro Beach	Ganchorra	BG4/45	F	19.36	18.96	2.7
21/03/2015	Faro Beach	Ganchorra	BG4/46	M	21.36	20.78	3.25
21/03/2015	Faro Beach	Ganchorra	BG4/47	F	21.85	21.42	4.18
21/03/2015	Faro Beach	Ganchorra	BG4/48	F	18.82	18.46	2.77
21/03/2015	Faro Beach	Ganchorra	BG4/49	M	15.2	14.89	1.06
21/03/2015	Faro Beach	Ganchorra	BG4/50	M	13.04	12.5	0.69

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
21/03/2015	Faro Beach	Ganchorra	BG4/51	F	21.49	20.62	3.09
21/03/2015	Faro Beach	Ganchorra	BG4/52	F	18.57	17.92	2.46
21/03/2015	Faro Beach	Ganchorra	BG4/53	M	20.75	20.02	3.03
21/03/2015	Faro Beach	Ganchorra	BG4/54	F	18.37	18.06	2.4
21/03/2015	Faro Beach	Ganchorra	BG4/55	F	20.78	20.16	3.76
21/03/2015	Faro Beach	Ganchorra	BG4/56	F	17.57	17.12	2.04
21/03/2015	Faro Beach	Ganchorra	BG4/57	M	16.41	15.82	1.44
21/03/2015	Faro Beach	Ganchorra	BG4/58	F	17.49	17.32	2.14
21/03/2015	Faro Beach	Ganchorra	BG4/59	F	20.51	20.03	3.38
21/03/2015	Faro Beach	Ganchorra	BG4/60	F	21,00	20.24	3.67
21/03/2015	Faro Beach	Ganchorra	BG4/61	F	17.23	16.77	1.88
21/03/2015	Faro Beach	Ganchorra	BG4/62	F	18.25	17.62	2.32
21/03/2015	Faro Beach	Ganchorra	BG4/63	F	19.24	18.68	2.41
21/03/2015	Faro Beach	Ganchorra	BG4/64	F	18.97	18.61	2.81
21/03/2015	Faro Beach	Ganchorra	BG4/65	F	18.57	17.63	2.07
21/03/2015	Faro Beach	Ganchorra	BG4/66	F	17.75	17.55	1.89
21/03/2015	Faro Beach	Ganchorra	BG4/67	F	18.97	18.74	2.2
21/03/2015	Faro Beach	Ganchorra	BG4/68	M	18.26	17.17	1.87
21/03/2015	Faro Beach	Ganchorra	BG4/69	M	20.1	18.75	2.71
21/03/2015	Faro Beach	Ganchorra	BG4/70	M	20.91	19.62	2.95
21/03/2015	Faro Beach	Ganchorra	BG4/71	M	20.47	18.6	2.74
21/03/2015	Faro Beach	Ganchorra	BG4/72	M	18.43	17.3	2.01
21/03/2015	Faro Beach	Ganchorra	BG4/73	M	15.44	14.63	1.11
21/03/2015	Faro Beach	Ganchorra	BG4/74	M	16.57	15.28	1.41
21/03/2015	Faro Beach	Ganchorra	BG4/75	M	15.53	14.91	1.29
21/03/2015	Faro Beach	Ganchorra	BG4/76	M	19.92	18.81	2.49
21/03/2015	Faro Beach	Ganchorra	BG4/77	M	22.67	20.81	3.69
21/03/2015	Faro Beach	Ganchorra	BG4/78	M	17.6	16.78	1.77
21/03/2015	Faro Beach	Ganchorra	BG4/79	M	17.23	16.34	1.57
21/03/2015	Faro Beach	Ganchorra	BG4/80	F	19.08	18.54	3.02
21/03/2015	Faro Beach	Ganchorra	BG4/81	F	19.95	19.2	3.33
21/03/2015	Faro Beach	Ganchorra	BG4/82	F	21.01	20.02	3.07
21/03/2015	Faro Beach	Ganchorra	BG4/83	F	16.57	15.96	1.77
21/03/2015	Faro Beach	Ganchorra	BG4/84	F	17.03	16.63	1.66
21/03/2015	Faro Beach	Ganchorra	BG4/85	F	17.05	16.95	1.67
21/03/2015	Faro Beach	Ganchorra	BG4/86	F	18.33	17.9	2.7
21/03/2015	Faro Beach	Ganchorra	BG4/87	F	17.83	17.8	1.92
21/03/2015	Faro Beach	Ganchorra	BG4/88	F	17.75	17.4	2.35
21/03/2015	Faro Beach	Ganchorra	BG4/89	F	16.95	16.15	2.01
21/03/2015	Faro Beach	Ganchorra	BG4/90	F	19.73	19.13	3.09
21/03/2015	Faro Beach	Ganchorra	BG4/91	F	18.26	18.09	2.61
21/03/2015	Faro Beach	Ganchorra	BG4/92	F	18.3	17.64	2.46
21/03/2015	Faro Beach	Ganchorra	BG4/93	F	16.97	16.54	1.98
21/03/2015	Faro Beach	Ganchorra	BG4/94	F	17.72	17.34	2.25
21/03/2015	Faro Beach	Ganchorra	BG4/95	F	17.06	16.4	2.02
21/03/2015	Faro Beach	Ganchorra	BG4/96	F	19.32	18.39	2.27
21/03/2015	Faro Beach	Ganchorra	BG4/97	F	16.13	15.46	1.59
21/03/2015	Faro Beach	Ganchorra	BG4/98	F	18.1	17.51	2.41
21/03/2015	Faro Beach	Ganchorra	BG4/99	F	17.28	16.88	2.04
21/03/2015	Faro Beach	Ganchorra	BG4/100	F	17.52	17.08	2.29

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
21/03/2015	Faro Beach	Ganchorra	BG4/101	F	19.88	19,00	3.14
21/03/2015	Faro Beach	Ganchorra	BG4/102	F	16.95	16.36	1.79
21/03/2015	Faro Beach	Ganchorra	BG4/103	F	17.35	16.98	2.17
21/03/2015	Faro Beach	Ganchorra	BG4/104	F	16.84	15.96	1.78
21/03/2015	Faro Beach	Ganchorra	BG4/105	F	16.49	15.93	1.86
21/03/2015	Faro Beach	Ganchorra	BG4/106	F	16.17	15.79	1.73
21/03/2015	Faro Beach	Ganchorra	BG4/107	F	19.34	19.01	2.47
21/03/2015	Faro Beach	Ganchorra	BG4/108	F	18.49	18.29	1.93
21/03/2015	Faro Beach	Ganchorra	BG4/109	F	17.02	16.6	1.72
21/03/2015	Faro Beach	Ganchorra	BG4/110	F	17.44	16.94	1.74
21/03/2015	Faro Beach	Ganchorra	BG4/111	F	17,00	16.24	1.59
21/03/2015	Faro Beach	Ganchorra	BG4/112	M	21.13	20.46	2.98
21/03/2015	Faro Beach	Ganchorra	BG4/113	M	17.06	16.02	1.63
21/03/2015	Faro Beach	Ganchorra	BG4/114	M	17.2	16.24	1.74
21/03/2015	Faro Beach	Ganchorra	BG4/115	M	17.42	16.59	1.45
21/03/2015	Faro Beach	Ganchorra	BG4/116	M	16.64	15.57	1.35
21/03/2015	Faro Beach	Ganchorra	BG4/117	M	16.34	15.5	1.44
21/03/2015	Faro Beach	Ganchorra	BG4/118	M	17.27	16.3	1.63
21/03/2015	Faro Beach	Ganchorra	BG4/119	M	18.67	17.56	2.24
21/03/2015	Faro Beach	Ganchorra	BG4/120	F	17.17	16.88	1.96
21/03/2015	Faro Beach	Ganchorra	BG4/121	F	20.29	19.52	3.45
21/03/2015	Faro Beach	Ganchorra	BG4/122	F	16.2	15.45	1.59
21/03/2015	Faro Beach	Ganchorra	BG4/123	F	18.59	17.85	1.84
21/03/2015	Faro Beach	Ganchorra	BG4/124	F	17.83	17.46	1.96
21/03/2015	Faro Beach	Ganchorra	BG4/125	F	15.59	15.01	1.43
21/03/2015	Faro Beach	Ganchorra	BG4/126	F	17.85	17.15	1.85
21/03/2015	Faro Beach	Ganchorra	BG4/127	F	18.33	17.95	2.4
21/03/2015	Faro Beach	Ganchorra	BG4/128	F	19.39	19.06	3.05
21/03/2015	Faro Beach	Ganchorra	BG4/129	F	16.33	15.66	1.77
21/03/2015	Faro Beach	Ganchorra	BG4/130	F	20.44	20.03	2.8
21/03/2015	Faro Beach	Ganchorra	BG4/131	F	18.12	17.62	2.43
21/03/2015	Faro Beach	Ganchorra	BG4/132	F	18.15	17.99	2.06
21/03/2015	Faro Beach	Ganchorra	BG4/133	F	17.28	17,00	2.13
21/03/2015	Faro Beach	Ganchorra	BG4/134	F	18.44	17.48	2.25
21/03/2015	Faro Beach	Ganchorra	BG4/135	F	21.07	20.82	3.01
21/03/2015	Faro Beach	Ganchorra	BG4/136	F	18.71	18.18	1.99
21/03/2015	Faro Beach	Ganchorra	BG4/137	F	18.14	17.73	1.83
21/03/2015	Faro Beach	Ganchorra	BG4/138	F	16,00	15.63	1.87
21/03/2015	Faro Beach	Ganchorra	BG4/139	F	16.6	16.19	1.8
21/03/2015	Faro Beach	Ganchorra	BG4/140	F	18.46	17.75	2.19
21/03/2015	Faro Beach	Ganchorra	BG4/141	F	20.46	20.32	3.99
21/03/2015	Faro Beach	Ganchorra	BG4/142	F	18.78	18.06	2.47
21/03/2015	Faro Beach	Ganchorra	BG4/143	F	16.33	15.83	1.62
21/03/2015	Faro Beach	Ganchorra	BG4/144	M	19.94	18.94	2.69
21/03/2015	Faro Beach	Ganchorra	BG4/145	M	15.17	14.35	1.01
21/03/2015	Faro Beach	Ganchorra	BG4/146	M	16.96	15.87	1.58
21/03/2015	Faro Beach	Ganchorra	BG4/147	M	15.84	14.94	1.25
21/03/2015	Faro Beach	Ganchorra	BG4/148	M	18.19	17.08	1.91
21/03/2015	Faro Beach	Ganchorra	BG4/149	M	20.11	18.68	2.75
21/03/2015	Faro Beach	Ganchorra	BG4/150	M	13.16	12.5	0.75

DATA RECORD OF *PORTUMNUS LATIPES* OF FIFTH SAMPLING.

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
18/04/2015	Faro Beach	Ganchorra	BG5/1	F	18.61	17.87	2.32
18/04/2015	Faro Beach	Ganchorra	BG5/2	F	19.14	18.67	2.72
18/04/2015	Faro Beach	Ganchorra	BG5/3	M	21.53	20.31	3.05
18/04/2015	Faro Beach	Ganchorra	BG5/4	F	17.65	17.07	1.65
18/04/2015	Faro Beach	Ganchorra	BG5/5	F	16.41	15.64	1.58
18/04/2015	Faro Beach	Ganchorra	BG5/6	F	19.41	18.54	2.45
18/04/2015	Faro Beach	Ganchorra	BG5/7	F	18.13	18.04	2.31
18/04/2015	Faro Beach	Ganchorra	BG5/8	M	18.99	18.28	2.11
18/04/2015	Faro Beach	Ganchorra	BG5/9	M	20.24	19.74	2.62
18/04/2015	Faro Beach	Ganchorra	BG5/10	F	16.67	16.42	1.89
18/04/2015	Faro Beach	Ganchorra	BG5/11	F	16.83	16.36	1.75
18/04/2015	Faro Beach	Ganchorra	BG5/12	M	20.63	19.48	2.83
18/04/2015	Faro Beach	Ganchorra	BG5/13	F	15.53	14.99	1.42
18/04/2015	Faro Beach	Ganchorra	BG5/14	F	17.93	17.83	2.1
18/04/2015	Faro Beach	Ganchorra	BG5/15	F	16.86	16.47	1.85
18/04/2015	Faro Beach	Ganchorra	BG5/16	F	18.09	17.06	2.11
18/04/2015	Faro Beach	Ganchorra	BG5/17	F	17.3	16.93	2.15
18/04/2015	Faro Beach	Ganchorra	BG5/18	M	16.53	15.77	1.46
18/04/2015	Faro Beach	Ganchorra	BG5/19	M	21.6	20.74	3.19
18/04/2015	Faro Beach	Ganchorra	BG5/20	M	18.2	17.66	1.94
18/04/2015	Faro Beach	Ganchorra	BG5/21	F	16.47	16.47	1.79
18/04/2015	Faro Beach	Ganchorra	BG5/22	M	20.97	20.14	2.82
18/04/2015	Faro Beach	Ganchorra	BG5/23	F	19.85	19.3	2.96
18/04/2015	Faro Beach	Ganchorra	BG5/24	F	19.83	19.59	2.38
18/04/2015	Faro Beach	Ganchorra	BG5/25	M	23.92	23.22	4.32
18/04/2015	Faro Beach	Ganchorra	BG5/26	F	18.59	17.98	2.16
18/04/2015	Faro Beach	Ganchorra	BG5/27	M	21.07	19.96	3.07
18/04/2015	Faro Beach	Ganchorra	BG5/28	M	20.39	19.26	2.59
18/04/2015	Faro Beach	Ganchorra	BG5/29	M	18.64	17.76	1.71
18/04/2015	Faro Beach	Ganchorra	BG5/30	M	17.92	16.91	1.54
18/04/2015	Faro Beach	Ganchorra	BG5/31	F	17.2	16.69	2.02
18/04/2015	Faro Beach	Ganchorra	BG5/32	F	18.94	18.7	2.75
18/04/2015	Faro Beach	Ganchorra	BG5/33	F	17.5	16.72	2.01
18/04/2015	Faro Beach	Ganchorra	BG5/34	F	16.01	15.41	1.71
18/04/2015	Faro Beach	Ganchorra	BG5/35	M	16.22	15.57	1.43
18/04/2015	Faro Beach	Ganchorra	BG5/36	F	17.71	17.58	2.13
18/04/2015	Faro Beach	Ganchorra	BG5/37	F	16.72	16.34	2,00
18/04/2015	Faro Beach	Ganchorra	BG5/38	M	15.16	14.28	1.03
18/04/2015	Faro Beach	Ganchorra	BG5/39	F	18.74	17.96	2.45
18/04/2015	Faro Beach	Ganchorra	BG5/40	F	17.04	16.69	1.61
18/04/2015	Faro Beach	Ganchorra	BG5/41	M	18.7	17.42	2.09
18/04/2015	Faro Beach	Ganchorra	BG5/42	F	17.34	16.61	1.91
18/04/2015	Faro Beach	Ganchorra	BG5/43	M	22.84	21.99	3.81
18/04/2015	Faro Beach	Ganchorra	BG5/44	F	16.12	15.55	1.78
18/04/2015	Faro Beach	Ganchorra	BG5/45	M	19.79	18.21	2.53
18/04/2015	Faro Beach	Ganchorra	BG5/46	F	19.62	18.78	3.01
18/04/2015	Faro Beach	Ganchorra	BG5/47	F	17.09	16.49	1.66
18/04/2015	Faro Beach	Ganchorra	BG5/48	M	17.59	16.99	1.95
18/04/2015	Faro Beach	Ganchorra	BG5/49	F	17.99	17.49	2.41
18/04/2015	Faro Beach	Ganchorra	BG5/50	M	16.32	15.4	1.24

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
18/04/2015	Faro Beach	Ganchorra	BG5/51	M	20.91	19.39	2.66
18/04/2015	Faro Beach	Ganchorra	BG5/52	M	23.7	22.62	4.17
18/04/2015	Faro Beach	Ganchorra	BG5/53	F	16.7	16.46	2.06
18/04/2015	Faro Beach	Ganchorra	BG5/54	M	14.87	14.06	1.04
18/04/2015	Faro Beach	Ganchorra	BG5/55	F	17.3	17.13	2.17
18/04/2015	Faro Beach	Ganchorra	BG5/56	M	16.48	15.78	1.35
18/04/2015	Faro Beach	Ganchorra	BG5/57	M	20.92	19.95	2.88
18/04/2015	Faro Beach	Ganchorra	BG5/58	F	18.3	17.41	2.33
18/04/2015	Faro Beach	Ganchorra	BG5/59	F	20.34	19.73	2.12
18/04/2015	Faro Beach	Ganchorra	BG5/60	F	16.01	15.54	1.21
18/04/2015	Faro Beach	Ganchorra	BG5/61	M	16.38	16.03	1.29
18/04/2015	Faro Beach	Ganchorra	BG5/62	F	19.17	18.86	2.57
18/04/2015	Faro Beach	Ganchorra	BG5/63	M	23.9	22.76	2.85
18/04/2015	Faro Beach	Ganchorra	BG5/64	F	17.88	16.88	2.12
18/04/2015	Faro Beach	Ganchorra	BG5/65	F	16.63	16.02	1.78
18/04/2015	Faro Beach	Ganchorra	BG5/66	F	16.94	16.77	1.78
18/04/2015	Faro Beach	Ganchorra	BG5/67	M	17.44	16.72	1.62
18/04/2015	Faro Beach	Ganchorra	BG5/68	F	17.73	17.06	2.16
18/04/2015	Faro Beach	Ganchorra	BG5/69	F	17.04	16.62	1.82
18/04/2015	Faro Beach	Ganchorra	BG5/70	M	20.39	19.07	2.59
18/04/2015	Faro Beach	Ganchorra	BG5/71	F	19.28	18.32	3.07
18/04/2015	Faro Beach	Ganchorra	BG5/72	F	18.42	18.06	2.16
18/04/2015	Faro Beach	Ganchorra	BG5/73	F	12.95	12.44	0.72
18/04/2015	Faro Beach	Ganchorra	BG5/74	F	17.61	16.96	1.99
18/04/2015	Faro Beach	Ganchorra	BG5/75	F	16.78	16.33	1.87
18/04/2015	Faro Beach	Ganchorra	BG5/76	F	19.33	18.62	2.8
18/04/2015	Faro Beach	Ganchorra	BG5/77	M	21.58	20.42	2.86
18/04/2015	Faro Beach	Ganchorra	BG5/78	M	21.03	19.89	2.89
18/04/2015	Faro Beach	Ganchorra	BG5/79	M	17.51	16.74	1.62
18/04/2015	Faro Beach	Ganchorra	BG5/80	F	14.97	14.67	1.29
18/04/2015	Faro Beach	Ganchorra	BG5/81	F	16.58	16.08	1.94
18/04/2015	Faro Beach	Ganchorra	BG5/82	F	17.7	17.49	2.21
18/04/2015	Faro Beach	Ganchorra	BG5/83	M	19.91	19.03	2.75
18/04/2015	Faro Beach	Ganchorra	BG5/84	F	15.98	15.53	1.89
18/04/2015	Faro Beach	Ganchorra	BG5/85	F	16.23	15.32	1.99
18/04/2015	Faro Beach	Ganchorra	BG5/86	M	19.64	18.21	2.34
18/04/2015	Faro Beach	Ganchorra	BG5/87	F	17.48	17.03	2.25
18/04/2015	Faro Beach	Ganchorra	BG5/88	F	18.04	17.76	2.25
18/04/2015	Faro Beach	Ganchorra	BG5/89	F	16.52	15.89	1.59
18/04/2015	Faro Beach	Ganchorra	BG5/90	M	17.67	16.91	1.58
18/04/2015	Faro Beach	Ganchorra	BG5/91	F	17.31	17.1	2.25
18/04/2015	Faro Beach	Ganchorra	BG5/92	M	21.11	20.5	2.53
18/04/2015	Faro Beach	Ganchorra	BG5/93	F	18.3	17.96	2.63
18/04/2015	Faro Beach	Ganchorra	BG5/94	M	17.4	16.75	1.68
18/04/2015	Faro Beach	Ganchorra	BG5/95	F	19.54	19.1	2.65
18/04/2015	Faro Beach	Ganchorra	BG5/96	F	15.09	14.55	1.16
18/04/2015	Faro Beach	Ganchorra	BG5/97	F	16.48	16.32	1.87
18/04/2015	Faro Beach	Ganchorra	BG5/98	F	20.36	19.54	2.29
18/04/2015	Faro Beach	Ganchorra	BG5/99	F	16.6	16.26	1.84
18/04/2015	Faro Beach	Ganchorra	BG5/100	F	17.11	16.55	1.82

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)	Weight(g)
18/04/2015	Faro Beach	Ganchorra	BG5/101	M	19.11	18.11	2.16
18/04/2015	Faro Beach	Ganchorra	BG5/102	F	16.58	15.93	1.71
18/04/2015	Faro Beach	Ganchorra	BG5/103	F	17.58	17.11	1.89
18/04/2015	Faro Beach	Ganchorra	BG5/104	F	17.82	17.2	1.97
18/04/2015	Faro Beach	Ganchorra	BG5/105	F	17.65	17.28	2.18
18/04/2015	Faro Beach	Ganchorra	BG5/106	F	18.38	17.64	2.51
18/04/2015	Faro Beach	Ganchorra	BG5/107	M	17,00	15.82	1.54
18/04/2015	Faro Beach	Ganchorra	BG5/108	F	18.54	17.81	2.69
18/04/2015	Faro Beach	Ganchorra	BG5/109	M	19.78	18.38	2.36
18/04/2015	Faro Beach	Ganchorra	BG5/110	F	16.69	16.47	2.23
18/04/2015	Faro Beach	Ganchorra	BG5/111	F	17.11	16.44	2.03
18/04/2015	Faro Beach	Ganchorra	BG5/112	F	16.99	16.58	2.6
18/04/2015	Faro Beach	Ganchorra	BG5/113	F	19.17	18.86	2.66
18/04/2015	Faro Beach	Ganchorra	BG5/114	F	18.41	18.12	2.47
18/04/2015	Faro Beach	Ganchorra	BG5/115	F	16.34	15.93	1.82
18/04/2015	Faro Beach	Ganchorra	BG5/116	F	17.6	16.9	2.37
18/04/2015	Faro Beach	Ganchorra	BG5/117	F	15.9	15.26	1.61
18/04/2015	Faro Beach	Ganchorra	BG5/118	F	16.62	16.66	2.09
18/04/2015	Faro Beach	Ganchorra	BG5/119	F	17.52	17.05	2.1
18/04/2015	Faro Beach	Ganchorra	BG5/120	F	18.46	18.16	2.59
18/04/2015	Faro Beach	Ganchorra	BG5/121	M	21.11	19.59	2.95
18/04/2015	Faro Beach	Ganchorra	BG5/122	M	20.3	18.59	2.59
18/04/2015	Faro Beach	Ganchorra	BG5/123	F	17.58	17.68	2.15
18/04/2015	Faro Beach	Ganchorra	BG5/124	F	17.23	17.01	2.15
18/04/2015	Faro Beach	Ganchorra	BG5/125	M	20.2	18.79	2.45
18/04/2015	Faro Beach	Ganchorra	BG5/126	M	18.23	17.84	2.08
18/04/2015	Faro Beach	Ganchorra	BG5/127	M	21.35	19.95	2.87
18/04/2015	Faro Beach	Ganchorra	BG5/128	F	16.4	15.88	1.6
18/04/2015	Faro Beach	Ganchorra	BG5/129	F	15.69	15.19	1.27
18/04/2015	Faro Beach	Ganchorra	BG5/130	F	16.4	15.72	1.79
18/04/2015	Faro Beach	Ganchorra	BG5/131	F	17.22	16.75	2.01
18/04/2015	Faro Beach	Ganchorra	BG5/132	F	17.31	16.86	1.93
18/04/2015	Faro Beach	Ganchorra	BG5/133	F	16.89	16.18	1.93
18/04/2015	Faro Beach	Ganchorra	BG5/134	F	17.92	17.3	2.26
18/04/2015	Faro Beach	Ganchorra	BG5/135	F	14.7	14.38	1.28
18/04/2015	Faro Beach	Ganchorra	BG5/136	F	15.95	15.75	1.67
18/04/2015	Faro Beach	Ganchorra	BG5/137	M	20.67	19.47	2.39
18/04/2015	Faro Beach	Ganchorra	BG5/138	F	16.43	15.91	1.87
18/04/2015	Faro Beach	Ganchorra	BG5/139	F	17.35	16.51	1.59
18/04/2015	Faro Beach	Ganchorra	BG5/140	F	16.7	16.21	1.95
18/04/2015	Faro Beach	Ganchorra	BG5/141	M	20.25	19.5	2.4
18/04/2015	Faro Beach	Ganchorra	BG5/142	M	17.27	16.5	1.53
18/04/2015	Faro Beach	Ganchorra	BG5/143	F	19.27	18.91	2.89
18/04/2015	Faro Beach	Ganchorra	BG5/144	M	20.23	19.53	2.59
18/04/2015	Faro Beach	Ganchorra	BG5/145	F	17,00	15.99	1.94
18/04/2015	Faro Beach	Ganchorra	BG5/146	F	15.69	15.26	1.2
18/04/2015	Faro Beach	Ganchorra	BG5/147	M	20.38	18.75	2.22
18/04/2015	Faro Beach	Ganchorra	BG5/148	F	17.31	16.55	2.2
18/04/2015	Faro Beach	Ganchorra	BG5/149	M	18.85	17.35	2.39
18/04/2015	Faro Beach	Ganchorra	BG5/150	F	16.89	16.88	2.15

DATA RECORD OF *PORTUMNUS LATIPES* OF SIXTH SAMPLING.

Data	Sampling area	Method	N° Sample	Sex	Length(mm)	Width(mm)
21/05/2015	Faro Beach	Metal Stake	BG6/1	M	18.95	17.8
21/05/2015	Faro Beach	Metal Stake	BG6/2	F	20.52	20.19
21/05/2015	Faro Beach	Metal Stake	BG6/3	M	15.47	14.46
21/05/2015	Faro Beach	Metal Stake	BG6/4	F	20.91	21.59
21/05/2015	Faro Beach	Metal Stake	BG6/5	F	19.29	19.1
21/05/2015	Faro Beach	Metal Stake	BG6/6	F	19.06	19.39
21/05/2015	Faro Beach	Metal Stake	BG6/7	F	18.26	18.04
21/05/2015	Faro Beach	Metal Stake	BG6/8	F	17.12	16.51
21/05/2015	Faro Beach	Metal Stake	BG6/9	M	18.57	18.07
21/05/2015	Faro Beach	Metal Stake	BG6/10	M	21.01	19.48
21/05/2015	Faro Beach	Metal Stake	BG6/11	M	20.44	18.49
21/05/2015	Faro Beach	Metal Stake	BG6/12	F	14.77	14.92
21/05/2015	Faro Beach	Metal Stake	BG6/13	M	22.65	20.86
21/05/2015	Faro Beach	Metal Stake	BG6/14	M	19.91	18.96
21/05/2015	Faro Beach	Metal Stake	BG6/15	F	19.74	19.17
21/05/2015	Faro Beach	Metal Stake	BG6/16	F	21.17	19.59
21/05/2015	Faro Beach	Metal Stake	BG6/17	F	19,00	19.18
21/05/2015	Faro Beach	Metal Stake	BG6/18	M	17.21	17.15
21/05/2015	Faro Beach	Metal Stake	BG6/19	F	18.54	18,00
21/05/2015	Faro Beach	Metal Stake	BG6/20	M	20.16	19.36
21/05/2015	Faro Beach	Metal Stake	BG6/21	M	20.25	19.77
21/05/2015	Faro Beach	Metal Stake	BG6/22	F	19.42	18.84
21/05/2015	Faro Beach	Metal Stake	BG6/23	M	19.14	17.06
21/05/2015	Faro Beach	Metal Stake	BG6/24	F	21.1	21.16
21/05/2015	Faro Beach	Metal Stake	BG6/25	F	21.05	20.68
21/05/2015	Faro Beach	Metal Stake	BG6/26	M	20.02	18.21
21/05/2015	Faro Beach	Metal Stake	BG6/27	F	21.38	20.44
21/05/2015	Faro Beach	Metal Stake	BG6/28	F	15.48	14.96
21/05/2015	Faro Beach	Metal Stake	BG6/29	F	21.04	20.59
21/05/2015	Faro Beach	Metal Stake	BG6/30	F	20.72	20.27
21/05/2015	Faro Beach	Metal Stake	BG6/31	M	19.41	19.06
21/05/2015	Faro Beach	Metal Stake	BG6/32	M	23.27	22.1
21/05/2015	Faro Beach	Metal Stake	BG6/33	M	20.7	20.36
21/05/2015	Faro Beach	Metal Stake	BG6/34	M	17.33	16.14
21/05/2015	Faro Beach	Metal Stake	BG6/35	F	18.19	17.89
21/05/2015	Faro Beach	Metal Stake	BG6/36	M	24.7	23.5
21/05/2015	Faro Beach	Metal Stake	BG6/37	F	19.1	18.5
21/05/2015	Faro Beach	Metal Stake	BG6/38	M	22.5	21.2
21/05/2015	Faro Beach	Metal Stake	BG6/39	M	22.5	22.3
21/05/2015	Faro Beach	Metal Stake	BG6/40	F	19.7	19.4
21/05/2015	Faro Beach	Metal Stake	BG6/41	F	19.4	19.2
21/05/2015	Faro Beach	Metal Stake	BG6/42	F	20,00	19.2
21/05/2015	Faro Beach	Metal Stake	BG6/43	M	19.2	18.3
21/05/2015	Faro Beach	Metal Stake	BG6/44	M	20,00	19.1
21/05/2015	Faro Beach	Metal Stake	BG6/45	M	17.3	16.4
21/05/2015	Faro Beach	Metal Stake	BG6/46	M	11.1	15,00
21/05/2015	Faro Beach	Metal Stake	BG6/47	M	19.1	19,00
21/05/2015	Faro Beach	Metal Stake	BG6/48	M	16.4	15.8
21/05/2015	Faro Beach	Metal Stake	BG6/49	M	22.5	21.3
21/05/2015	Faro Beach	Metal Stake	BG6/50	F	19.1	19.6

Data	Sampling area	Method	N° Sample	Sex	Length(mm)	Width(mm)
21/05/2015	Faro Beach	Metal Stake	BG6/51	F	19.2	18.1
21/05/2015	Faro Beach	Metal Stake	BG6/52	M	20.3	19.4
21/05/2015	Faro Beach	Metal Stake	BG6/53	M	20,00	19.7
21/05/2015	Faro Beach	Metal Stake	BG6/54	M	19.1	18.1
21/05/2015	Faro Beach	Metal Stake	BG6/55	M	19.1	18,00
21/05/2015	Faro Beach	Metal Stake	BG6/56	F	20.6	19.3
21/05/2015	Faro Beach	Metal Stake	BG6/57	F	18.35	17.8
21/05/2015	Faro Beach	Metal Stake	BG6/58	M	19.3	18.2
21/05/2015	Faro Beach	Metal Stake	BG6/59	F	21.2	20.55
21/05/2015	Faro Beach	Metal Stake	BG6/60	F	18.6	18.2
21/05/2015	Faro Beach	Metal Stake	BG6/61	M	17,00	16.4
21/05/2015	Faro Beach	Metal Stake	BG6/62	M	16,00	15.2
21/05/2015	Faro Beach	Metal Stake	BG6/63	M	16.95	16.5
21/05/2015	Faro Beach	Metal Stake	BG6/64	M	20.3	19.1
21/05/2015	Faro Beach	Metal Stake	BG6/65	F	20.7	19.35
21/05/2015	Faro Beach	Metal Stake	BG6/66	M	25.3	24.1

DATA RECORD OF *PORTUMNUS LATIPES* OF SEVENTH SAMPLING.

Data	Sampling area	Method	N° Sample	Sex	Length(mm)	Width(mm)
01/06/2015	Faro Beach	IPMA	BG7/1	F	21.2	20.59
01/06/2015	Faro Beach	IPMA	BG7/2	F	18.38	17.97
01/06/2015	Faro Beach	IPMA	BG7/3	F	16.4	16.63
01/06/2015	Faro Beach	IPMA	BG7/4	F	16.38	15.79
01/06/2015	Faro Beach	IPMA	BG7/5	F	20.17	19.31
01/06/2015	Faro Beach	IPMA	BG7/6	F	18.08	17.79
01/06/2015	Faro Beach	IPMA	BG7/7	F	16.26	15.48
01/06/2015	Faro Beach	IPMA	BG7/8	F	18.56	18.41
01/06/2015	Faro Beach	IPMA	BG7/9	?	-	19.58
01/06/2015	Faro Beach	IPMA	BG7/10	F	20.64	19.86
01/06/2015	Faro Beach	IPMA	BG7/11	F	17.33	16.87
01/06/2015	Faro Beach	IPMA	BG7/12	M	17.1	16.15
01/06/2015	Faro Beach	IPMA	BG7/13	F	17.81	16.91
01/06/2015	Faro Beach	IPMA	BG7/14	F	18.18	17.47
01/06/2015	Faro Beach	IPMA	BG7/15	F	17.27	16.48
01/06/2015	Faro Beach	IPMA	BG7/16	F	18.08	17.7
01/06/2015	Faro Beach	IPMA	BG7/17	F	19.42	19.12
01/06/2015	Faro Beach	IPMA	BG7/18	F	19.66	18.68
01/06/2015	Faro Beach	IPMA	BG7/19	F	19.28	18.91
01/06/2015	Faro Beach	IPMA	BG7/20	F	18.08	17.85
01/06/2015	Faro Beach	IPMA	BG7/21	F	18.62	17.97
01/06/2015	Faro Beach	IPMA	BG7/22	F	19.51	19.05
01/06/2015	Faro Beach	IPMA	BG7/23	F	18.83	18.23
01/06/2015	Faro Beach	IPMA	BG7/24	F	17.65	17.38
01/06/2015	Faro Beach	IPMA	BG7/25	F	19.45	18.84
01/06/2015	Faro Beach	IPMA	BG7/26	F	17.5	17.29
01/06/2015	Faro Beach	IPMA	BG7/27	F	18.62	18.59
01/06/2015	Faro Beach	IPMA	BG7/28	F	18.88	18.5
01/06/2015	Faro Beach	IPMA	BG7/29	F	18.04	17.01
01/06/2015	Faro Beach	IPMA	BG7/30	F	16.54	16.22
01/06/2015	Faro Beach	IPMA	BG7/31	F	16.27	15.81
01/06/2015	Faro Beach	IPMA	BG7/32	F	15.73	15.4
01/06/2015	Faro Beach	IPMA	BG7/33	F	16.85	16.91
01/06/2015	Faro Beach	IPMA	BG7/34	M	21.31	20.2
01/06/2015	Faro Beach	IPMA	BG7/35	M?	17.39	16.5
01/06/2015	Faro Beach	IPMA	BG7/36	F	18.14	17.49
01/06/2015	Faro Beach	IPMA	BG7/37	F	17.87	17.76
01/06/2015	Faro Beach	IPMA	BG7/38	F	17.09	16.72
01/06/2015	Faro Beach	IPMA	BG7/39	F	16.16	16.29
01/06/2015	Faro Beach	IPMA	BG7/40	F	19.82	19.47
01/06/2015	Faro Beach	IPMA	BG7/41	F	17.74	17.04
01/06/2015	Faro Beach	IPMA	BG7/42	F	17.13	17.03
01/06/2015	Faro Beach	IPMA	BG7/43	F	19.74	19.1
01/06/2015	Faro Beach	IPMA	BG7/44	F	16.53	16.06
01/06/2015	Faro Beach	IPMA	BG7/45	F	14.79	14.71
01/06/2015	Faro Beach	IPMA	BG7/46	F	19.76	19.68
01/06/2015	Faro Beach	IPMA	BG7/47	F	18.27	17.89
01/06/2015	Faro Beach	IPMA	BG7/48	F	18.26	16.96
01/06/2015	Faro Beach	IPMA	BG7/49	F	14.96	14.91
01/06/2015	Faro Beach	IPMA	BG7/50	F	19.19	18.18

Data	Sampling area	Method	N° Sample	Sex	Length(mm)	Width(mm)
01/06/2015	Faro Beach	IPMA	BG7/51	F	15.73	15.6
01/06/2015	Faro Beach	IPMA	BG7/52	M	14.76	15.12
01/06/2015	Faro Beach	IPMA	BG7/53	M	22.67	21.54
01/06/2015	Faro Beach	IPMA	BG7/54	M	14.17	13.44
01/06/2015	Faro Beach	IPMA	BG7/55	F	14.93	14.23
01/06/2015	Faro Beach	IPMA	BG7/56	F	17.26	16.84
01/06/2015	Faro Beach	IPMA	BG7/57	F	16.28	15.66
01/06/2015	Faro Beach	IPMA	BG7/58	F	19.2	18.57
01/06/2015	Faro Beach	IPMA	BG7/59	F	19.98	19.5
01/06/2015	Faro Beach	IPMA	BG7/60	F	15.38	15.21
01/06/2015	Faro Beach	IPMA	BG7/61	?	18.18	17.9
01/06/2015	Faro Beach	IPMA	BG7/62	F	17.27	17.22
01/06/2015	Faro Beach	IPMA	BG7/63	F	18.3	17.54
01/06/2015	Faro Beach	IPMA	BG7/64	F	20.52	20.2
01/06/2015	Faro Beach	IPMA	BG7/65	F	15.83	15.67
01/06/2015	Faro Beach	IPMA	BG7/66	F	16.28	15.45
01/06/2015	Faro Beach	IPMA	BG7/67	F	17.39	16.62
01/06/2015	Faro Beach	IPMA	BG7/68	F	17.66	17.1
01/06/2015	Faro Beach	IPMA	BG7/69	F	14.59	14.51
01/06/2015	Faro Beach	IPMA	BG7/70	F	19.02	18.46
01/06/2015	Faro Beach	IPMA	BG7/71	F	15.55	15.27
01/06/2015	Faro Beach	IPMA	BG7/72	M	15.49	14.89
01/06/2015	Faro Beach	IPMA	BG7/73	M	16.58	15.6
01/06/2015	Faro Beach	IPMA	BG7/74	?	17.76	16.28
01/06/2015	Faro Beach	IPMA	BG7/75	?	16.11	15.04
01/06/2015	Faro Beach	IPMA	BG7/76	M	15.44	14.37
01/06/2015	Faro Beach	IPMA	BG7/77	M	13.46	13.2
01/06/2015	Faro Beach	IPMA	BG7/78	M	21.02	20.07
01/06/2015	Faro Beach	IPMA	BG7/79	M	17.18	16.57
01/06/2015	Faro Beach	IPMA	BG7/80	M	16.01	15.04
01/06/2015	Faro Beach	IPMA	BG7/81	M	14.89	13.91
01/06/2015	Faro Beach	IPMA	BG7/82	M	19.2	18.32
01/06/2015	Faro Beach	IPMA	BG7/83	M	22.27	21.1
01/06/2015	Faro Beach	IPMA	BG7/84	M	20.89	19.77
01/06/2015	Faro Beach	IPMA	BG7/85	M	18.66	18.42
01/06/2015	Faro Beach	IPMA	BG7/86	M	19.46	18.56
01/06/2015	Faro Beach	IPMA	BG7/87	M	20,00	19.36
01/06/2015	Faro Beach	IPMA	BG7/88	M	15.73	14.08
01/06/2015	Faro Beach	IPMA	BG7/89	M	16.94	16.3
01/06/2015	Faro Beach	IPMA	BG7/90	M	16.77	15.52
01/06/2015	Faro Beach	IPMA	BG7/91	F	19.24	19.35
01/06/2015	Faro Beach	IPMA	BG7/92	F	17.02	16.88
01/06/2015	Faro Beach	IPMA	BG7/93	F	15.8	15.89
01/06/2015	Faro Beach	IPMA	BG7/94	F	17.57	16.88
01/06/2015	Faro Beach	IPMA	BG7/95	F	16.85	16.33
01/06/2015	Faro Beach	IPMA	BG7/96	F	17.8	17.77
01/06/2015	Faro Beach	IPMA	BG7/97	F	16.98	16.79
01/06/2015	Faro Beach	IPMA	BG7/98	F	16.83	16.18
01/06/2015	Faro Beach	IPMA	BG7/99	F	17.06	16.88
01/06/2015	Faro Beach	IPMA	BG7/100	F	20.42	20.12

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)
01/06/2015	Faro Beach	IPMA	BG7/101	F	16.92	16.52
01/06/2015	Faro Beach	IPMA	BG7/102	F	16.72	16.32
01/06/2015	Faro Beach	IPMA	BG7/103	F	16.41	15.79
01/06/2015	Faro Beach	IPMA	BG7/104	F	16.58	17.02
01/06/2015	Faro Beach	IPMA	BG7/105	F	14.34	13.44
01/06/2015	Faro Beach	IPMA	BG7/106	F	19.54	18.51
01/06/2015	Faro Beach	IPMA	BG7/107	F	17.69	17.37
01/06/2015	Faro Beach	IPMA	BG7/108	F	18.58	18.06
01/06/2015	Faro Beach	IPMA	BG7/109	F	18.68	17.66
01/06/2015	Faro Beach	IPMA	BG7/110	F	16.9	15.99
01/06/2015	Faro Beach	IPMA	BG7/111	F	16.23	16,00
01/06/2015	Faro Beach	IPMA	BG7/112	F	20.78	20.17
01/06/2015	Faro Beach	IPMA	BG7/113	F	17.77	17.25
01/06/2015	Faro Beach	IPMA	BG7/114	F	14.94	13.84
01/06/2015	Faro Beach	IPMA	BG7/115	F	15.47	14.8

DATA RECORD OF *PORTUMNUS LATIPES* OF EIGHT SAMPLING.

Data	Sampling area	Method	N° Sample	Sex	Length(mm)	Width(mm)
18/06/2015	Faro Beach	Metal Stake	BG8/1	M	21.67	20.66
18/06/2015	Faro Beach	Metal Stake	BG8/2	M	17.78	16.83
18/06/2015	Faro Beach	Metal Stake	BG8/3	M	20.25	19.05
18/06/2015	Faro Beach	Metal Stake	BG8/4	M	19.4	18.36
18/06/2015	Faro Beach	Metal Stake	BG8/5	M	18.77	17.62
18/06/2015	Faro Beach	Metal Stake	BG8/6	M	24.31	23.63
18/06/2015	Faro Beach	Metal Stake	BG8/7	M	19.04	18.03
18/06/2015	Faro Beach	Metal Stake	BG8/8	M	22.74	21.59
18/06/2015	Faro Beach	Metal Stake	BG8/9	M	18.56	17.74
18/06/2015	Faro Beach	Metal Stake	BG8/10	M	20.71	19.12
18/06/2015	Faro Beach	Metal Stake	BG8/11	M	17.31	16.1
18/06/2015	Faro Beach	Metal Stake	BG8/12	M	19.86	18.77
18/06/2015	Faro Beach	Metal Stake	BG8/13	M	23.7	22.55
18/06/2015	Faro Beach	Metal Stake	BG8/14	M	22.81	21.67
18/06/2015	Faro Beach	Metal Stake	BG8/15	M	20.85	19.13
18/06/2015	Faro Beach	Metal Stake	BG8/16	M	23.11	21.56
18/06/2015	Faro Beach	Metal Stake	BG8/17	M	19.24	18.48
18/06/2015	Faro Beach	Metal Stake	BG8/18	M	21.81	20.7
18/06/2015	Faro Beach	Metal Stake	BG8/19	M	20.04	19.11
18/06/2015	Faro Beach	Metal Stake	BG8/20	M	19.63	18.38
18/06/2015	Faro Beach	Metal Stake	BG8/21	M	22.85	21.92
18/06/2015	Faro Beach	Metal Stake	BG8/22	M	19.72	18.33
18/06/2015	Faro Beach	Metal Stake	BG8/23	M	21.57	20.37
18/06/2015	Faro Beach	Metal Stake	BG8/24	M	23.16	21.74
18/06/2015	Faro Beach	Metal Stake	BG8/25	M	18.98	17.75
18/06/2015	Faro Beach	Metal Stake	BG8/26	M	18.56	17.44
18/06/2015	Faro Beach	Metal Stake	BG8/27	M	19.02	17.65
18/06/2015	Faro Beach	Metal Stake	BG8/28	M	22.09	21.01
18/06/2015	Faro Beach	Metal Stake	BG8/29	M	22.49	21.09
18/06/2015	Faro Beach	Metal Stake	BG8/30	M	18.63	17.58
18/06/2015	Faro Beach	Metal Stake	BG8/31	M	16.83	15.56
18/06/2015	Faro Beach	Metal Stake	BG8/32	M	20.66	19.54
18/06/2015	Faro Beach	Metal Stake	BG8/33	M	20.75	19.67
18/06/2015	Faro Beach	Metal Stake	BG8/34	M	19.56	18.47
18/06/2015	Faro Beach	Metal Stake	BG8/35	M	20.56	19.88
18/06/2015	Faro Beach	Metal Stake	BG8/36	M	20.05	18.76
18/06/2015	Faro Beach	Metal Stake	BG8/37	M	20.77	19.95
18/06/2015	Faro Beach	Metal Stake	BG8/38	M	20.99	19.66
18/06/2015	Faro Beach	Metal Stake	BG8/39	M	21.97	21.06
18/06/2015	Faro Beach	Metal Stake	BG8/40	M	21.41	20.18
18/06/2015	Faro Beach	Metal Stake	BG8/41	M	23.92	22.61
18/06/2015	Faro Beach	Metal Stake	BG8/42	M	18.75	17.34
18/06/2015	Faro Beach	Metal Stake	BG8/43	M	22.59	21.51
18/06/2015	Faro Beach	Metal Stake	BG8/44	M	21.34	19.94
18/06/2015	Faro Beach	Metal Stake	BG8/45	M	21.68	20.68
18/06/2015	Faro Beach	Metal Stake	BG8/46	M	23.19	21.57
18/06/2015	Faro Beach	Metal Stake	BG8/47	M	19.73	19.03
18/06/2015	Faro Beach	Metal Stake	BG8/48	M	19.35	18.1
18/06/2015	Faro Beach	Metal Stake	BG8/49	M	19.14	17.94
18/06/2015	Faro Beach	Metal Stake	BG8/50	F	19.33	18.18

Data	Sampling area	Method	Nº Sample	Sex	Length(mm)	Width(mm)
18/06/2015	Faro Beach	Metal Stake	BG8/51	F	20.2	19.57
18/06/2015	Faro Beach	Metal Stake	BG8/52	F	19.2	18.57
18/06/2015	Faro Beach	Metal Stake	BG8/53	F	19.92	19.42
18/06/2015	Faro Beach	Metal Stake	BG8/54	F	19.05	18.31
18/06/2015	Faro Beach	Metal Stake	BG8/55	F	21.4	21.19
18/06/2015	Faro Beach	Metal Stake	BG8/56	F	19.33	18.72
18/06/2015	Faro Beach	Metal Stake	BG8/57	F	16.71	16.36
18/06/2015	Faro Beach	Metal Stake	BG8/58	F	20.23	20.31
18/06/2015	Faro Beach	Metal Stake	BG8/59	F	19.98	19.39
18/06/2015	Faro Beach	Metal Stake	BG8/60	F	19.8	19.09

ANNEX 3

DATA OF INDIVIDUALS USED FOR FECUNDITY STUDY (STAGE I).

Sample	Length	Width	Total wet weight of eggs (mg)	Sample wet weight of eggs (mg)	Number of eggs counted	Number of eggs in the sample
BG1/28	15.43	15.78	142.51	9.71	826	12122,9
BG3/32	15.84	15.20	127.54	5.07	353	8880,0
BG2/132	15.96	15.90	277.47	10.86	601	15355,4
BG1/14	16.16	16.21	243.95	6.72	369	13395,5
BG1/20	16.45	16.93	145.46	10.45	829	11539,4
BG2/104	17.05	17.02	337.50	4.44	251	19079,4
BG2/80	17.30	16.79	339.63	5.27	291	18753,8
BG1/21	17.36	16.85	136.04	10.62	965	12361,5
BG1/29	17.38	16.62	190.23	9.69	671	13172,8
BG1/5	17.48	16.61	152.91	10.84	988	13936,8
BG1/19	17.79	16.96	214.52	10.90	1045	20566,4
BG2/107	18.17	17.70	361.48	7.03	264	13574,8
BG2/39	18.54	17.43	259.92	5.75	390	17629,4
BG1/6	18.56	17.32	234.15	10.08	825	19164,1
BG1/27	18.11	17.22	174.20	9.35	771	14364,5
BG3/128	18.96	18.57	133.97	5.64	671	15938,6
BG4/63	19.24	18.68	182.99	6.88	823	21889,6
BG3/13	19.95	19.34	596.62	5.42	321	35334,9
BG3/102	20.01	19.50	329.88	5.76	496	28406,3
BG2/110	21.37	20.65	233.82	4.96	390	18385,0

DATA OF INDIVIDUALS USED FOR FECUNDITY STUDY (STAGE II).

Sample	Length	Width	Total wet weight of eggs (mg)	Sample wet weight of eggs (mg)	Number of eggs counted	Number of eggs in the sample
BG3/72	15.91	15.53	126.28	10.71	1063	12533,7
BG3/74	15.96	15.49	122.42	4.12	652	19373,3
BG3/27	16.27	15.41	357.02	4.95	211	15218,4
BG4/36	16.77	15.95	227.33	4.95	545	25029,3
BG3/73	17.50	16.91	195.25	6.20	652	20532,7
BG1/23	17.52	16.81	187.25	10.86	830	14311,0
BG3/145	17.85	16.76	232.83	4.83	774	37310,6
BG3/101	18,00	17.51	121.65	4.25	759	21725,3
BG3/21	18.30	17.72	411.80	5.58	215	15866,8
BG4/52	18.57	17.92	198.98	5.88	779	26361,5
BG3/30	18.67	18.33	371.24	8.19	827	37486,6
BG2/128	19.13	19.29	344.71	6.13	295	16588,8
BG2/74	19.30	19.42	516.29	5.81	299	26569,8
BG1/17	19.46	18.80	204.06	9.85	784	16241,9
BG4/101	19.88	19,00	388.65	7.82	790	39262,6
BG3/71	20.04	19.57	423.05	7.61	558	31020,0
BG4/55	20.78	20.16	463.65	5.98	583	45202,0
BG3/2	20.92	19.97	736.38	5.63	162	21188,9
BG3/23	20.94	19.93	770.00	5.26	215	31473,4
BG4/47	21.85	21.42	495.27	6.39	566	43869,0

DATA OF INDIVIDUALS USED FOR FECUNDITY STUDY (STAGE III).

Sample	Length	Width	Total wet weight of eggs (mg)	Sample wet weight of eggs (mg)	Number of eggs counted	Number of eggs in the sample
BG2/87	15.32	15.34	242.46	5.93	276	11284,8
BG3/77	16.20	15.88	184.37	4.60	214	8577,2
BG1/4	16.62	16.7	96.45	10.51	963	8837,4
BG3/66	16.76	15.97	140.92	8.03	329	5773,7
BG1/13	17.32	16.90	193.94	9.06	634	13571,5
BG3/79	17.34	16.47	254.92	10.07	465	11771,4
BG2/131	17.44	16.58	76.82	5.25	310	4536,0
BG0/1	17.47	16.32	191.25	4.46	216	9262,3
BG3/68	17.56	17.52	174.27	5.95	219	6414,3
BG3/69	17.72	16.85	107,00	6.11	346	6059,2
BG3/75	18.14	17.34	168.47	9.56	631	11119,7
BG1/24	18.28	18.04	167.52	10.35	1001	16201,7
BG3/70	18.84	18.00	276.18	4.16	134	8896,2
BG3/78	18.93	18.81	275.32	6.57	312	13074,6
BG3/65	19,00	18.74	132.78	4.45	288	8593,4
BG1/11	19.26	17.78	101.70	9.79	470	4882,4
BG3/64	19.93	18.96	351.21	4.93	239	17026,2
BG3/76	20.12	20.07	305.10	8.88	520	17866,2
BG3/67	20.22	19.37	264.39	5.61	353	16636,3
BG4/59	20.51	20.03	523.62	6.85	346	26448,5

ANNEX 4

DATA RECORD OF INDIVIDUALS USED FOR ESTIMATING THE NUMBER OF EGGS PER 1 GRAM OF SAMPLE (STAGE I).

Sample	Length	Total weight	Total eggs in 1g sample
BG1/28	15.43	1.64	7392.0
BG3/32	15.84	1.53	5803.9
BG2/132	15.96	1.83	8390.9
BG1/14	16.16	1.76	7611.1
BG1/20	16.45	2.21	5221.4
BG2/104	17.05	2.16	8833.1
BG2/80	17.30	2.04	9193.0
BG1/21	17.36	2.13	5803.5
BG1/29	17.38	1.90	6933.0
BG1/5	17.48	1.81	7699.9
BG1/19	17.79	2.50	8226.5
BG2/107	18.17	2.21	6142.4
BG2/39	18.54	2.23	7905.5
BG1/6	18.56	2.18	8790.9
BG1/27	18.11	2.04	7041.4
BG3/128	18.96	2.65	6014.6
BG4/63	19.24	2.41	9082.8
BG3/13	19.95	3.08	11472.4
BG3/102	20.01	2.84	10002.2
BG2/110	21.37	2.76	6661.2

DATA RECORD OF INDIVIDUALS USED FOR ESTIMATING THE NUMBER OF EGGS PER 1 GRAM OF SAMPLE (STAGE II).

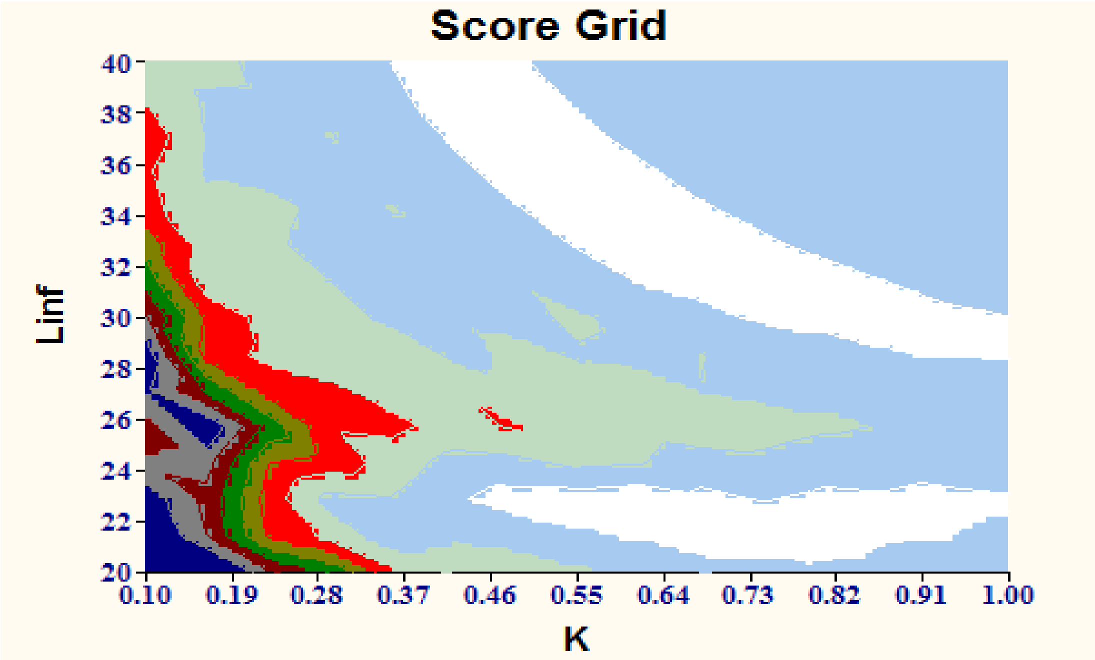
Sample	Length	Total weight	Total eggs in 1g sample
BG3/72	15.91	1.42	8826.5
BG3/74	15.96	1.53	12662.3
BG3/27	16.27	1.78	8549.7
BG4/36	16.77	1.81	13828.3
BG3/73	17.50	1.88	10921.7
BG1/23	17.52	1.90	7532.1
BG3/145	17.85	2.05	18200.3
BG3/101	18.00	2.16	10058.0
BG3/21	18.3	2.55	6222.3
BG4/52	18.57	2.46	10716.0
BG3/30	18.67	2.75	13631.5
BG2/128	19.13	3.10	5351.2
BG2/74	19.30	3.48	7635.0
BG1/17	19.46	2.97	5468.7
BG4/101	19.88	3.14	12504.0
BG3/71	20.04	2.99	10374.6
BG4/55	20.78	3.76	12021.8
BG3/2	20.92	3.33	6363.0
BG3/23	20.94	3.61	8718.4
BG4/47	21.85	4.18	10495.0

DATA RECORD OF INDIVIDUALS USED FOR ESTIMATING THE NUMBER OF EGGS PER 1 GRAM OF SAMPLE (STAGE III).

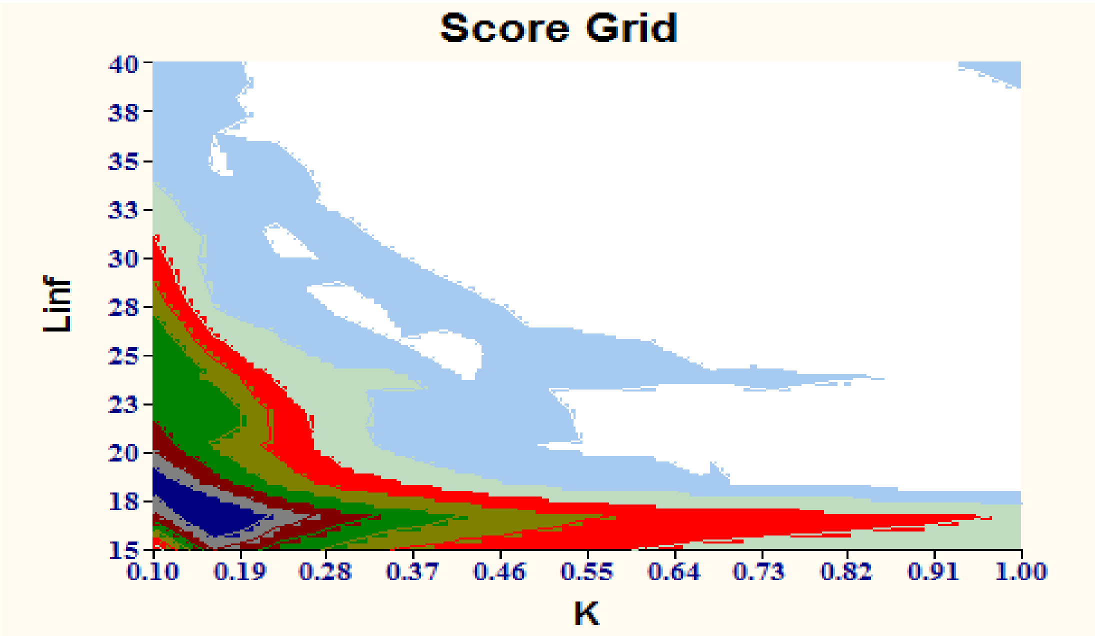
Sample	Length	Total weight	Total eggs in 1g sample
BG2/87	15.32	1.59	7097.4
BG3/77	16.20	1.59	5394.5
BG1/4	16.62	2.35	3760.6
BG3/66	16.76	1.65	3499.2
BG1/13	17.32	2.31	5875.1
BG3/79	17.34	1.86	6328.7
BG2/131	17.44	2.00	2268.0
BG0/1	17.47	2.12	4369.0
BG3/68	17.56	2.10	3054.4
BG3/69	17.72	1.44	4207.8
BG3/75	18.14	2.01	5532.2
BG1/24	18.28	2.60	6231.4
BG3/70	18.84	2.51	3544.3
BG3/78	18.93	2.47	5293.3
BG3/65	19.00	2.54	3383.2
BG1/11	19.26	2.59	1885.1
BG3/64	19.93	2.91	5850.9
BG3/76	20.12	3.24	5514.3
BG3/67	20.22	2.85	5837.3
BG4/59	20.51	3.38	7825.0

<u>ANNEX 5</u>

MALE CONTOUR PLOT WHICH CORRESPONDS WITH ELEFAN ANALYSIS.



FEMALE CONTOUR PLOT WHICH CORRESPONDS WITH ELEFAN ANALYSIS.



ANNEX 6

DATA FROM THE FIRST DAY OF THE AREA OF ATTRACTION EXPERIMENT. NUMBERS CORRESPOND TO CRABS CAUGHT PER STAKE.

Date	Hour	Distance	Stake 1	Stake 2	Stake 3	Stake 4
05/06/2015	9:50	1m	0	1	0	0
05/06/2015	10:35	1m	0	0	1	0
05/06/2015	11:00	1m	0	1	0	0
05/06/2015	11:30	1m	0	1	0	0
05/06/2015	12:05	1m	0	0	0	1
05/06/2015	9:50	2m	0	0	0	0
05/06/2015	10:35	2m	0	0	1	0
05/06/2015	11:00	2m	1	0	0	0
05/06/2015	11:30	2m	0	0	0	0
05/06/2015	12:05	2m	0	0	0	0
05/06/2015	9:50	4m	0	0	0	0
05/06/2015	10:35	4m	1	0	1	0
05/06/2015	11:00	4m	0	0	0	0
05/06/2015	11:30	4m	0	0	0	0
05/06/2015	12:05	4m	3	0	1	x
05/06/2015	9:50	8m	0	0	0	0
05/06/2015	10:35	8m	0	1	1	0
05/06/2015	11:00	8m	0	0	2	0
05/06/2015	11:30	8m	0	0	0	0
05/06/2015	12:05	8m	2	x	1	1
05/06/2015	9:50	16m	0	0	0	0
05/06/2015	10:35	16m	0	0	0	0
05/06/2015	11:00	16m	0	1	0	0
05/06/2015	11:30	16m	1	0	0	0
05/06/2015	12:05	16m	x	0	2	0

DATA FROM THE SECOND DAY OF THE AREA OF ATTRACTION EXPERIMENT. NUMBERS CORRESPOND TO CRABS CAUGHT PER STAKE.

Date	Hour	Distance	Stake 1	Stake 2	Stake 3	Stake 4
08/06/2015	12:30	1m	0	0	0	0
08/06/2015	12:57	1m	0	0	0	0
08/06/2015	13:19	1m	0	0	0	0
08/06/2015	13:39	1m	0	0	1	0
08/06/2015	14:03	1m	0	0	0	0
08/06/2015	12:30	2m	0	0	0	1
08/06/2015	12:57	2m	0	0	0	0
08/06/2015	13:19	2m	0	0	0	0
08/06/2015	13:39	2m	0	0	1	0
08/06/2015	14:03	2m	1	0	0	0
08/06/2015	12:30	4m	0	0	0	0
08/06/2015	12:57	4m	0	1	0	0
08/06/2015	13:19	4m	0	0	0	1
08/06/2015	13:39	4m	2	0	1	1
08/06/2015	14:03	4m	0	0	0	0
08/06/2015	12:30	8m	0	0	0	0
08/06/2015	12:57	8m	1	0	0	0
08/06/2015	13:19	8m	2	0	0	2
08/06/2015	13:39	8m	1	0	1	0
08/06/2015	14:03	8m	1	1	1	0
08/06/2015	12:30	16m	0	0	0	0
08/06/2015	12:57	16m	0	0	0	0
08/06/2015	13:19	16m	0	2	0	0
08/06/2015	13:39	16m	1	0	0	0
08/06/2015	14:03	16m	1	0	0	0

DATA FROM THE THIRD DAY OF THE AREA OF ATTRACTION EXPERIMENT. NUMBERS CORRESPOND TO CRABS CAUGHT PER STAKE.

Date	Hour	Distance	Stake 1	Stake 2	Stake 3	Stake 4
18/06/2015	10:35	1m	0	0	0	1
18/06/2015	11:03	1m	1	0	0	0
18/06/2015	11:26	1m	0	0	0	0
18/06/2015	11:55	1m	0	0	0	0
18/06/2015	12:25	1m	0	0	1	0
18/06/2015	10:35	2m	0	0	0	0
18/06/2015	11:03	2m	0	0	1	0
18/06/2015	11:26	2m	0	0	0	0
18/06/2015	11:55	2m	1	1	1	1
18/06/2015	12:25	2m	1	0	0	1
18/06/2015	10:35	4m	1	1	0	1
18/06/2015	11:03	4m	0	0	0	1
18/06/2015	11:26	4m	1	0	0	0
18/06/2015	11:55	4m	1	1	4	2
18/06/2015	12:25	4m	0	0	0	1
18/06/2015	10:35	8m	0	0	1	0
18/06/2015	11:03	8m	1	0	1	1
18/06/2015	11:26	8m	1	3	2	2
18/06/2015	11:55	8m	2	0	0	1
18/06/2015	12:25	8m	0	2	2	0
18/06/2015	10:35	16m	0	0	0	0
18/06/2015	11:03	16m	5	0	1	1
18/06/2015	11:26	16m	0	0	2	3
18/06/2015	11:55	16m	0	0	4	1
18/06/2015	12:25	16m	0	0	2	1

ANNEX 7

DATA RECORD OF SURVEY WITH "INSTITUTO PORTUGUÊS DO MAR E DA ATMOSFERA" IN THE SOUTH COAST OF PORTUGAL.

Station		Depth (m)	Longitude	Latitude	Nº Individuals	Biomass	Extension
22	**A**	3.0	-7,57500000	37,13583333	1	1.3	1
40	**A**	3.0	-7,72500000	37,04983333	1	1.3	2.5
44	**A**	3.0	-7,75833333	37,03233333	9	16.97	1
48	**A**	3.0	-7,79166667	36,99633333	3	4.49	1
49	**A**	3.0	-7,80000000	36,99266667	5	10.23	1
50	**B**	4.8	-7,80833333	36,98833333	1	1.3	2.5
51	**A**	3.0	-7,81666667	36,98833333	1	1.97	5.5
	B	4.8	-7,81666667	36,98750000	8	18.6	
	C	6.6	-7,81666667	36,98433333	1	1.65	1.5
53	**A**	3.0	-7,83333333	36,98300000	11	26.93	1.5
	C	6.6	-7,83333333	36,97883333	1	2.71	1.5
54	**A**	3.0	-7,84166667	36,98066667	29	69.32	1.5
	B	4.8	-7,84166667	36,97850000	5	12.97	2
55	**A**	3.0	-7,85000000	36,97633333	14	34.18	1.5
	B	4.8	-7,85000000	36,97316667	1	1.51	2
59	**A**	3.0	-7,88333333	36,95650000	6	10.46	1
62	**A**	3.0	-7,90833333	36,96116667	14	25.46	1
63	**A**	3.0	-7,91666667	36,96316667	35	70.91	1.5
	C	6.6	-7,91666667	36,96150000	11	22.94	1
64	**B**	4.8	-7,92500000	36,96450000	11	20.46	1.5
66	**A**	3.0	-7,94166667	36,97116667	3	4.99	1.5
	B	4.8	-7,94166667	36,97016667	1	1.59	2
67	**A**	3.0	-7,95000000	36,97550000	2	4.45	2
68	**A**	3.0	-7,95833333	36,97866667	7	14.47	1
69	**B**	4.8	-7,96666667	36,98233333	5	9.44	1.5
	B	4.8	-7,98333333	36,99466667	1	1.29	2
73	**A**	3.0	-8,00000000	37,00783333	3	4.87	2.5
74	**A**	3.0	-8,00833333	37,01166667	3	4.41	2
	B	4.8	-8,00833333	37,01050000	1	3.05	1
75	**A**	3.0	-8,01666667	37,01783333	2	4.05	3
76	**A**	3.0	-8,02500000	37,02150000	9	16.97	2
	B	4.8	-8,02500000	37,02100000	2	3.17	2
77	**A**	3.0	-8,03333333	37,02700000	5	10.08	3
	B	4.8	-8,03333333	37,02583333	3	5.55	1
78	**A**	3.0	-8,04166667	37,03283333	2	2.77	2
	B	4.8	-8,04166667	37,03166667	1	1.39	1
79	**A**	3.0	-8,05000000	37,03783333	5	8.39	1
80	**A**	3.0	-8,05833333	37,04183333	42	72.53	1.5
	B	4.8	-8,05833333	37,04133333	5	9.22	1.5
81	**A**	3.0	-8,06666667	37,04766667	13	19.25	1.5
	B	4.8	-8,06666667	37,04616667	1	1.39	1.5
82	**A**	3.0	-8,07500000	37,05183333	1	1.34	1
83	**A**	3.0	-8,08333333	37,05650000	9	14.56	1.5
	B	4.8	-8,08333333	37,05633333	3	4.87	1
84	**A**	3.0	-8,09166667	37,06050000	7	10.04	2
90	**A**	3.0	-8,16666667	37,08383333	1	1.39	1.5
92	**A**	3.0	-8,18333333	37,08716667	4	8.65	1

DATA RECORD OF SURVEY WITH "INSTITUTO PORTUGUÊS DO MAR E DA ATMOSFERA" IN THE SOUTH-WESTERN COAST OF PORTUGAL.

Station	Depth (m)	Longitude	Latitude	Nº Individuals	Biomass	Extension
55	3	-8,826166667	38,416666667	9	15.16	1
60	3	-8,816166667	38,400000000	12	20.56	1
61	6	-8,816833333	38,400000000	5	7.38	1
65	3	-8,806500000	38,383333333	28	40.36	1
66	9	-8,808833333	38,383333333	6	7.93	1.5
70	5	-8,800333333	38,366666667	17	18.65	1
71	7	-8,801500000	38,366666667	4	6.79	1
74	3	-8,793166667	38,350000000	28	37.07	1
75	7	-8,794666667	38,350000000	1	1,00	
79	5	-8,788500000	38,333333333	11	14.69	1
80	7	-8,790000000	38,333333333	1	1.21	1
84	3	-8,784000000	38,316666667	38	59.56	1
85	6	-8,784333333	38,316666667	16	26,00	1
86	10	-8,786500000	38,316666667	10	14.50	1
89	3	-8,781333333	38,300000000	30	47.22	1
90	6	-8,782000000	38,300000000	37	55.86	1
91	10	-8,783333333	38,300000000	1	1.65	1
94	5	-8,780000000	38,283333333	21	38.25	1
95	9	-8,781500000	38,283333333	18	29.16	1
99	3	-8,778000000	38,266666667	12	20.46	1
100	7	-8,778833333	38,266666667	7	11.71	1
104	5	-8,778000000	38,250000000	5	6.23	1
105	9	-8,779666667	38,250000000	3	4.45	1
109	3	-8,776833333	38,233333333	25	36.51	1
110	7	-8,777833333	38,233333333	1	1.12	1
111	3	-8,777833333	38,216666667	7	11.51	1
112	9	-8,780333333	38,216666667	4	4.83	1
113	3	-8,780166667	38,200000000	2	3.52	1
114	7	-8,780833333	38,200000000	7	10.79	1
115	5	-8,782500000	38,183333333	11	15.67	1
116	9	-8,784000000	38,183333333	8	11.34	1
117	13	-8,784666667	38,183333333	9	13.33	1
120	5	-8,786333333	38,166666667	15	23.47	1
122	12	-8,787500000	38,166666667	3	4.51	1
124	5	-8,790500000	38,150000000	7	12.79	1
125	8	-8,791500000	38,150000000	11	14.16	1
126	11	-8,791833333	38,150000000	2	3.31	1
129	5	-8,794333333	38,133333333	9	20.57	1
130	7	-8,795333333	38,133333333	6	11.18	1
131	10	-8,795833333	38,133333333	5	7.60	1
134	5	-8,800000000	38,116666667	7	11.24	1
135	9	-8,800833333	38,116666667	7	11.46	1
136	15	-8,802500000	38,116666667	1	1.92	1
139	5	-8,806166667	38,100000000	4	5.71	1
140	8	-8,807833333	38,100000000	4	6.16	1

Station	Depth (m)	Longitude	Latitude	Nº Individuals	Biomass	Extension
141	12	-8,808666667	38,100000000	1	2.08	1
144	5	-8,813000000	38,083333333	9	13.36	1
145	9	-8,813833333	38,083333333	2	3.35	1
146	12	-8,815333333	38,083333333	2	2.88	1
149	5	-8,819500000	38,066666667	4	6.95	1
150	10	-8,820166667	38,066666667	8	12.45	1
151	12	-8,820666667	38,066666667	8	10.99	1
154	5	-8,827500000	38,050000000	9	17.23	1
155	9	-8,827666667	38,050000000	12	15.76	1
157	20	-8,832000000	38,050000000	1	2.19	1
158	5	-8,835333333	38,033333333	9	16.27	1
159	7	-8,835500000	38,033333333	1	1.39	1
160	12	-8,836166667	38,033333333	4	6.43	1
161	18	-8,839000000	38,033333333	1	1.79	1
162	5	-8,842666667	38,016666667	8	11.55	1
163	9	-8,843333333	38,016666667	7	9.85	1
166	5	-8,852833333	38,000000000	9	11.18	1
167	7	-8,853000000	38,000000000	1	0.92	1
168	12	-8,854333333	38,000000000	6	8.19	1
170	5	-8,865666667	37,983333333	3	3.78	1
171	9	-8,866000000	37,983333333	3	4.99	1
174	5	-9,254666667	38,650000000	12	16.06	1
175	7	-9,257333333	38,650000000	12	18.74	1
176	8	-9,294500000	38,650000000	11	15.19	1
177	9	-9,269666667	38,650000000	7	11.93	1.5
178	4	-9,240166667	38,633333333	23	39.92	1
179	8	-9,241833333	38,633333333	5	7.42	1
180	11	-9,244500000	38,633333333	2	2.79	1
182	5	-9,223333333	38,616666667	12	16.97	1
184	10	-9,229833333	38,616666667	8	8.73	2.5
186	6	-9,215166667	38,600000000	13	14.19	1
190	4	-9,205166667	38,583333333	25	31.35	1
191	6	-9,206833333	38,583333333	4	2.70	
194	5	-9,197166667	38,566666667	7	7.08	1
195	8	-9,199166667	38,566666667	2	1.53	1
198	4	-9,189500000	38,550000000	14	17.35	1
199	7	-9,190666667	38,550000000	6	7.46	1
202	3	-9,185500000	38,533333333	17	25.37	1
203	6	-9,186666667	38,533333333	3	3.32	1
204	9	-9,187000000	38,533333333	2	2.07	1
205	20	-9,195000000	38,533333333	19	28.98	1.5
207	8	-9,185833333	38,516666667	7	7.61	1
208	12	-9,187333333	38,516666667	6	6.84	1
210	4	-9,185166667	38,500000000	3	3.46	1
211	7	-9,185833333	38,500000000	9	9.79	1
212	10	-9,186333333	38,500000000	3	3.45	1
214	6	-9,186833333	38,483333333	3	3.73	1
216	14	-9,190166667	38,483333333	2	2.15	1

DATA RECORD OF SURVEY WITH "INSTITUTO PORTUGUÊS DO MAR E DA ATMOSFERA" IN THE NORTH WEST COAST OF PORTUGAL.

Station	Depth (m)	Longitude	Latitude	Nº Individual	Biomass	Extension
11				2	1.83	1
17				3	2.53	1
19	21	-8,84600000	41,11666667	27	23.80	1
67	8	-8,68033333	40,95000000	1	0.46	1
76	8	-8,74633333	40,91666667	18	18.54	1.5
81	10	-8,76366667	40,90000000	17	24.94	1
85	8	-8,78433333	40,88333333	5	7.65	1.5
107	10	-8,84616667	40,81666667	1	0.87	2
146	10	-8,75150000	40,70000000	1	0.81	3
156	10	-8,87750000	40,65833333	25	25.56	3.5
161	8	-8,86750000	40,65000000	29	34.71	2
166	10	-8,82333333	40,63333333	10	14.61	1
170	8	-8,89283333	40,60833333	7	11.84	1
176	10	-8,81350000	40,60000000	1	1.01	1
201	10	-8,86666667	40,51666667	8	8.17	2
206	8	-8,94300000	40,50000000	10	8.90	1
210	28	-8,86516667	40,50000000	18	22.68	4.5
223	8	-8,82850000	40,43333333	25	28.97	1.5
228	10	-8,93616667	40,40000000	1	0.56	4
233	8	-8,89433333	40,36666667	11	9.84	2
238	10	-8,88316667	40,33333333	9	8.32	1

ANNEX 8

SYMPOSIUM PROCEEDINGS: IBERIAN ATLANTIC MARGIN (MIA 2015) 21 -23 SEPTEMBER, MALAGA (SPAIN)

Aspectos de la biología reproductiva del cangrejo de arena (*Portumnus latipes*) en la costa sur de Portugal

Aspects of the reproductive biology of Pennant´s swimming crab (*Portumnus latipes*) in the south of Portugal

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Abstract:

Pennant´s swimming crab (*Portumnus latipes*), a small crab found in the intertidal and wash zone of sandy, exposed beaches was sampled on a bimonthly basis from February to June 2015 in the Praia de Faro, southern Portugal. Highest percentages of berried females were found in the earliest samples, indicating a winter to early spring reproductive period. Three egg development stages were observed (I: yellowish, II: orange, and III: grey coloration). Fecundity was estimated for the different stages and the relationships between carapace width (CW), carapace length (CL) explored. Fecundity was significantly related to body size measurements but the number of eggs per gram of female was not significantly different across the observed size range. Fecundity decreased with egg development stage from orange to grey phase, indicating egg loss over time. Mean fecundities per gram of female for stages I, II and III were 7711.1; 10004.0 and 4837.6 eggs respectively.

Key words: *Portugal, Portumnus latipes, sandy beach, sex ratio and fecundity*

1. INTRODUCTION

The most dynamic soft bottom habitats like sandy beaches, occur on the open coasts of temperate and tropical regions (Davies, 1972). The open sandy beaches are defined by their morphodynamics, and described in terms of wave exposure, characteristics of the sediments and tidal ranges. Previous studies analysed micro and mesotidal areas, showing that there is a relationship between macroinfauna in the intertidal zone and wave interaction and beach morphodynamics (McLachlan *et al.,* 1996). Although sandy beaches present a uniform appearance, they are characterised by great ecological diversity in marine fauna (Rodil *et al*., 2006).

This study was conducted in the intertidal area of a sandy beach that provides a habitat for a diversity of macroinfauna, dominated by crustaceans, molluscs and polychaetes (Brown & McLachlan, 1990). It focuses on a species of Decapod crustacean, Pennant´s swimming crab, *Portumnus latipes* (Pennant, 1777). Pennant´s swimming crab (Figure 1) is a typical organism of the foreshore of sandy beaches and surf zone that buries itself in the sand 100-150 mm below the surface sand and probably swims just above the sand surface (Türkay & Stecher, 2013). Regarding the distribution, according to Türkay & Stecher (2013) it is most abundant in the North Sea and more abundant in the Southern Bight than farther north and east. In this study the species was captured in southern Portugal, on Faro beach. *P. latipes* is a poorly known species. The study aims to contribute to a better understanding of the biology and ecology of this species due to it is importance as a prey item of fish such as sea bass (*Dicentrarchus labrax*), gilthead seabream (*Sparus aurata*) and white seabream (*Diplodus sargus*). Samples (approximately bi-monthly) were taken to the laboratory for biological studies (determination of sex, sex ratio, reproductive cycle, fecundity).

Fig. 1. Live female P. latipes with orange (Stage II) eggs.

2. MATERIALS AND METHODS

2.1 Study area

This study was conducted in the westernmost of the spits and barrier islands in the Ria Formosa ecosystem (Southern Portugal), namely Faro beach, Ancão litoral (Anfuso & Ruiz, 2004). It is a 10 km long system that changes depending on the migration of the tidal inlet (Ciavola *et al*., 1998), with a width ranging between 50 and 250 meters (Anfuso & Ruiz, 2004). Ancão spit presents a mesotidal range between 0.5 and 3.5 meters (during neap and spring tides respectively).

2.2 Sampling and capture techniques

Seven samplings were performed bi-monthly between February and June 2015 in Faro beach. All sampling took place during neap tides in the maximum low tide. Individuals were collected in the intertidal zone, with at least 60 specimens in each sample. For the capture of the individuals a metal stake with length 35 cm and width 0.9 cm was used. The metal stake was introduced in the sand with a piece of sardine, *Sardina pilchardus* (Walbaum, 1792), attached as bait. After 10-15 minutes metal stakes were checked for *P. Latipes* attracted to the bait and the crabs collected by hand. All captured specimens were stored inside a plastic container with sea water and were transported to the laboratory for further analyses.

2.3 Laboratory work

In the laboratory all individuals were properly marked and identified. Subsequently, crabs were measured with digital callipers to the nearest 0.01 mm. Standard measurements were taken: carapace width, the distance between the rostral tip and the tip of the dorsal spines (CW), and carapace length, from the tip of the median frontal tooth to the posterior terminal border of the carapace (CL) for each specimen sampled (Paula, 1988). In parallel, sex was determined by examination of the shape of the abdomen. Subsequently, all individuals were weighed using a balance (precision of 0.01 g). Finally, female maturity state was determined from the existence of eggs.

The sex ratio of each sample was determined as the proportion of males to females, and expressed as the number of males per 100 females.

The estimation of fecundity was performed by counting eggs. For that purpose three groups of berried females were established depending on the colour of eggs (I: yellowish, II: orange and III: grey) which indicates the egg development stage, from the lowest to the highest respectively (Rodríguez-Domínguez *et al.,* 2012). Twenty berried females from each group, including the widest range of sizes of individuals were selected (Kensler, 2015). The CW and CL were recorded using an electronic caliper with 0.01 mm precision. All the individuals were preserved in 96% alcohol in individual plastic containers. The total egg mass from each female was carefully separated from the pleopods by using a scalpel and tweezers in the petri dish (Da Silva et al., 2004). Subsequently, by mean of a stereoscopic microscope, the remains of pleopods and sand were removed from the eggs mass. The samples were dried in the hood to evaporate any residual alcohol for about 10 minutes. A 5-10mg subsample was taken from the total egg mass of each female using a 0.0001 mg precision balance following a modification of (Kensler, 2015). Finally, all the eggs in each subsample were counted manually using a stereoscopic microscope. To calculate the fecundity of the berried females, the total number of eggs for each female was calculated from the subsample egg count values and the weights of the subsample and the total egg mass. Power and linear models were fitted to the fecundity data as a function of CW and CL and the best model selected based on the r values and significance. The relationship between fecundity and total weight of the females was also explored.

3. RESULTS

3.1 Sex ratio

A total of 839 individuals were sampled, of which 528 were females, 296 males and 15 of indeterminate sex. A higher percentage of females than males was found in all samples except one, as shown Figure 2. All the values per sample were expressed as a percentage because the same number of individuals were not obtained in all samples.

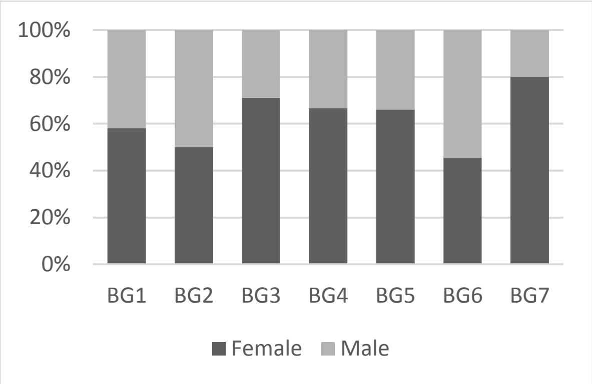

Fig. 2 Percentage of females based on the total number of individuals in each sample (from February to June 2015).

3.2 Reproductive cycle

The results obtained provide some information about the reproductive cycle of *P. latipes* between February and June. During the first three months of sampling, a high percentage of females with eggs was observed. Later, during the two samplings in May and June a large decrease was observed in the percentage of berried females (Figure 3).

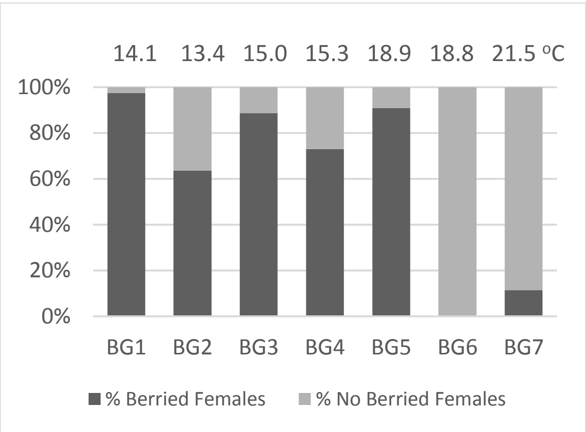

Fig. 3 Percentage of berried females during the period of study with the sea surface temperature (ºC).

3.3 Fecundity

The fecundity differed for the different states of egg development, with a decrease in fecundity with egg development (orange > yellowish > grey) (Figure 3). Significant positive relationships were found between fecundity and CW and CL. CL ranged from 15,43mm to 21,37mm (Stage I), 15,91mm to 21,85mm (Stage II) and 15,32mm to 20,51mm (Stage III), while CW ranged from 15,20mm to 20,65mm, 15,41mm to 21,42mm and 15,34mm to 20,07mm respectively for the Stage I, II and III eggs. The minimum and maximum values observed in the total number of eggs were 8880 to 35334, 12533 to 45201 and 4536 to 26448 respectively for the different stages of egg development (Figure 4).

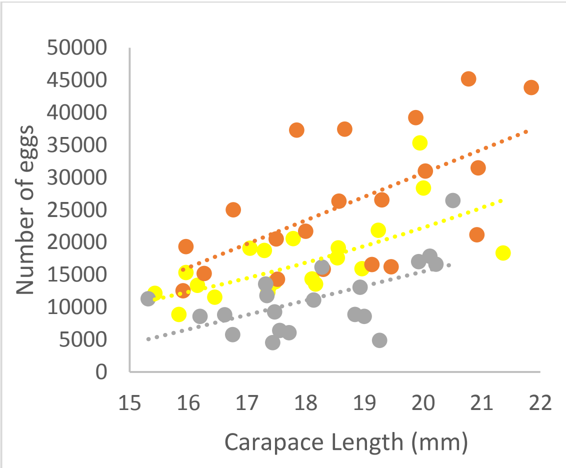

Fig. 4. Power model fit between the number of eggs and carapace length for females with yellowish eggs (yellow circles) and linear model fits for females with orange and grey eggs (N=20).

The highest number of eggs was observed in the orange colored eggs stage of development with orange coloration eggs. On the other hand, the smallest values were obtained in grey colored eggs, coinciding with the last development state of the eggs.

Table 1 shows the estimated parameters of the fitted power and linear models and the significance of r for models applied to the fecundity – CW and fecundity – CL data for the three egg development stages (Table I).

Table I: Parameters of the power and linear models fitted to the fecundity-CW and fecundity-CL data for the three egg development stages and associated r values.

Model	Coloration	Parameters				
Carapace Length		a	b	R^2	r	Significance
Power	Yellowish	7.984	2.648	0.502	0.709	p<0.001
Linear	Yellowish	-30231	2656	0.449	0.67	p<0.01
Power	Orange	11.448	2.616	0.379	0.6156	p<0.01
Linear	Orange	-42265	3646.7	0.38	0.6164	p<0.01
Power	Grey	2.909	2.819	0.224	0.473	p<0.05
Linear	Grey	-29132	2230.1	0.342	0.585	p<0.01
Carapace Width		a	b	R^2	r	Significance
Power	Yellowish	3.327	2.98	0.51	0.714	p<0.001
Linear	Yellowish	-35760	3049	0.46	0.678	p<0.01
Power	Orange	29.193	2.321	0.33	0.574	p<0.01
Linear	Orange	-35096	3368.6	0.335	0.579	p<0.01
Power	Grey	0.415	3.53	0.344	0.587	p<0.01
Linear	Grey	-35107	2641.6	0.453	0.673	p<0.01

3.4 Number of eggs per 1 gram of sample

Despite the variation in the total number of eggs with respect to the carapace measurements, the number of eggs per gram of female was constant across all sizes. Linear regressions of the number of eggs per gram of female against CL gave non-significant ($p>0.05$) r values of 0.341; 0.189 and 0.110 for yellowish, orange and grey eggs respectively, reflecting a horizontal trend (figure not shown). The mean total fecundity values obtained for each stage of development were 7711.1, 10004.0 and 4837.6 eggs per gram of female respectively for stages I, II and III eggs. With increasing size, individuals have proportionally greater numbers of eggs. Egg size did not vary between individuals, but it differs between the stages of development. Differences between the first two stages with respect to the last one were observed, in which the total number of eggs was lower for the same amount of sample (1g). In this case, the total number of eggs is lower due to a higher density of eggs produced by a further development of the eggs.

4. DISCUSSION

The sampling method used in this study proved to be effective, providing adequate numbers of undamaged individuals for the biological studies. However, it should be noted that earlier trials in winter months resulted in few or no captures. This is probably due to low activity or feeding levels at lower temperatures (less than 13ºC), resulting in low attraction rates to the baited stakes. Significant catches started to be made in February when the highest proportions of berried females were found. Thus, it can be concluded that the reproductive period probably starts in winter, with a peak in February-March. An alternative sampling method, such as a dredge for bivalves, would be required for the coldest months of the year.

P. latipes begin brooding in winter, as is the case for other small portunid species from the nearby Northwestern Mediterranean, *Liocarcinus depurator* (Abelló, 1989) and *L. arcuatus* from Northwestern Spain (Muiño et al., 2000). The breeding season of P. latipes extends to the spring, with a marked decrease in the proportion of berried females by June, with water temperature above 20ºC.

As in other portunid species (Abelló, 1989; Muiño, 2000), fecundity was high and highly variable for similar sized crabs. Fecundity values for similar size ranges of *L. arcuatus* and *L. depurator* are comparable (Abelló, 1989; Muiño, 2000).

The fecundity of the earliest stage eggs (yellowish color) was lower than that of the intermediate stage (orange color). This may be due to the fact that first stage eggs were still being produced. The decrease in numbers of late stage eggs (grey color) could be attributed to egg losses over time, since the crabs live in the turbulent surf zone and bury in the sand. Thus egg loss is expected to happen. A decrease in the number of eggs per brood with egg development has been reported for other portunid species such as *L. arcuatus* (Muiño *et al.,* 2000).

The work presented here is part of a larger study on the population dynamics and distribution of *P. latipes* along the coast of Portugal. Ongoing work includes analysis of length frequency distributions for estimation of growth parameters, estimation of abundance based on mark-recapture studies, estimation of density from dredge surveys, mapping of the distribution of the species along the coast of Portugal and analysis of sediment characteristics in different sampling locations.

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