First Report

of the implementation of the FIP

Spanish crayfish, *Procambarus clarkii*, with fyke nets & traps in Andalusia and Extremadura

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Contents

1 Executive Summary

FIP activities started in August 2021, with field work and data collection carried out in Andalusia Guadalquivir basin using fyke nets, a typical gear from the rice field fisheries. The eight months delay in the start of the FIP implementation hindered the work in Extremadura as the fishing season had already ended. Therefore, no trap targeting Spanish crayfish was sampled since this gear is only used at the lakes of the Guadiana basin. Field works were carried out in two different days in September and October at Andalusia rice fields and Alfocan facilities. Sampling data from Alfocan and South Ocean were also provided and analysed. Results shows a 1:1 sex ratio, and usually a normal distribution of crayfish length frequencies. However, both companies have different sampling measures procedures and these need to be aligned in a single established measurement. The team recommends the Postorbital Carapace Length (POCL) since it is the European measurement legally required for crustacean species. From this preliminary assessment there are several points that can be highlighted, namely the low proportion of bycatch of common carp juveniles at Andalusia rice fields and the lack of fishers' engagement and organisation. In order to fully assess the Spanish crayfish fishery, further work and additional data needs to be collected.

2 Introduction

Commercial interest of Spanish crayfish, also called red swamp crayfish, *Procambarus clarkii*, began in the late 1800s in Louisiana. The development and improvement of transportation and cold storage shifted the consumption of crayfish from rural areas to higher volume markets in the US and beyond [1]. By the mid-20th century experiments to farm crayfish began to grow in order to provide a more dependable source [1]. Since then, *P. clarkii*, has been introduced worldwide quickly becoming the most widespread crayfish species [2].

For centuries crayfish has had considerable gastronomic interest in Spain. The North American species probably arrived into the country in 1958, when high mortality rates of the native crayfish were detected, possibly related with the attempt to introduce new species [1]. Spreading rapidly across the Iberian Peninsula, crayfish caused severe impacts on aquatic species and ecosystems [5]. Several crayfish species have been introduced for commercial purposes in Spain (Fig.1), with different levels of success [3]. In 1974, the Spanish Government, under the Ministry of the Environment supervision, introduced *P. clarkii* in the Guadalquivir rice fields with great success, in order to improve the development of the local socio-economy [4].

Fig.1. Introductions of exotic crayfish species in Spain [3].

2.1 Habitat and ecology

Procambarus clarkii was originally distributed from northern Mexico to Florida, and north to southern Illinois and Ohio [1, 4]. It can be found in lentic and lotic freshwater habitats: sluggish streams and lentic habitats, swamps, ditches, sloughs and ponds, especially in vegetation and leaf litter, avoiding high flow streams and ditches [1]. Highly territorial, it exhibits aggressive behavior among its own species. Burrows during drought or cold periods, and it feeds on insects, larvae, and detritus with a preference for animal matter [1]. Its life cycle, approximately 5 years, is well suited to the annual spring flooding and summer dry season's common to large river systems and floodplains. However, in Spanish marshes and rice fields (Fig. 2) [1, 3], due to the fact that its reproductive period is dependent on both environmental and endogenous physiological factors, it can change between different regions [6]. *P. clarkii* mating occur in open water, and the eggs remain attached to the female abdomen buried in the mud until it spawns in open waters. Burrowing activity for reproduction could occur along the year [1]. Depending on size and condition of the female, the number of eggs laid varies between 200 and 500 per hatch [1]. It is a fast-grower with 21 incubation days, growing up to 2 cm after one month and up to 8 cm length in three months, in a range of temperature that can vary between 10-22ºC to >30ºC [1]. Anastácio *et al.* (1995) followed several *P. clarkii* cohorts in the rice fields of Mondego River in Portugal, where Postorbital Carapace Length (POCL) size and age structured were studied (table 1).

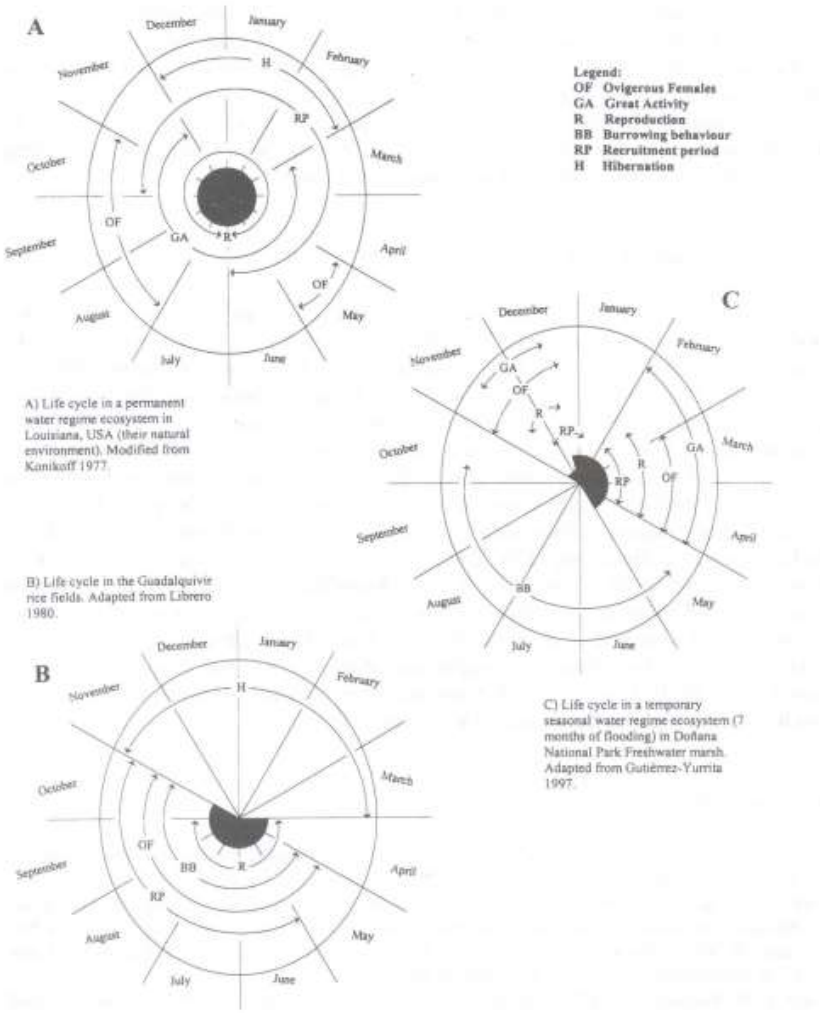

Fig.2. Life cycles of Spanish crawfish in the lower Guadalquivir marshes and its natural environment [3].

Table 1. Evolution of the average POCL in *P. clarkii* (adapted from Anastácio *et al.*, 1995)

POCL (mm)	*Age (days)*
0 -- 10	0 -- 100
10 -- 20	100 -- 200
20 -- 30	200 -- 300
30 -- 40	300 -- 400
> 40	> 400

Procambarus clarkii is a key species in the function of aquatic ecosystems, as it physically alter its environment and changes the availability of resources for other species [3]. By reducing the

aquatic vegetation cover that favours the development of phytoplankton communities, it changes the ecological balance by increasing the turbidity of the water [1, 3].

2.2 Spanish legislation and the crayfish fishery

In order to support the Directives 92/43/CEE[1], 2000/60/CE[2], 2008/56/CE[3] and 2009/147/CE[4], Regulation (EU) N 1143/2014[5] of 22 of October establishes standards to prevent, minimize and mitigate the adverse effects of invasive alien species on biodiversity and associated ecosystem services, on human health and security, as well as to reduce their social and economic consequences. The regulation in its article 9, establishes in exceptional cases, including those of a social or economic nature, the possibility of issuing licenses to empower institutions to carry out activities other than those of ex situ research or conservation, with invasive alien species. After the publication of Royal Decree 630/2013[6], which regulates the Spanish Catalog of Invasive Exotic Species, the Autonomous Community of Andalusia approves the Order of 6 of May 2014 on cessations adapted to the new legal conditions and management issues that affect inland fisheries. In the above-mentioned order, fishing for *Procambarus clarkii* is prohibited, as the species is not included among those authorized for the exercise of inland fishing, as established in Article 2. However, given the socio-economic importance that crayfish food industry has had in the lower Guadalquivir region, its professional extraction was allowed [7]. The crayfish fishery is regulated by specific regulations on health and consumption, and is limited to the geographical area of Almonte, Hinojos, Aznalcázar, Villamanrique de la Condesa, Isla Mayor, La Puebla del Río, Coria del Río, Los Palacios and Villafranca, Utrera, Las Cabezas, Lebrija, Trebujena and Sanlúcar de Barrameda marshes',[7] and managed by Order of 3 of August 2016[7] on the species control plan for Marisma del Guadalquivir, and by Resolution of 25 of October 2016[8] on the control plan for Extremadura.

[1] https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=celex:31992L0043, accessed at 20/10/2021
[2] https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=celex%3A32000L0060, accessed at 20/10/2021
[3] https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=CELEX%3A32008L0056, accessed at 20/10/2021
[4] https://eur-lex.europa.eu/legal-content/PT/TXT/?uri=celex%3A32009L0147, accessed at 20/10/2021
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32014R1143, accessed at 20/10/2021
[6] https://www.boe.es/buscar/doc.php?id=BOE-A-2013-8565, accessed at 20/10/2021

[7] https://www.juntadeandalucia.es/boja/2016/152/BOJA16-152-00030-14325-01_00096695.pdf, downloaded 20/10/2021
[8] http://doe.juntaex.es/pdfs/doe/2016/2200o/16061720.pdf, downloaded 20/10/2021

Therefore, the industry associated to this crayfish fishery is based in the lower Guadalquivir [3]. According to information obtained personally with the producers, half of the crayfish catch is supplied by fishers from Andalusia region, more specifically Isla Mayor. The other half is equally distributed between fishers from Extremadura region (Guadiana) and Portugal. There are no fisher's association or other business organizations associated to the crayfish fishery.

During 2015, processed *P. clarkii* amounted to 4 539 tons, corresponding to 21,08 million euros [7]. Spanish crayfish is appreciated for being a 100% natural-wild origin product and for its industry which has achieved differentiation in the market through the implementation of high standards of food quality (with ISO, BRC and IFS certifications), compared to the lower price of the Chinese product [7]. In 2015, a total of 798 jobs were associated to crayfish: 539 fishers, 209 workers in processing and marketing and 50 workers in auxiliary companies [7].

3 Work plan

FIP activities started in August 2021 with an eight months delay of what was initially planned, compromising some of the tasks, namely the sampling *in situ* of Extremadura fishing sites. The following planned FIP tasks were carried out:

Gathering Information (August 2021 – November 2021)

- Literature review
- Biology and stock information

Experimental planning (September 2021 – October 2021)

- Defining sampling areas and points
- Preparing sampling material

Data collection *in situ* (September 2021 – October 2021)

- Collecting biological data (size, weight, sex, behavior, habitat, geographic position) from crayfish and bycatch:
    i. Fishery
    ii. Processing plants

Data analyses (October 2021 – December 2021)

- Biological data compilation and analysis

- Review of sampling planning
- Bycatch identification and characterization.

Reporting and project management (August 2021- December 2021)

- Drafting report
- Managing activities
- FIP reporting (August, January)

4. Results

The first visit to the production facilities occurred on the 21st of September (Fig. 3), where a first identification of the rice fields where fishing occurs was made. In addition, the entire production system of two processing plants was observed, from the arrival of the catch by fishers until different final products were obtained. Also, a first meeting with Federación de Arroceros de Sevilla at Andalusia, which is one of the identified stakeholders, was made on September 21, where the FIP was presented.

Fig.3. First visit to the fishery site and Alfocan's production facilities, 21of September 2021.

Field work was conducted on the 8th of October to collect fishery data *in situ*, including bycatch evaluation, and at the producer facilities. Catch data were collected following a fisherman during one day of his normal fishing activity on Isla Mayor rice fields in Andalusia.

At Alfocan facilities, data were collected (size measurements a) and c) as shown in Fig.4; and sex ratio) at the arrival point where fishers deliver their catches. Since individuals' lengths have been measured differently in each factory, which is also different from what is recommended for crustaceans' species (Fig. 4), two different measurements were taken in order to estimate a

conversion factor between measurements. Data from South Ocean was provided to the team only in December. At this point the fishing season had already ended, since during the winter crayfish buries in the sediments, and thus a different but comparable measurement was not taken. Nevertheless, two attempts to find specimens at Portuguese water courses were carried out (December 15 and 16), but without success as the hibernation season had already started. Nonetheless, the data provide by South Ocean was compiled and the crayfish distribution size was assessed, but without a deeper analyse since there are no comparable measurement data, either collected in the field or in literature.

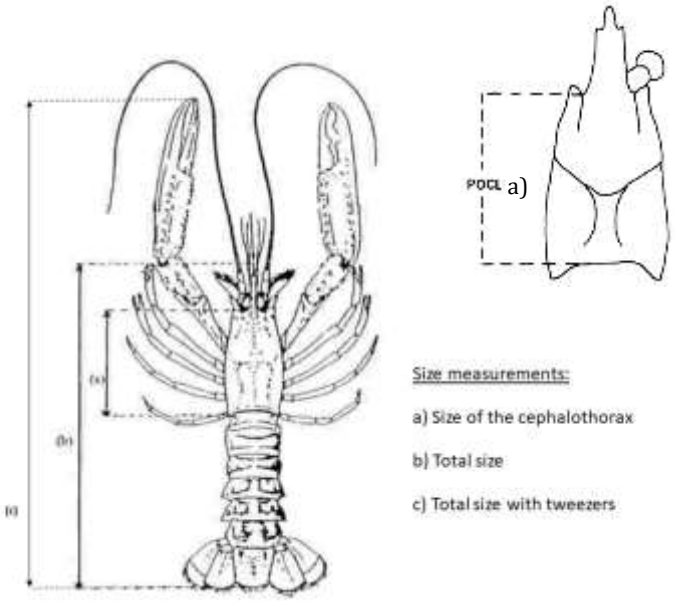

Fig. 4. Size measurements for crayfish, shrimps and lobsters: a) measure recommended for crustaceans' species (POCL – postorbital carapace length); b) South Ocean measurement (PRBT - point of the rostrum until the base of telson); c) Alfocan measurement (total length with tweezers).

4.1. Fisheries characterization *in situ*

The initial experimental design included the collection of data at each fyke net in order to have catch characterization of each net in the different fishing points. However, it was only possible to follow one fisherman during his normal fishing activity and he collected several nets at a time. Thus, a random sampling scheme was instead carried out, where data were treated globally.

i) Catch per Unit of Effort - CPUE

The fisherman followed had 200 fyke nets distributed along the rice field, and hauls in average 100 per day within a 2,5 hour period (fishing activity occurred between 8h30am and 11h00am), corresponding in average between 200 and 300 kg of crayfish per day. Based on this day of field work, a first draft CPUE was calculated using the number of hours each fyke net was in the water and number of fyke nets as proxies for fishing effort.

Total catch weight: 297kg

Number of fyke nets collected: 97

Fishing time per fyke net: 48 hours

Average *P. clarkii* weight per fyke net collected ($CPUE_{fyke\ net}$) = 297/97 = 3 kg/fyke net

$$CPUE(hours) = \frac{Average\ P.clarkii\ weight\ per\ fyke\ net\ collected}{Fishing\ time\ per\ fyke\ net}$$

CPUE = 3/48 = 0,052 kg/h

A CPUE of 0,052 means that in average 0.052kg of *P. clarkii* are caught per hour, or 3 kg of crayfish are caught per fyke net, depending on the fishing effort proxy used.

ii) Sex ratio

Random sampling showed a homogeneous distribution among both sexes with a slightly higher percentage of males, as featured in Table 1. No relationship was found regarding size and sex, which is also corroborated by literature [6].

Table 1. Crayfish sex ratio sampled *in situ*

	N	*%*
Total Sampled Individuals:	175	100
Number of females:	79	45
Number of males:	96	55

iii) Length frequency

Catches were distributed between 22 and 45 mm, with a peak at 36 mm, indicating that the catch was mainly composed of adult individuals, aged above 300 days [6].

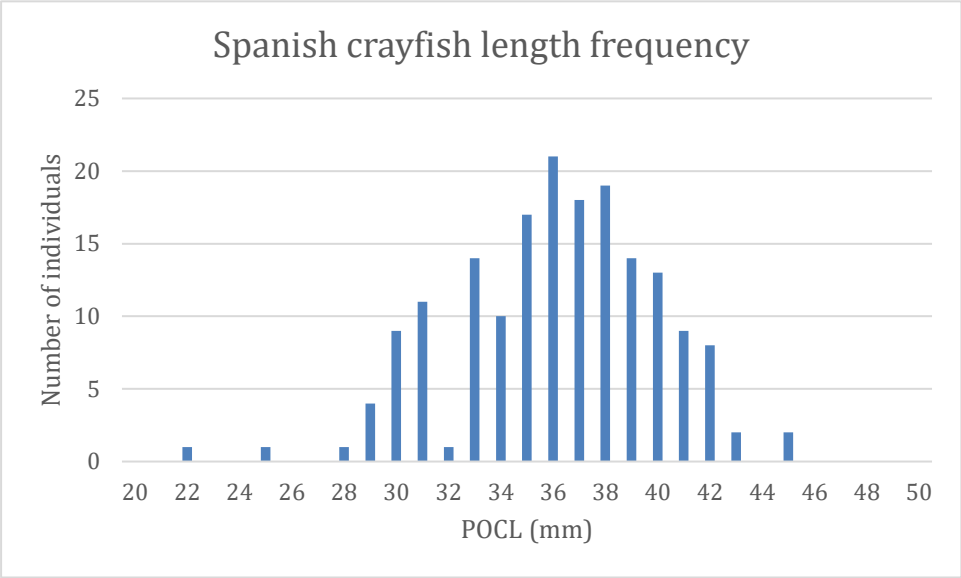

Fig. 5. – *Procambarus clarkii* length (POCL in mm) frequency sampled on the 8th October.

iv) Bycatch characterization

Bycatch was identified and measured from the 97 total fyke nets observed. Only juveniles of common carp (*Cyprinus carpio*) (Fig. 6), which is also an invasive species, were found. Common carp bycatch was low, with the majority of the traps only having the targeted species.

Fig. 6. *Cyprinus carpio* juvenile.[9]

A total of 167 individual carps were measured and sacrificed according to the procedures for invasive species. Bycatch proportion can be assessed using two different ways: i) Using total catch weight and estimating de number of *C. carpio* individuals caught for *P. clarkii* individuals; and ii) using the number of fyke nets sampled. The results of both methods are presented below

i) Using total catch weight and estimating de number of C. carpio individuals caught for P. clarkii individuals

Knowing that the total weight of crayfish caught was 297 kg and that the 2 kg sample (measured at Alfocan facilities) corresponded to 93 crayfish individuals, it was possible to raise the sampled fyke nets bycatch measured to the total catch, in order to estimate the total of individuals' bycaught. The resulting estimate constitutes the first proportion of common carp bycatch in the Spanish crayfish fishery.

1st – Estimate the number of Spanish crayfish individuals that corresponds to 297 kg

$$Number\ of\ crayfish\ caught\ = \frac{total\ weight\ sampled\ x\ number\ of\ individuals\ sampled}{sample\ weight}$$

Number of crayfish caught = (297x93)/2 = 13 811 individuals

2nd – Estimate the proportion of common carp accidentally caught per Spanish crayfish

$$Percentage\ of\ carp\ bycaught\ per\ crayfish = \frac{number\ of\ carp}{number\ of\ crayfish}\ x\ 100$$

Percentage of carp bycatch per crayfish = 167/13 811 = 1,2%

ii) Using the number of fyke nets sampled

Using the number of fyke nets sampled it is possible to estimate the catch frequency of common crap bycaught by fyke nets. The resulting estimate constitutes the first catch frequency of common carp bycatch in the Spanish crayfish fishery.

$$Carp\ catch\ frequency = \frac{number\ of\ carps}{number\ of\ fyke\ nets\ sampled}$$

[9] https://portal.ct.gov/DEEP/Fishing/Freshwater/Freshwater-Fishes-of-Connecticut/Common-Carp, accessed 20/12/2021

Carp catch frequency = 167/97 = 1,7 carp/fyke net

All *C. ciprius* caught were juveniles [8], most likely from the last spring spawn [9]. The maximun length found was 14,5 cm and the minimum 6 cm, with a peak at 7 cm and again at 10,5 cm.

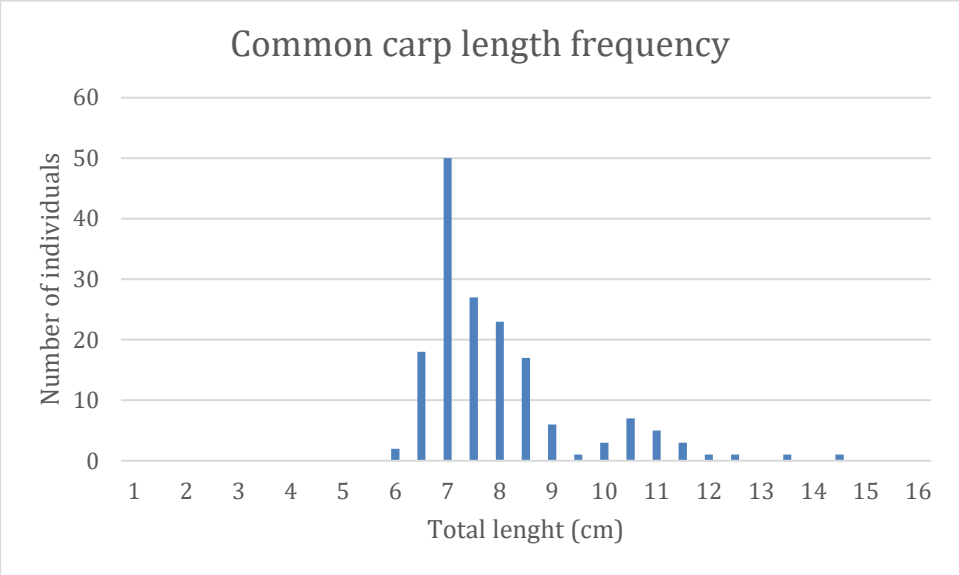

Fig. 7. – *C. carpio* catches length (total length in cm) frequency sampled on the 8th October.

v) Geographical distribution

Crayfish fishing in rice fields does not require a boat, as the gears are placed along water courses that can be accessed by foot (Fig. 8).

Fig. 8. Fishermen colleting one of his fyke net in a water channel in the rice field.

The possibility for accompanying a fishermen allowed for an insight on how fishing activity occurs and the area that a single fisher explores (Fig. 9). However, in order to get the full extent of fishing effort and gears it is necessary to have access to other fisher's data.

Fig. 9. Geographical distribution of fyke nets and fisher position every fifteen minutes, in a working day, between 8h30am and 11h00am.

4.2. Production characterization

Data collected by two producers, Alfocan and South Ocean, for the previous 2021 season was made available. Both producers have different methodology regarding their sampling process. Alfocan samples weekly (two or three samples per sampling day) while South Ocean samples once every month. Data from 1st September until 10th November were provided by Alfocan (weeks 35 – 45), while the data made available by South Ocean only includes two sampling days.

After the second site visit, Alfocan started to take two measurements to establish a conversion factor between POCL and total length with tweezers, and also started to use both ruler and caliper, to take the measurements. Regarding South Ocean, data were provided after the season ending. Therefore it was not possible to collect individuals' measures to obtain a similar conversion factor between POCL and fork length (see Fig. 4). For this reason, the analysis

presented below is mainly based on the data collected during the site visit to Alfocan facilities and the data provided by this producer. However length frequency and sex ratio were also assessed based on South Ocean data.

i) Sex ratio

Sex ratio and correlation with size were assessed using the total number of individuals sampled by Alfocan between week 35 and 45. As previously, no relationship was found between size and sex, and the distribution is homogeneous between both sexes (Tab. 2), with the number of females and males balanced in proportion near 1:1.

Table 2. Sex ratio of individuals sampled at Alfocan

	N	*%*
Total Sampled Individuals:	2384	100
Number of females:	1206	51
Number of males:	1178	49

ii) Length frequency

After the team visit to the Alfocan facilities, at week 40, the producer started to take two measurements (total length and POCL) in order to allow for an estimation of a correlation factor to apply to historical data.

Length frequency of individuals was calculated using data between week 40 and 45, where POCL measurements are available. A total of 1341 individuals were sampled. The length frequency reveals a normal distribution, with a minimum POCL size of 23 mm and a maximum of 48 mm, and a peak at 36 mm.

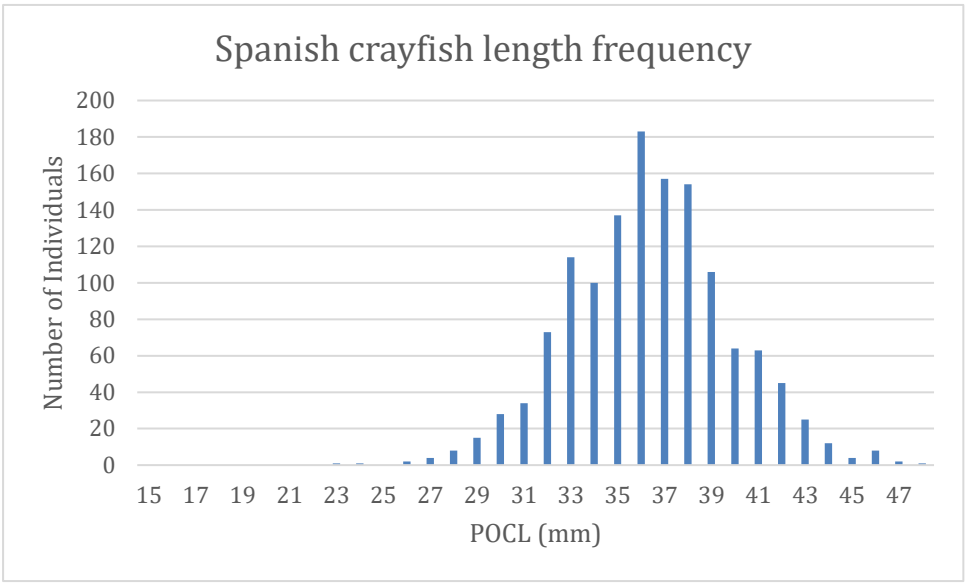

Fig. 10 – Length frequency (POCL in mm) of *Procambarus clarkii* sampled at Alfocan.

iii) Total length with tweezers and POCL correlation factor

A correlation test (Pearson's correlation test) was applied for POCL (independent variable) and total length w/ tweezers (dependent variable), with a correlation factor (r) of 0,77, which means that POCL and total size are 77% related with each other. A linear regression was then applied to assess a first conversion factor between total length w/ tweezers and POCL, given by the slope of the linear regression equation (Fig.11). The Conversion Factor assessed was 4,13; which means that total length w/ tweezers is in average 4,13 mm bigger than the cephalothorax. However, since the linear correlation factor (r^2) is 0,599 it means that, although a positive correlation exists between cephalothorax and total length with tweezers, it is not highly significant. Errors measurements could be decreasing the statistic correlation, since total length with the tweezers is an inaccurate measurement as the structures can easily break.

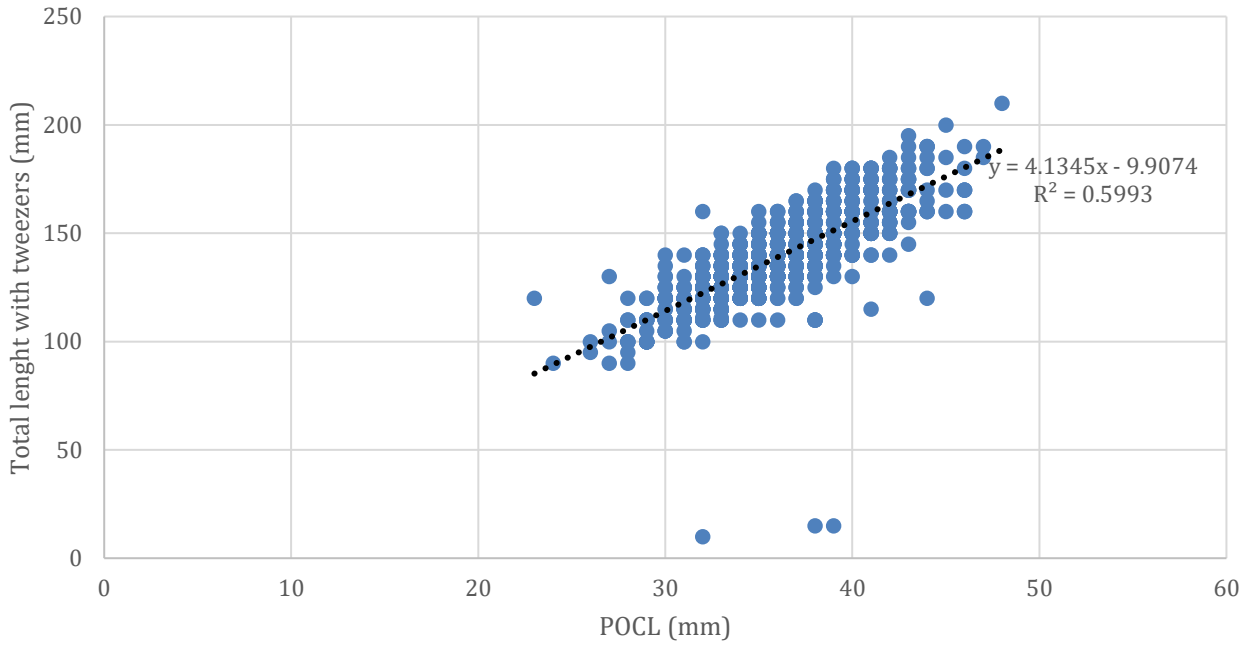

Fig. 11. – Linear regression between total length with tweezers and POCL measurements (mm) of *P. clarkii*.

iv) Length frequency comparison per weekly sampling

In order to know if there are significant differences between the measurements taken within each sampling day at Alfocan, total length with tweezers was compared between samples collected in each day and week. The results shows that there are no apparent significant differences between the measurements taken in the same sampling days, and there are slight differences between the weeks, with larger individuals appearing more frequently after October.

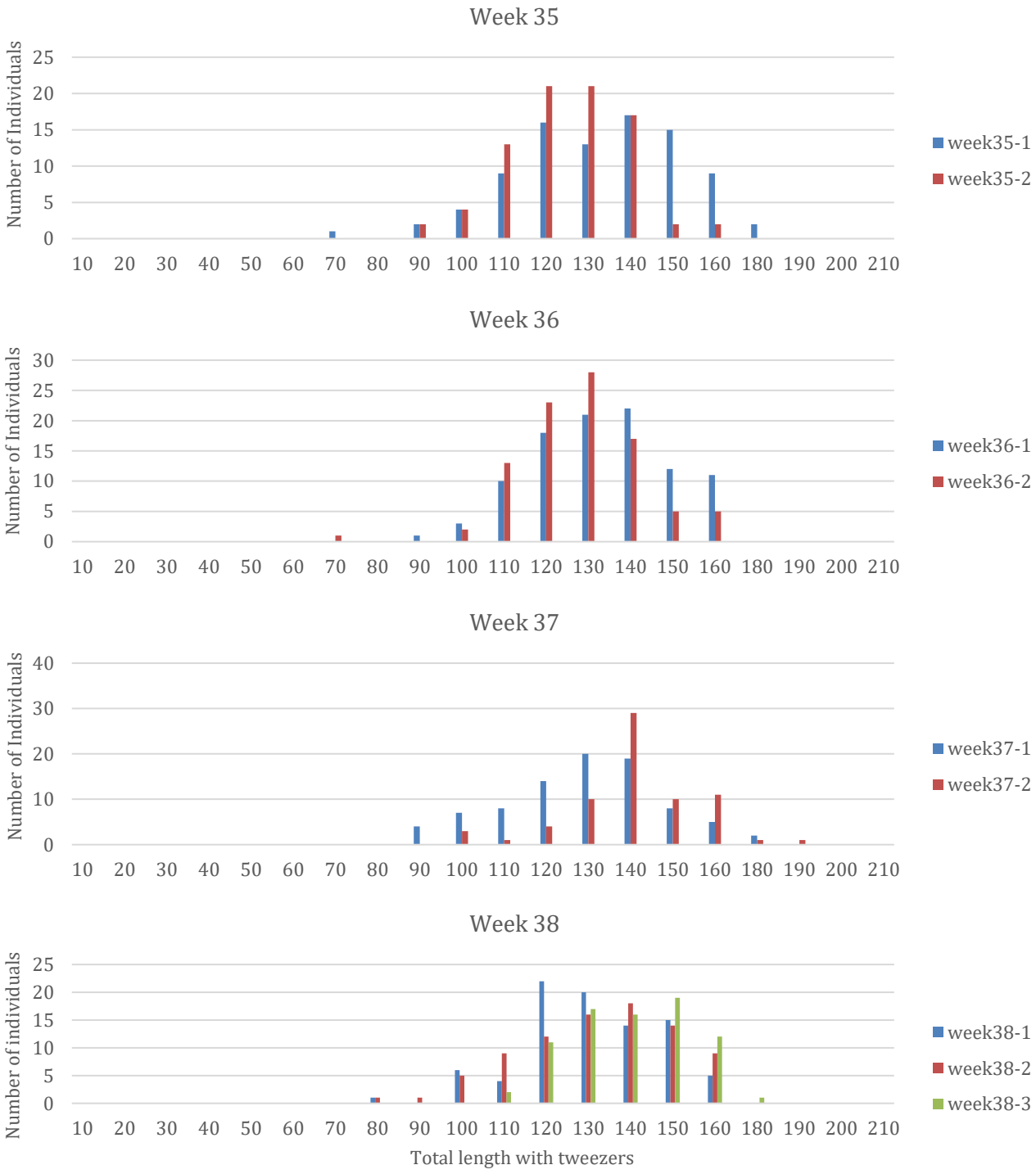

Fig. 12 a) Crayfish length frequency of all samples taken within a day of week 35 to 38.

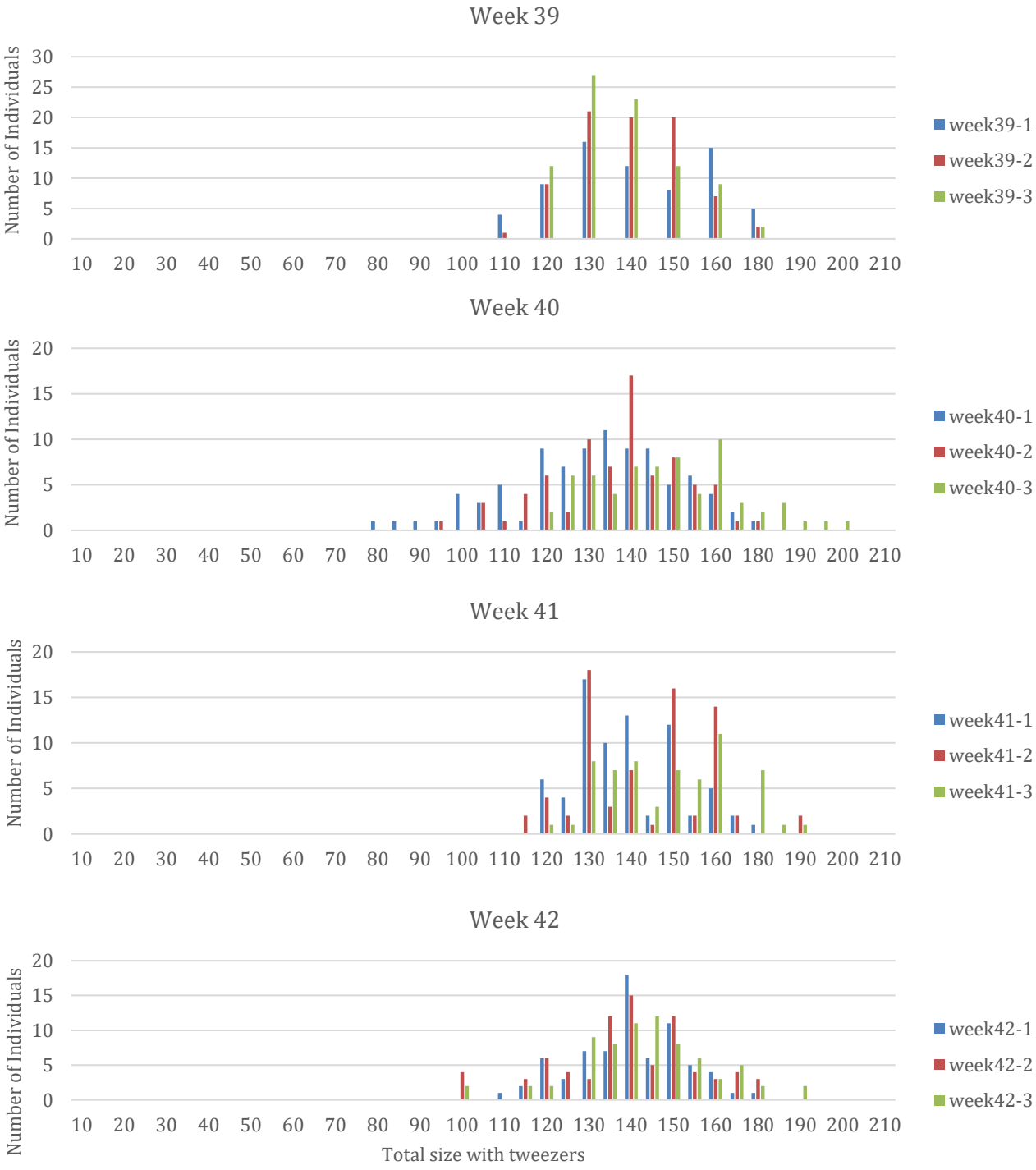

Fig. 12 b) Crayfish length frequency of all samples taken within a day of week 39 to 42.

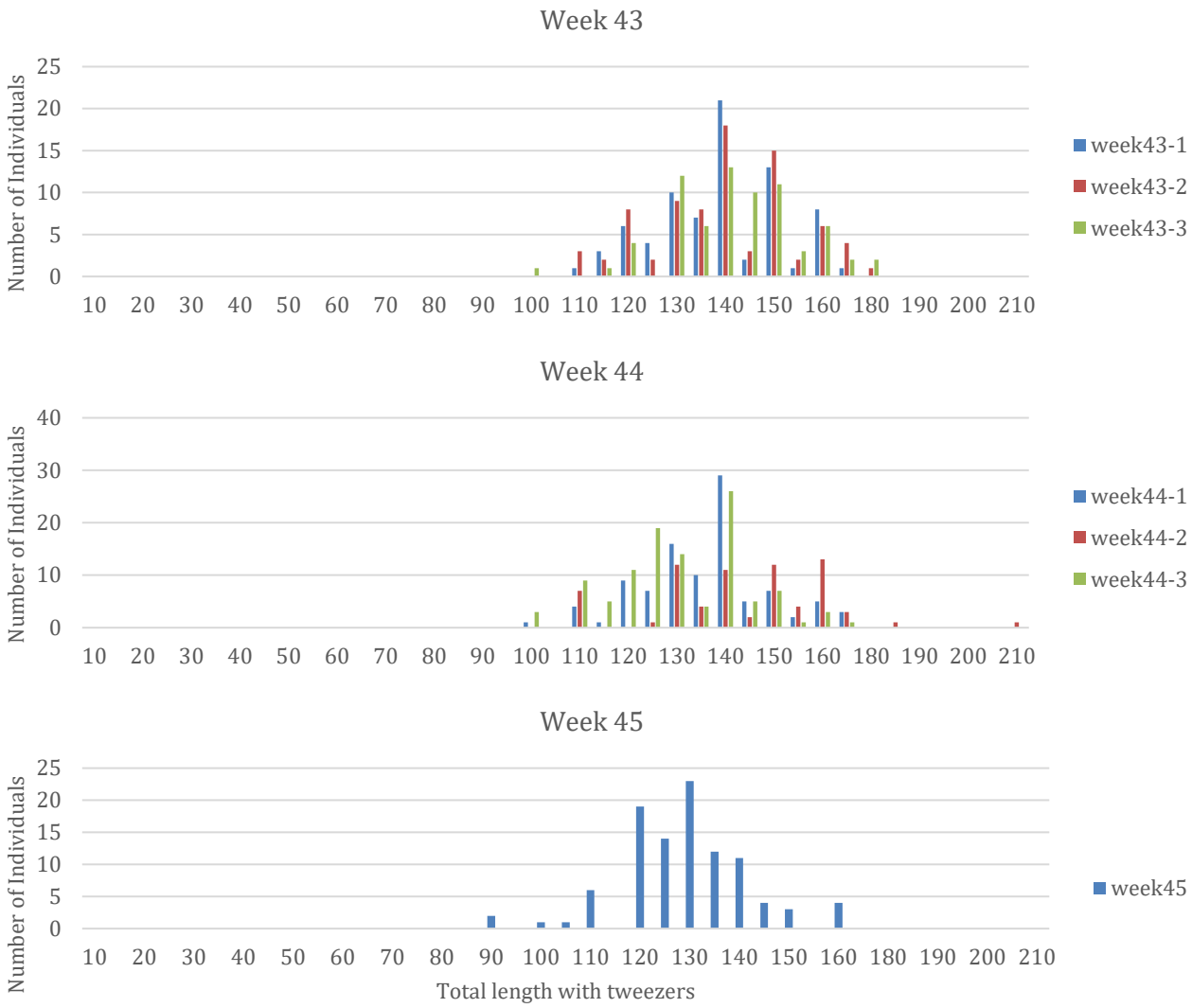

Fig. 12 c) Crayfish length frequency for all samples taken within a day of week 43 to 45.

v) South Ocean data analysis

It was not possible to obtain measurements to compare with the data provided by South Ocean using their measurement method, which is the length from the point of the rostrum until the base of telson (PRBT, see Fig.4). Since this producer only samples once a month, and the data provided concerns only two months (September and October), only two days were assessed. A total of 189 individuals were sampled for size (5 mm intervals) and sex distribution.

At South Ocean, sex ratio is similar with previous samples with a 1:1 proportion between females and males (Tab. 3). Also, length frequency is close to a normal distribution, as observed for

previous samples. Maximum size registered was 110 mm and minimum 30 mm, with the majority of individuals within 50 and 80 mm of total length, and an average size of 66,11 mm.

Table 3. Sex ratio of individuals sampled at South Ocean

	N	*%*
Total Sampled Individuals:	189	100
Number of females:	95	50.3
Number of males:	94	49.7

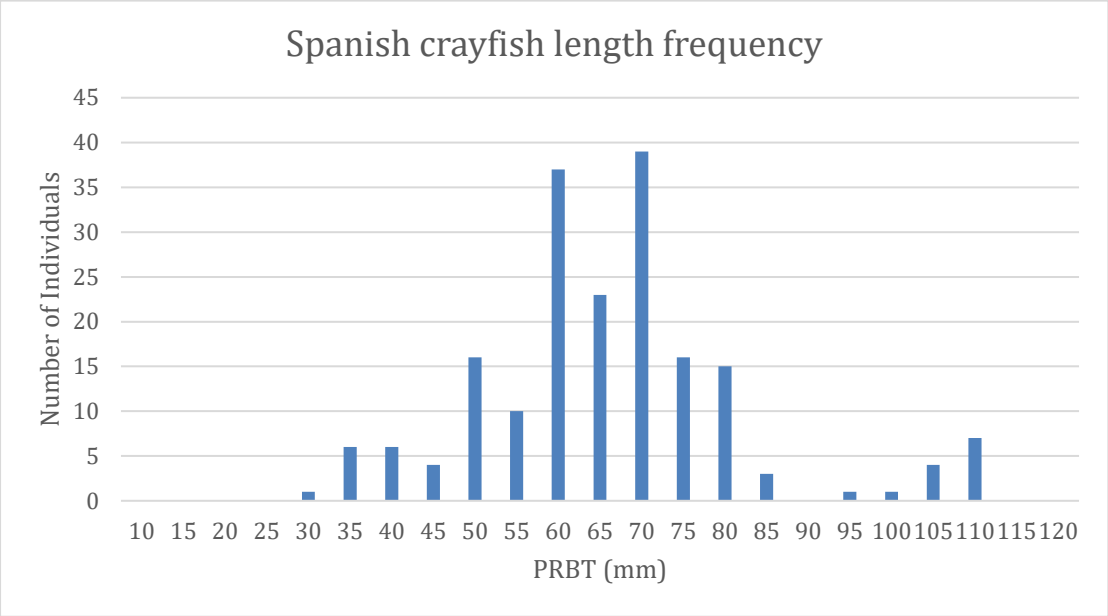

Fig. 13 – Length frequency (PRBT in 5 mm intervals) of *Procambarus clarkia* sampled at South Ocean.

5. Discussion

FIP activities started with a significant delay, hindering the beginning of field work in Extremadura. No trap targeting Spanish crayfish was observed, since this type of gear is used at lakes typical from the Guadiana basin. Field work and data collection was only possible at Andalusia's rice field fisheries with the use of fyke nets typical from the Guadalquivir basin.

Nevertheless, sufficient data was collected to do a preliminary analysis of catch distribution and bycatch characterization.

On the 21st of September a first visit to the rice fields where fishing activities occur was made, as well as to the Alfocan facilities, to acquire knowledge of the processing lines and control measures. During this first visit there was the realisation that the measures that Alfocan were carrying out in their weekly control were different of what is recommended for crustaceans' species in scientific literature. Alfocan was measuring total length with tweezers instead of Postorbital Carapace Length (POCL is the reference measure used in size-age structures studies [6, 8, 9]), which is an inaccurate measure since the tweezers are fragile structures prone to break. A second visit was then planned, in order to take individual measurements, and also to train Alfocan personnel to measure POCL, to allow for a conversion factor between the two measurements to be estimated.

On the 8th October a second visit was carried out to collect fisheries data. A fisherman from Andalusian rice fields was accompanied during his normal daily work, between 8h30am and 11h00 am, and a first assessment of *P. clarkii* catches was made. This fisherman had 200 fyke nets displayed along the rice fields channels (Fig. 8), and collects in average 100 per day, changing every day, which means that each fyke net operates 48h. During the field work, a total of 97 fyke nets were hauled, corresponding to a total catch of 297kg with an average of 3kg per fyke net. This allowed to estimate a first CPUE (catch per unit of effort) of the fishery. A CPUE of 0,052 was obtained, meaning that in average 0.052kg of *P. clarkii* is caught per hour. In order to estimate a more accurate CPUE it is necessary to obtain data regarding the number of fishers operating, the number of fishing gears currently in place, and its correspondent catches. A total of 175 individuals were measure, 45% were female and 55% were male, which shows a balanced sex ratio distribution. The majority of individuals measured had POCL between 30 and 40 mm, which may represent adult individuals aged more than 300 days [6], and there was no egg bearing females registered, which is in line with what is described in literature for its life cycle in the region [3].

Bycatch was assessed from all 97 fyke nets sampled and only common carp was found. A total of 167 individuals were measured, with an average size of 7,9 cm, corresponding to an early age of juvenile phase and probably from the last spring spawning season [9]. Bycatch was then

assessed using two approaches based in two different variables: 1 – total number of crayfish caught and 2 – the number of fyke nets sampled. The proportion of carp bycatch per crayfish was 1,2%, which means that 0,012 individuals of common carp were bycaught for each crayfish caught. On the other hand, using the fyke nets sampled, there are 1,7 common carp bycaught in each fyke net. Furthermore, as the team observed during the fieldwork, not all fyke nets had common carp inside. In order to get a deeper knowledge of bycatch distribution among the fishing area, more field work is needed to study in detail each fyke net catch. Nevertheless, both assessments are considerably low, especially bearing in mind that common carp is also a prolific invasive species in the same region. To the team's best knowledge this is the first study on bycatch characterization for the Spanish crayfish fishery.

After the second visit Alfocan stared to measure both POCL and total length with tweezers, in order to get sufficient data to assess a correlation factor between both measures. The data was later provided and analysed. A correlation was found between the two measurements ($r=0,77$), with a conversion factor of 4,81, but not highly significant ($r^2=0,60$), and thus more measurement may be needed to calibrate the Alfocan measurements.

Data provided by South Ocean requires future work as the data arrived only in December, with different measurements and methodology regarding frequency of sampling. This company measure total length from the top of the head until the base of telson (fig. 4) in 5 mm intervals. Although it was out of the fishing season, two sampling trips were carried out in Portugal to measure individuals with both PRBT and POCL. However, crayfish were already hibernating due to the cold and calibration was not possible.

In relation to the sampling frequency, one company samples 2 or 3 times in one day on a weekly bases with 1 mm intervals, while the other samples 1 time per month with 5 mm intervals. Although perhaps it is premature to conclude on the seasonal sampling frequency i.e. daily versus week versus month, as there is a need for more monthly data, there seems to be no significant differences between daily measurements. This leads to the conclusion that there is little need to sample several times within a day, and that perhaps that sampling effort could be directed to a different measurement measure being taken.

The two companies have different measurements and these need to be aligned, although both have equal sample size (2kg). It is unclear if national legislation requires a specific measurement

as there is no specification in legislation. Furthermore, it is unclear if a measurement procedure was detailed and agreed in the communications between the administration and the companies. Nevertheless, the European legally required measure is postorbital carapace length - POCL, while in the Portuguese legislation for freshwater species is PRBT, which is also the measurement that South Ocean have been taking. Therefore, it is recommended that both companies align their measurement and choose either PRBT or POCL, although we recommend for comparison with international studies that POCL is chosen.

Finally, regarding data transmission, a significant amount of time was spent inputting data in an editable database, at a very late stage of this study (data provided in December). The study would have benefited from this effort being otherwise spent on data analysis and gathering information and literature review. And we therefore suggest that future data should be transmitted already in editable format.

6. Conclusions and Recommendations

From this preliminary assessment fewer conclusions can be taken regarding stock status and the characterization of the fishery, particularly regarding fishing effort and species abundancy. Nevertheless, there are several preliminary points that can be highlighted, namely the lower proportion of bycatch in Andalusia's rice fields' fishery, but also the lack of fishers' engagement and organisation. In order to fully assess the Spanish crayfish fishery, the following recommendations ought to be considered:

1. A different sampling method should be considered to allow that each fyke net is sampled;
2. More data regarding fishers and fishing areas are required;
3. More measurements need to be taken during the season for calibration purposes;
4. A common reference measurement needs to be agreed between the companies and also with the Spanish administration;
5. Sampling effort should be refocused on different measurement procedures instead of daily frequency;
6. Data should be transmitted in electronic format in editable format (word, excel);
7. Data collection from Andalusia region should be ensured;

8. Data collection and field recognition from Extremadura region should be initiated;
9. The engagement of fishers should be promoted to allow for fishery data to be collected.

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