FACULTAD DE CIENCIAS DEL MAR

UNIVERSIDAD DE LAS PALMAS DE GRAN CANARIA

PHENOLOGICAL STUDY OF *GRACILARIA CERVICORNIS* (RHODOPHYTA) POPULATIONS IN GRAN CANARIA (CANARY ISLANDS)

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Final work to obtain the Marine Science Degree

Phenological Study of *Gracilaria cervicornis* (Rhodophyta) Populations in Gran Canaria (Canary Islands)

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Date and Signatures

Student First tutor Second tutor

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Phenological Study of *Gracilaria cervicornis* (Rhodophyta) Populations in Gran Canaria (Canary Islands)

1. ABSTRACT

Gracilaria cervicornis (Turner) J. Agardh (Rhodophyta) is a specie currently included in the Catalog of Protected Species in Canary Islands, in the "Endangered Species" category, since it is found in Canary Islands, only in the locality of Bañaderos (Gran Canaria). In order to evaluate the state of their populations, the phenological monitoring of populations was carried out for seven months. In this study we have been able to distinguish all phases of the life cycle of *Gracilaria cervicornis*, highlighting the first obtainment in Gran Canaria of the male gametophyte. Regarding the evolution of the populations in Bañaderos locality where *Gracilaria cervicornis* remains, we can affirm that the trend is positive, since we found its presence in a greater number of puddles and number of individuals has increased significantly with respect to those outlined in the previous works.

Key words: *Gracilaria cervicornis*, phenological study, life cycle, Gran Canaria

2. INTRODUCTION

Over the last decade, marine ecosystems dominated by human kind are experiencing the loss of populations and species, with still unknown consequences (Worm, et al, 2009). It is here where studies of the relationship between diversity and the proper functioning of ecosystems have a lineal or log-lineal relationship, as the majority of the patterns in ecology demonstrate (Arenas et al., 2006).

With the rapid increase in the extinction rate of species, there has been an increased interest in determining how loss of biodiversity could alter the ecological processes, vital for the proper functioning of ecosystems such as, for example, productivity, decomposition, or the cycle of nutrients. Various studies have provided clear proof that biological communities regulate ecological processes, arriving to very different conclusions with respect to the diversity of species and that it is independent from the functioning of the ecosystem (Cardinale *et al*., 2000).

The preservation of biodiversity is a fundamental objective in any modern society. It is of great importance in a community such as the Canary Islands, where its biota has evolved in an isolated way, creating large quantities of endemics with over 3600 species and 600 subspecies distributed amongst plant types, fungi and animals (Cardinale et al., 2000). .

Red algae are a very important species in many different ways. Firstly, it constitutes a main part of primary producers in coastal zones around the planet, allowing for the creation of corresponding food chains. Secondly, red algae are not only consumed directly by mankind for nutrition (dulse, nori, irish moss, etc.) but also is primarily exploited commercially for compounds called phycocolloids (agar, carrageen, etc.) due to their high commercial value.

The genus Gracilaria (Gracilariales, Rhodophyta), along with Gracilariopsis, Gelidium and Pterocladiella, constitute one of the primary sources of agar (known as agarophytes) so that its populations are exploited in order to extract this compound known to have many beneficial purposes to mankind (microbiology, nutrition, cosmetics). This genus groups some 200 species with a majority distribution in temperate and warm waters around the world. In Canary Islands, 7 species are known to exist (Haroun *et al*., 2002) with reduced populations and only in the central and oriental islands.

Of the 7 cited species, *Gracilaria cervicornis* (Turner) J Agardh (Fig. 1) is found currently included in the Catalogue of the Canary Protected Species in the category "endangered", due to, as stated by the existing legislation, it has been necessary to redact a recovery plan. This plan has been executed and delivered to the Sub-Department of the natural environment in the Canarian Government for its approval and implementation in November of 2015. (Haroun Tabraue and Viera Rodríguez, 2015).

Gracilaria cervicornis (Turner) J. Agardh was cited for the first time for A.C. as *Gracilaria ferox* J. Agardh (Canteras beach, Gran Canaria) by Gonzalez-Henríquez (1991). As recognized in the "Seguimiento de poblaciones de especies amenazadas" (Haroun Tabraue and Viera Rodriguez, 2014) BCM & TFC phyc. Herbarium sheets and the consulted bibliography take into account diverse areas in Gran Canaria Island: Bocabarranco (Gáldar), La Puntilla (Las Palmas), Barranquillo (Bañaderos, Arucas), Punta Gaviota (Pozo Izquierdo, Santa Lucía), Las Bajas (Pozo Izquierdo, Santa Lucía), Punta del Corral (Pozo Izquierdo, Santa Lucía), Punta de Maspalomas-Playa de la Cometa (San Bartolomé de Tirajana). However, in the cited study, it is indicated that all the populations have disappeared except the Bañaderos one (Arucas, Gran Canaria), which reinforces its incorporation in Catálogo Canario de Especies in the category "endangered". Equally, it is cautioned

that citations for other islands of A.C. are identified incorrectly and likely correspond to other species.

As this is a specie of high economic interest with the possibility of cultivation and/or increasing its range of distribution, studies were undertaken by ULPGC to further understand its variability and genetic differentiation (Sosa Henríquez, 1991, Sosa et al., 1996) along with its farming (Robledo Ramírez, 1993).

In the "Plan de recuperación de *Gracilaria cervicornis*" , reference is made to the different factors of pressure that populations undergo, including the construction of new elements in the coastline, the degradation of the intertidal habitat, due to the presence of residual waste water and brines in areas close to its populations.

This Recovery Plan (Haroun Tabraue y Viera Rodríguez, 2015) includes a series of measures and recommendations necessary to obtain the final objectives, directed towards preserving the current populations of the specie and its habitats. The present situation of the specie is serious as it is in an imminent risk of extinction, for which it is necessary to establish a series of compelling and urgent measures. The validity of this plan is associated to the fulfillment of those proposed objectives, although it could be renewed automatically in case that those objectives are not fulfilled (recovery of *Gracilaria cervicornis* populations).

Figure 1: Image of *Gracilaria cervicornis* (recovery plan of *Gracilaria cervicornis*, 2015).

This plan is implemented in application of Real Decreto 139/2011, which considers it a necessary tool to be able to monitor the conservation state of this specie included in "endangered" category, studying changes in its area of distribution, occupation and presence, population dynamics and viability, habitat situation, including an assessment of the quality, extent, degree of fragmentation and main threats as well as the evaluation of risk factors. (Haroun Tabraue and Viera Rodríguez, 2015).

This recovery plan follows, therefore, basic measures: mapping of the present populations of *Gracilaria cervicornis* as well as the other populations relevant to the same community; characterization of the habitat and the proposals that follow for the recovery, conservation and management of the populations of *Gracilaria cervicornis.*

The cited plan is developed under the application of the Real Decreto 139/2011, where it is considered a tool necessary to execute a monitoring of the current state of conservation of this specie, included in the category “endangered”, studying the changes in its area of distribution both occupancy and presence, dynamics and population viability, the location of the habitat, including an assessment of the quality, expansion, degree of fragmentation and the main threats as well as the evaluation of risk factors.

PURPOSE OF THE PRESENT STUDY

The main objective of the present study consists in the identification of the present situation of *Gracilaria cervicornis* in Gran Canary Islands, identifying phases of its reproductive cycle and the phonological monitoring of them, in order to be able to establish the bases for the recovery of the populations where the species previously inhabited.

The study follows the recovering plan of *Gracilaria cervicornis,* which considers the objectives met when, at least, 3 ample, nuclei of populations exist in viable natural conditions with a sufficient enough capacity to reproduce and disperse to colonize other areas on the coastline in the north of the island (Plan de recuperación de *Gracilaria cervicornis*, Haroun Tabraue and Viera Rodríguez, 2015).

3. MATERIALS AND METHODS

This development of this work is based on bibliographic information found regarding this species, in particular, official documents and scientific articles. Additionally, a practical study was necessary on the coastline where samples of the specie were taken to be thereupon studied in a laboratory setting.

3.1. *Gracilaria cervicornis* (Turner) J. Agardh

Classification:

Phylum	Rhodophyta
Class	Florideophyceae
Order	Gracilariales
Family	Gracilariaceae
Genus	Gracilaria

3.1.1. TAXONOMICAL DESCRIPTION

According to Littler & Littler (2000), thalli arise from a discoid holdfast; erect thallus from 4-10 cm in high, red-brown to green-yellow in the upper parts; branches arising at close intervals in upper parts and giving plant a fan-like or corymbose appearance, terete o subterete, to about 2mm in width, with the apices obtuse to acute. In transverse section it is possible to recognise a cortex consisting of 2-3 layers of pigmented cortical cells, 2 subcortical layers and an inner medulla composed of large cells. Tetrasporangium are oval, cruciately divided, scattered in dense clusters just below surface of terasporangial plants (Fig. 2). Male gametophytes bear spermatangial in small vase-shaped cavities (Fig. 3). On the female gametophyte mature cystocarps are hemispherical and scattered all over the thallus (Fig. 4).

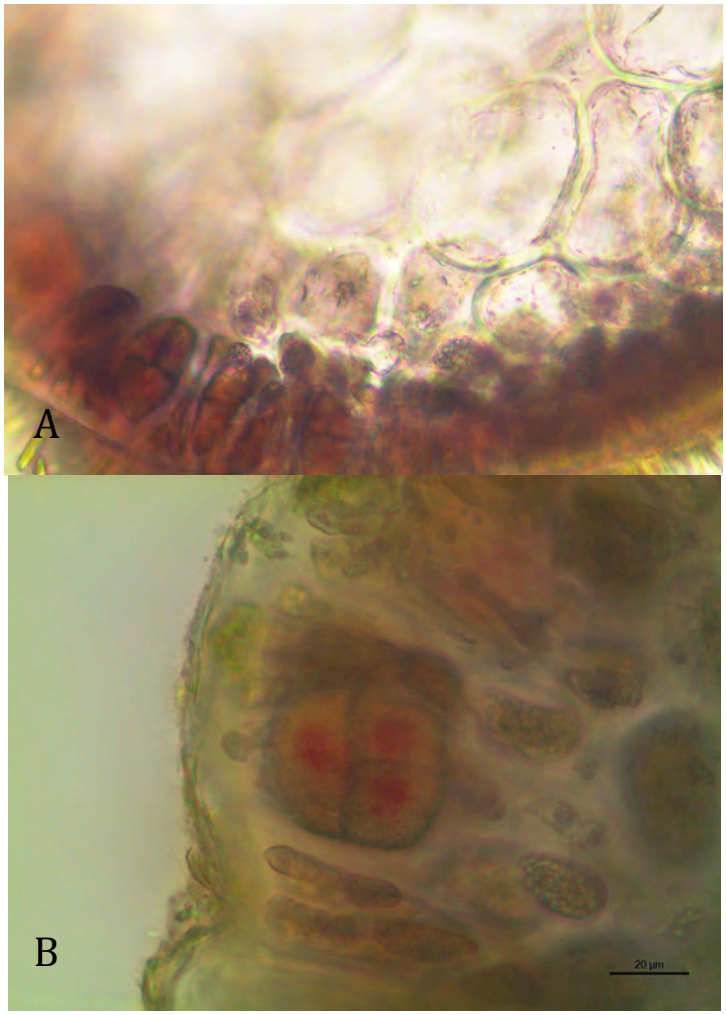


Figure 2: Tranversal cut of a *Gracilaria cervicornis* thallus A. Layer of tetrasporangium; B. Magnified image of a tetrasporangium (photographs taken personally in the ULPGC laboratory)

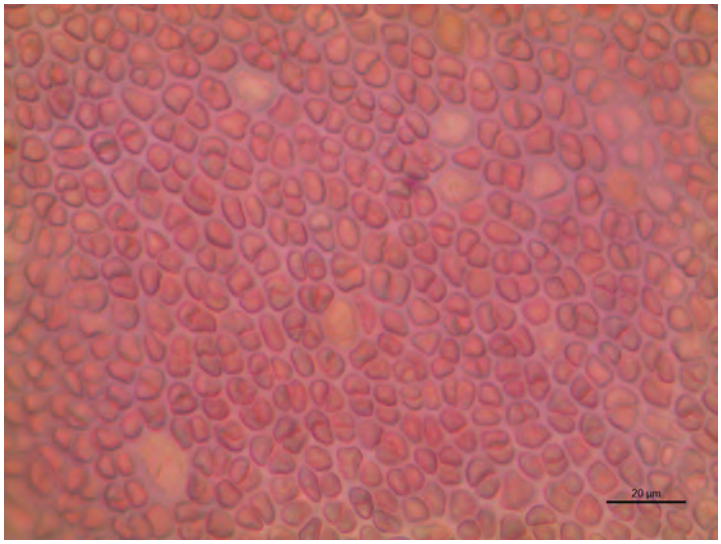


Figure 3: Empty spermatangial cavities of *Gracilaria cervicornis* male gametophyte (photograph taken personally in the ULPGC laboratory).

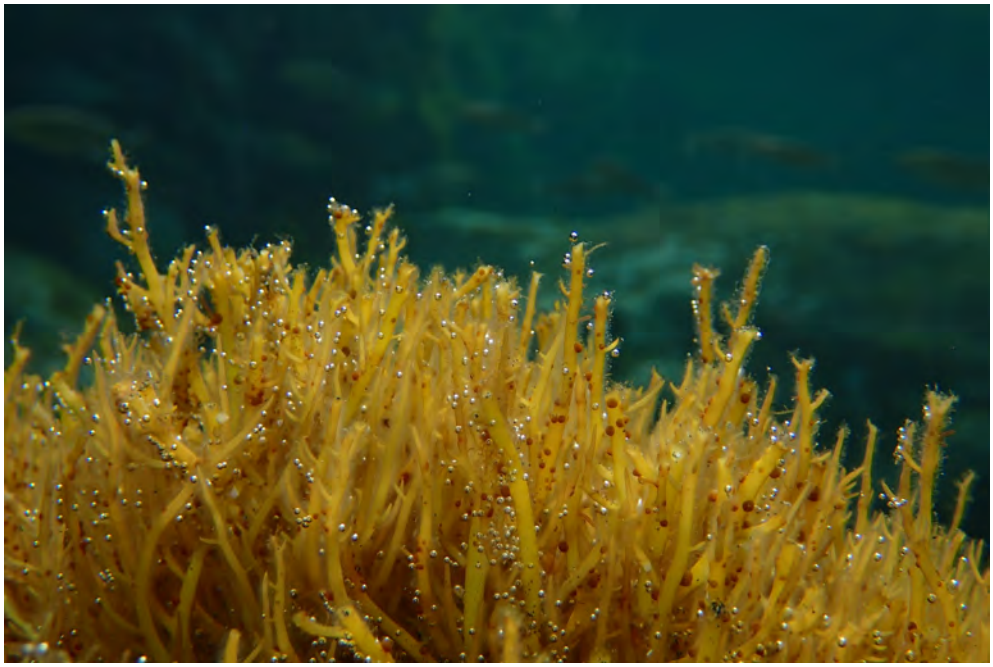


Figure 4: *Gracilaria cervicornis* with cistocarps in terminal branches (Haroun Tabraue and Viera Rodríguez, 2015).

Life history is according the Polysiphonia-type described for other species of Gracilaria (Fig 11) and very common for Rhodophyta with gametophytes (male and female) quite similar to sporophyte.

3.1.2. HABITAT

The populations of *Gracilaria cervicornis* are distributed mainly in medium coast, occupying both the funds as well as the edges of puddles areas. In these situations, they share and compete for their space with other animal and vegetative species such as: *Ellisolandia elongata* (J.Ellis & Solander) K.R.Hind & G.W.Saunders, *Jania rubens* (Linnaeus) J.V.Lamouroux, *Rytiphlaea tinctoria* (Clemente) C.Agardh, *Padina pavonica* (Linnaeus) Thivy, *Dictyota dichotoma* (Hudson) J.V.Lamouroux, *Sargassum cymosum* C.Agardh, Ulva clathrata (Roth) C.Agardh, *Caulerpa racemosa* (Forsskål) J.Agardh.

3.1.3. WORLDWIDE DISTRIBUTION

Europe: Italy, Spain, Central America and Carribean, Bermuda, Florida, Texas (USA), Mexico, Belize, Panama, Bahamas, Barbados, Costa Rica, Cuba, Dominican Republic, Jamaica, Puerto Rico, Antilles, Trinidad-Tobago, Virgin Islands, South America, Argentina, Brasil, Colombia, Venezuela; África, Cameroon, Ecuatorial Guinea, Ghana, Kenya, Morroco, Tunez . (Guiry & Guiry, 2014).

3.1.4. CURRENT SITUATION

The specie is not protected by national legislation currently (as indicated in Annex 1), but it is by local Canary legislation, registered in the catalogue of protected species under the category of "endangered".

3.2. SAMPLING

The study was undertaken in only one location, in the coast of El Puertillo in Bañaderos (Coordinates UTM: 28.149675, -15.540164) on the north coast of Gran Canaria in the municipality of Arucas (Fig. 5)

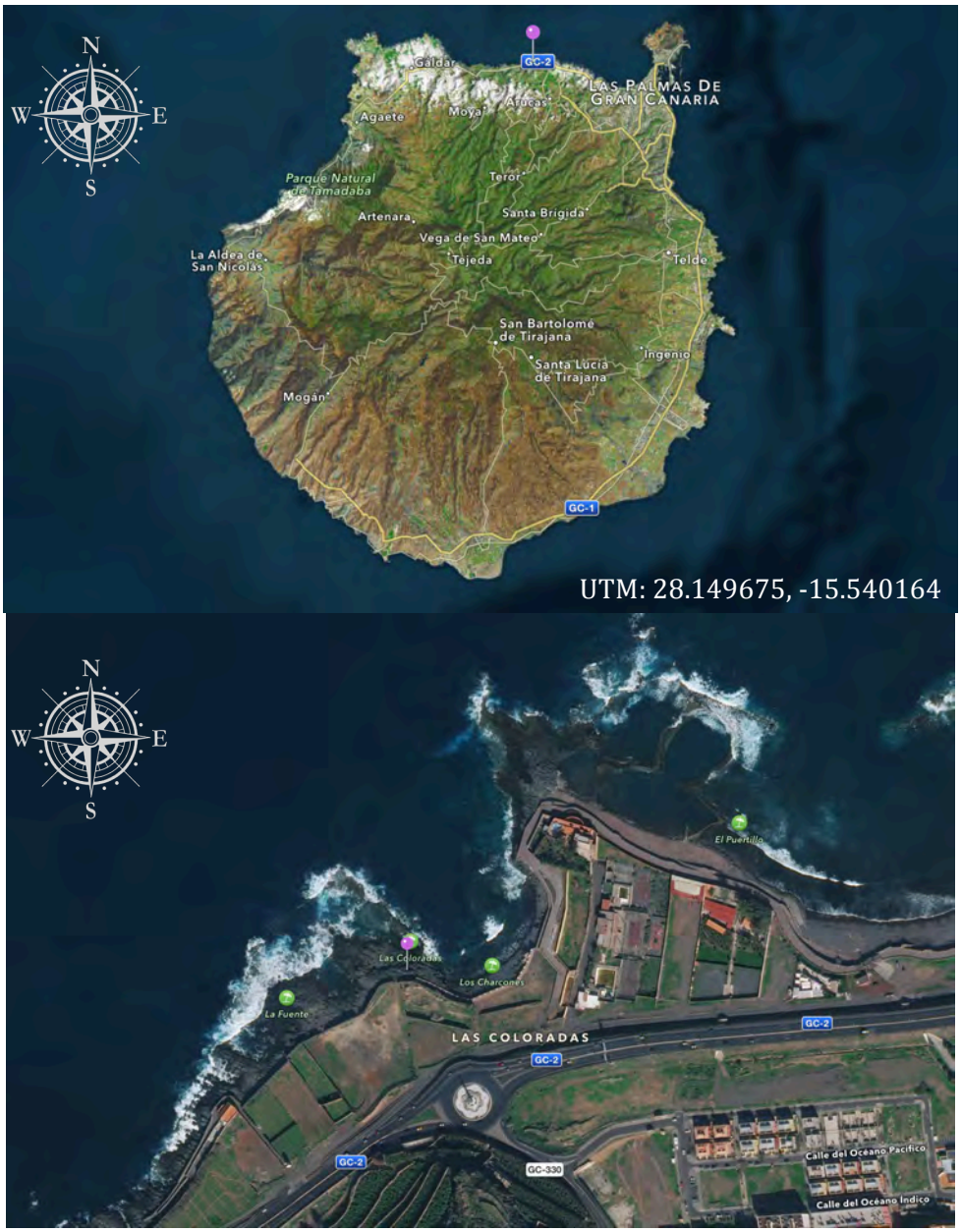


Figure 5: Location of Gracilaria cervicornis sampling with corresponding UTM coordinates (image made with Google Earth).

With the information obtained from the Plan de recuperación de *Gracilaria cervicornis* (Haroun Tabraue and Viera Rodríguez, 2015), sampling was carried out between January and June 2016. These samples were taken once a month coinciding with the maximum low tide for to be able to observe the exposed macrophytes (taking into account the table of tides). It is a rocky coastline in which there are numerous puddles, some of great dimensions such as the one called "Charco de la Pita". In addition to the aforementioned puddle, three smaller pools were sampled in which individuals were also found (Fig. 6).

Figure 6: Puddles where took place the sampling of *Gracilaria cervicornis*. A. Sampling area; B. Puddle nº3 with *Gracilaria cervicornis* individuals present; C. Photograph of *Gracilaria cervicornis* taken in puddle nº3.

The procedure to be followed was, firstly, to locate the individuals of *Gracilaria cervicornis* and then count them. A few specimens of the species were collected because of their scarcity and to be protected. Individuals of the companion species were also collected in order to identify them in the laboratory.

Once the samples were taken, they were transported to the laboratory in the building of Basic Sciences in the University of las Palmas de Gran Canaria, to be examined in further detail. First, they were deposited into a bucket, where the individuals of *Gracilaria cervicornis* were separated based on which pool they were taken from (1, 2, 3 or 4) (Fig. 7). Successively, they were separated from the other accompanying species using the same technique. All were placed in different numbered jars with seawater and formalin at 4%, preparing them to be conserved in darkness.

For its study, each sample was deposited in a Petri dish to determine each species with the help of a stereoscopic microscope (Wild M3Z). It was necessary to transversally slice the samples to be able to see the internal structure in the optic microscope (Olympus CX41) with built-in camera (Jenoptik ProgRes CT3). In any case, it follows the guideline that tells us the taxonomic key.

The different species were identified using the taxonomic key of Afonso Carrillo & Sansón (1999). For the current taxonomic nomenclature it has been used Algeabase (Guiry & Guiry, 2014).

After verifying *Gracilaria cervicornis* specie using the stereoscopic microscope, cross sections were made to determine the phase of the cycle in which each individual was.

Figura 7. Geolocation of the intertidal pools where took place the sampling of *Gracilaria cervicornis*. 1. Puddle nº1 (28º8'58.38"N; 15º32'27.22"O); 2. Puddle nº2 (8º8'58.35"N; 15º32'23.76"O); 3. Puddle nº3 (28º8'58.32"N; 15º32'23.72"O); 4. Puddle nº4 (28º 8'58.39"N; 15º32'24.12"O); 5. Pita's puddle (28º8'58.62"N; 15º32"26.77"O).

4. RESULTS

The results in this study are focused on the evolution of the specie *Gracilaria cervicornis* throughout the months sampled (January to July of 2016). Due to the little information that is in Gran Canaria, it was not able to establish a comparison in the number of individuals with respect to previous years. However, by making available the approximate location of the species over the past years, a comparison was able to be undertaken on their location.

A registry of the individuals of *Gracilaria cervicornis* found in Bañaderos coast was undertaken, counting the groups of individuals observed in pools 1, 2, 3 and 4 (Fig. 8). The population evolution of these communities was studied during the months of January to July, along with every separate pool. During the month of May, it was impossible due to the condition of the sea.

We observe how a significant difference exists in the different pools, being much more important in the pool nº 3 for the greater quantity of the individuals present from the first day of the simple. There is an important seasonal evolution since January, where we found temperatures of the cooler waters (18-21ºC) and where individuals were only found in pool 3. When the cold weather passes, the temperature of the sea starts to increase to a maximum temperature of 23-25ºC (Fig. 10). It is important to highlight that the access was difficult to pool nº 1, being closer to the infralittoral coast it is more frequently covered by the mar and for that reason primarily inaccessible. During the June sample, new pool was found with six groups of individuals, all of which were very epiphytic, mostly *Spyridia filamentosa* (Wulfen) Harvey.

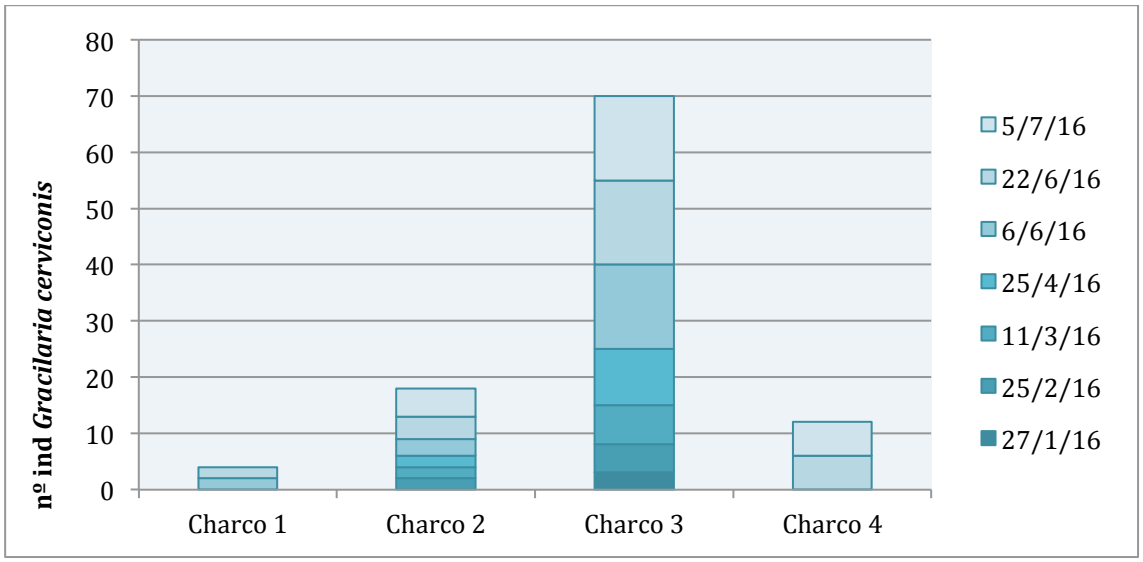


Figure 8: Number of individuals of *Gracilaria cervicornis* present the days of low tide between the months of January to July 2016 in the intertidal pools of Bañaderos, Gran Canaria.

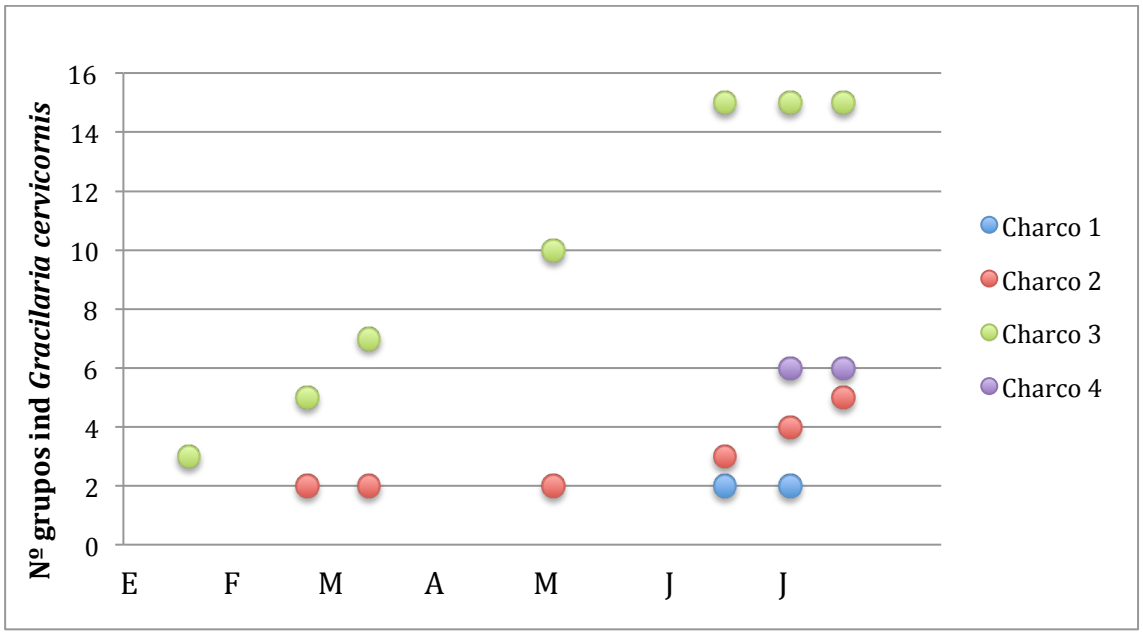


Figure 9: Evolution of groups of *Gracilaria cervicornis* individuals at different puddles off Bañadero's coast, Gran Canaria.

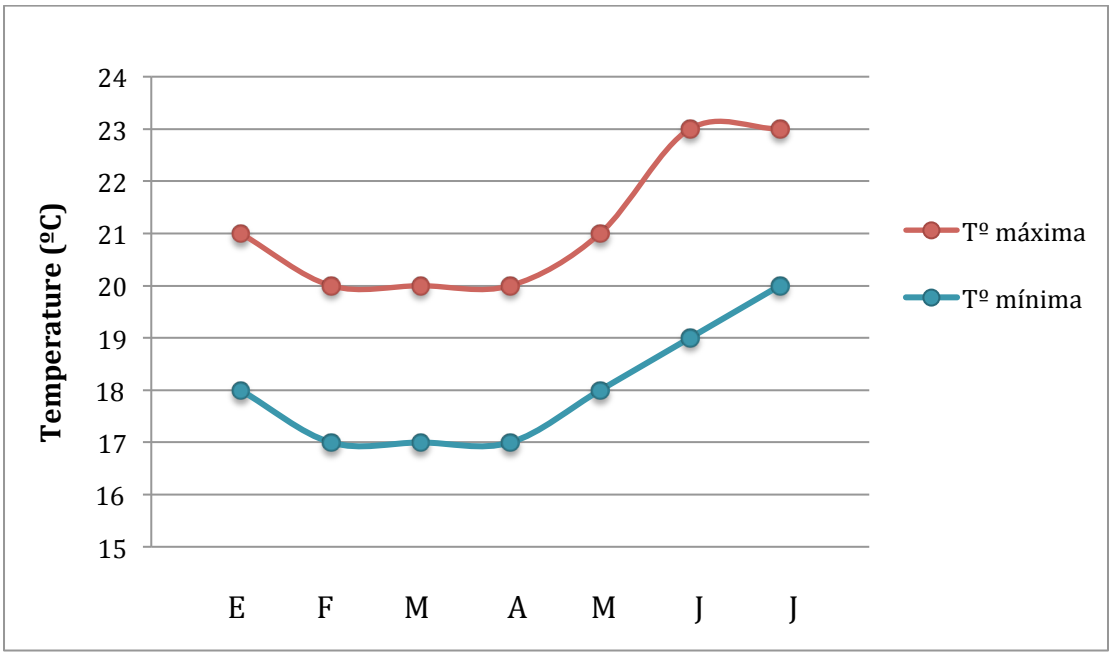


Figure 10. Evolution of the maximum and minimum temperatures of the water sampling in the municipality of Arucas, Gran Canaria. From January to July 2016 (seatemperature.info, 2016).

In addition to determine the number of individuals, the phenology of *Gracilaria cervicornis* (Fig. 11) was studied along with the phase in which each individual was found collected at distinct dates (Fig. 12 y 13).

The reproductive phase which was found with more frequency in this study was the gametophytic one, concretely the feminine recognizable by the cistocarps present. They were found in the first samples and in lesser quantity individuals of the tetrasporophytic phase and in the sample from February, a group of male gametophytes found for the first time in the study of the specie in Gran Canaria. These facts allow us to affirm, for the first time that in the populations found in Gran Canaria, the biological cycle of the species can be completed (Fig. 11).

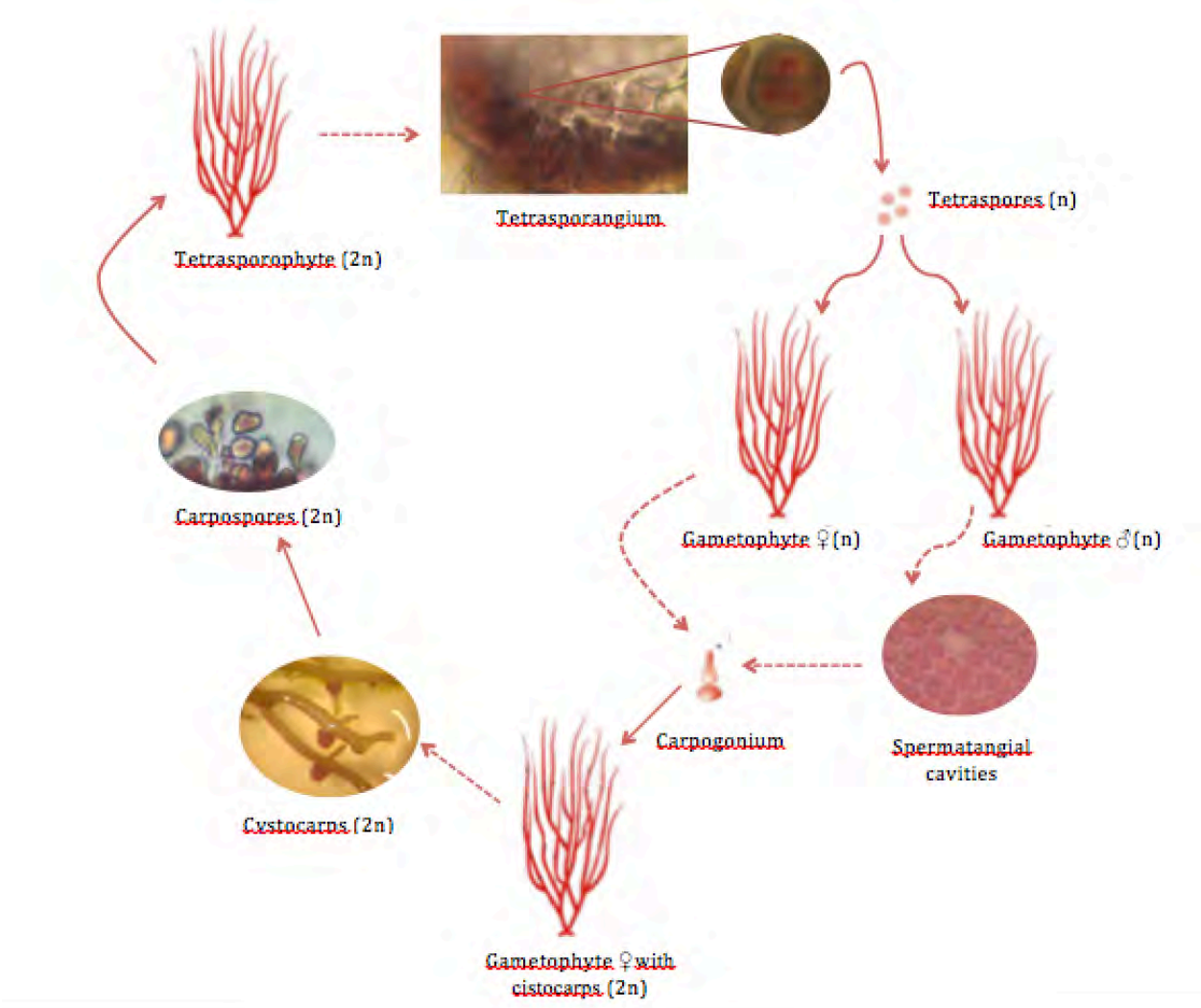
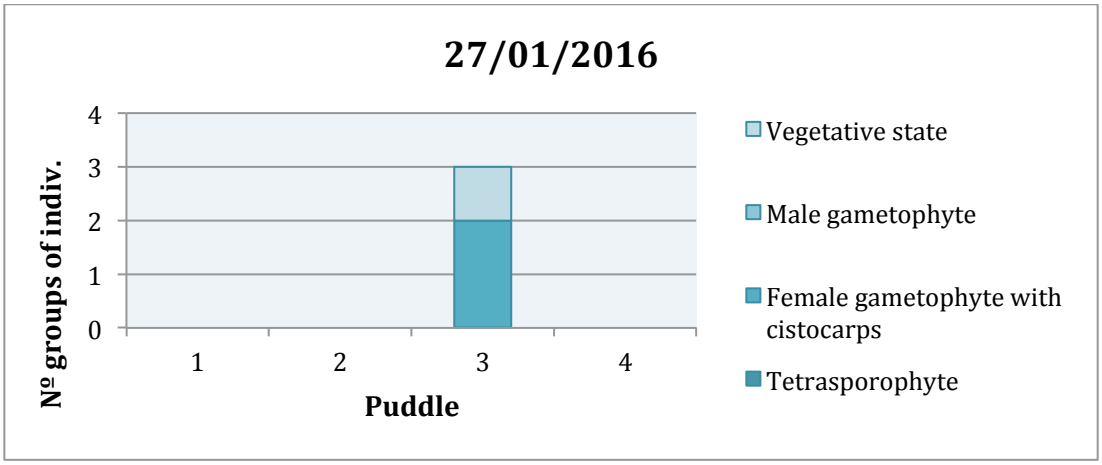


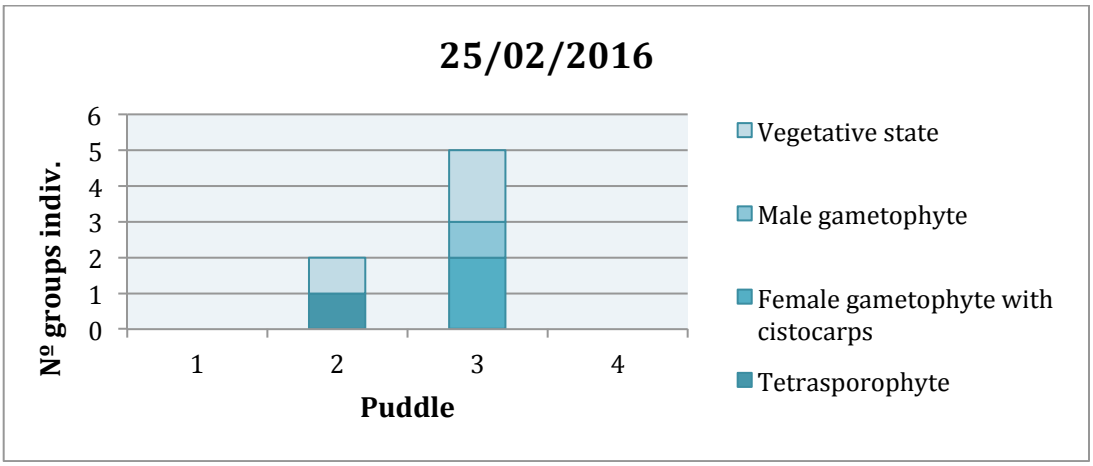
Figure 11. Life cycle of *Gracilaria cervicornis*.

Date	Cycle phase	Puddle 1	Puddle 2	Puddle 3	Puddle 4
27/1/16	Tetrasporophyte	0	0	0	0
	Female gametophyte with cistocarps	0	0	2	0
	Male gametophyte	0	0	0	0
	Vegetative state	0	0	1	0
25/2/16	Tetrasporophyte	0	1	0	0
	Gametofito femenino con cistocarpos	0	0	2	0
	Male gametophyte	0	0	1	0
	Vegetative state	0	1	2	0
11/3/16	Tetrasporophyte	0	1	0	0
	Female gametophyte with cistocarps	0	0	3	0
	Male gametophyte	0	0	0	0
	Vegetative state	0	1	4	0
25/4/16	Tetrasporophyte	0	1	0	0
	Female gametophyte with cistocarps	0	0	4	0
	Male gametophyte	0	0	0	0
	Vegetative state	0	1	6	0
06/06/16*	Tetrasporophyte	0	0	0	0
	Female gametophyte with cistocarps	2	1	9	0
	Male gametophyte	0	0	0	0
	Vegetative state	0	2	6	0
22/6/17	Tetrasporophyte	0	0	0	0
	Female gametophyte with cistocarps	2	0	15	4
	Male gametophyte	0	0	0	0
	Vegetative state	0	4	0	2**
5/7/16	Tetrasporophyte	0	0	0	0
	Female gametophyte with cistocarps	0	1	0	4
	Male gametophyte	0	0	0	0
	Vegetative state	0	4	15	2**

* Day of long waves; it couldn't perform a good sampling.
** Individuals with a lot of epiphytes.

Figure 12. Phenology of *Gracilaria cervicornis* individuals present at each intertidal puddle .


27/01/2016
Nº groups of indiv.
4
3
2
1
0
1
2
3
4
Puddle
Vegetative state
Male gametophyte
Female gametophyte with cistocarps
Tetrasporophyte


25/02/2016
Nº groups indiv.
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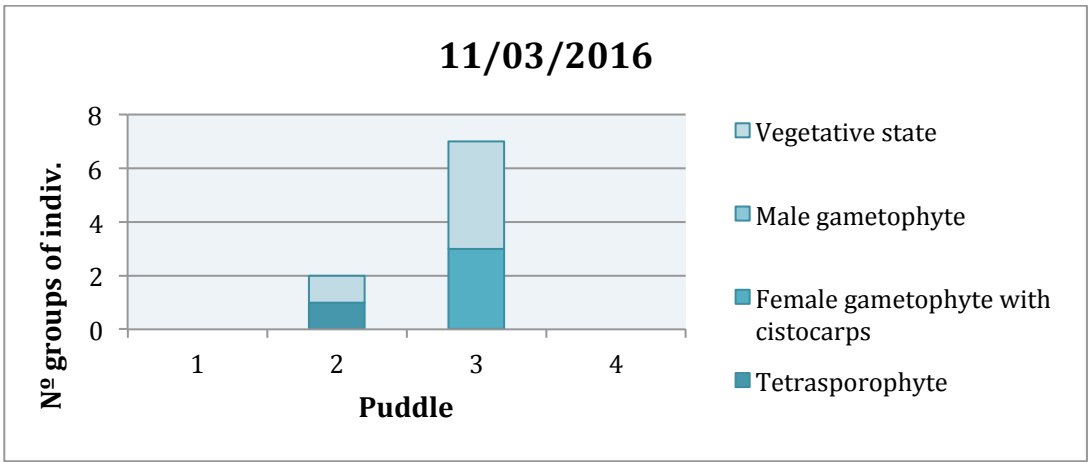
5
4
3
2
1
0
1
2
3
4
Puddle
Vegetative state
Male gametophyte
Female gametophyte with cistocarps
Tetrasporophyte


11/03/2016
Nº groups of indiv.
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2
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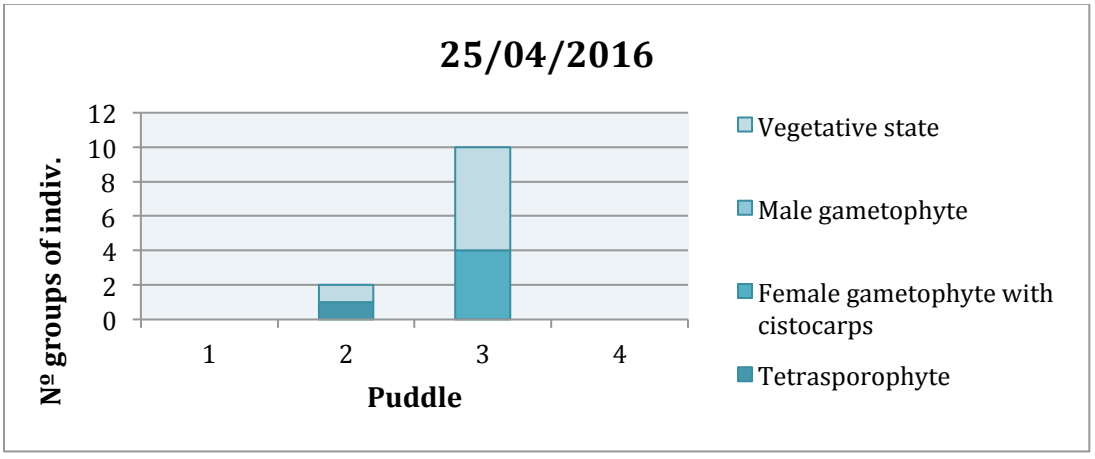
1
2
3
4
Puddle
Vegetative state
Male gametophyte
Female gametophyte with cistocarps
Tetrasporophyte


25/04/2016
Nº groups of indiv.
12
10
8
6
4
2
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1
2
3
4
Puddle
Vegetative state
Male gametophyte
Female gametophyte with cistocarps
Tetrasporophyte

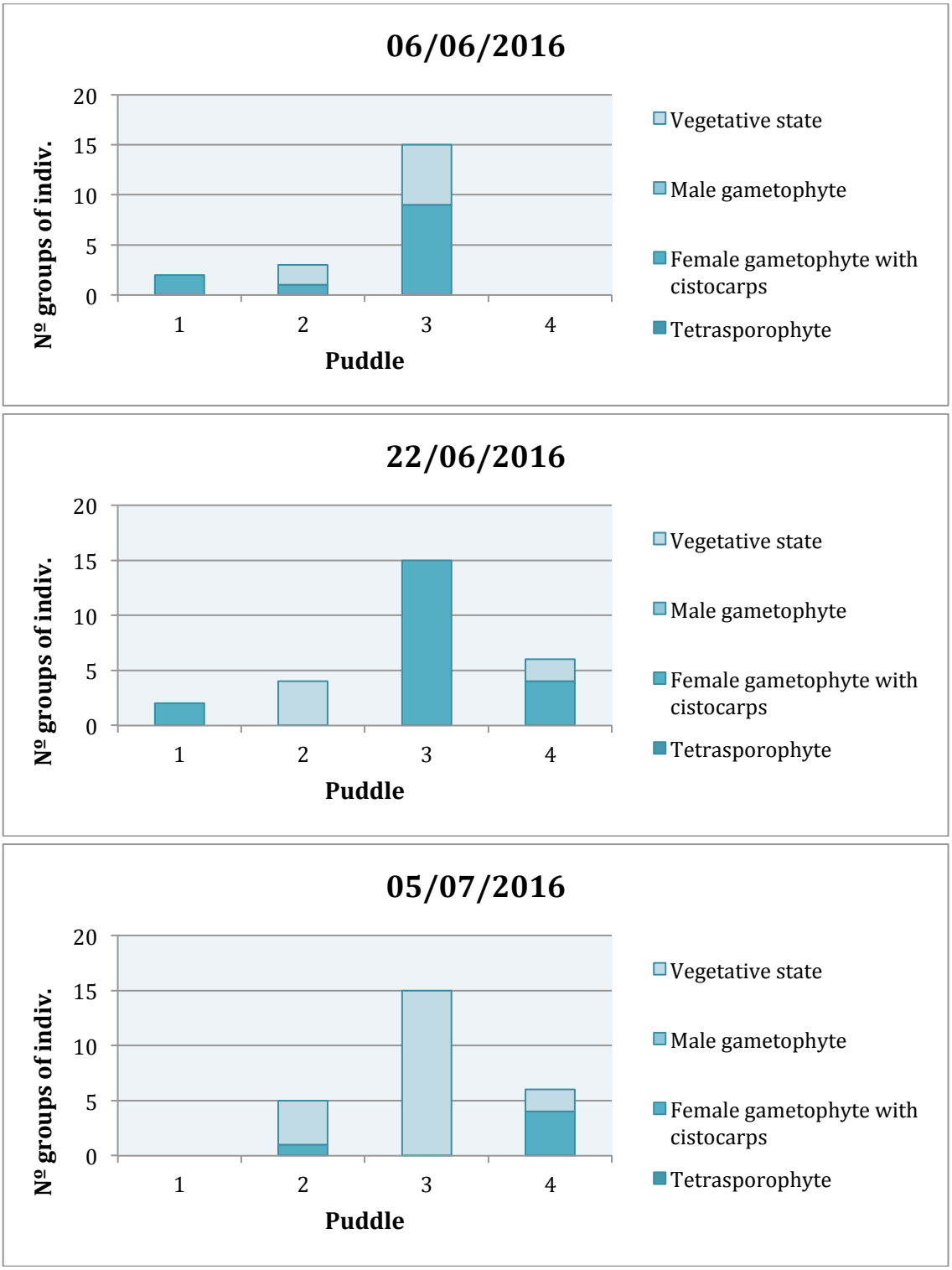

Figure 13. Number of individuals of *Gracilaria cervicornis* collected and monthly evolution in their phases of the life cycle.

EPIPHYTES

We found *Gracilaria cervicornis* in the boarders of the pools, both in the groupings as well as the separate individuals, which were found frequently accompanied by *Cystoseira humilis*, Schousboe ex. Kützing also formed on the boarders. In the array, 6 additional epiphyte species were found *Ceramium diaphanum* (Lightfoot) Roth, *Ellisolandia elongata* (J.Ellis & Solander) K.R.Hind & G.W.Saunders, *Hypnea musciformis* (Wulfen) J.V.Lamouroux, *Jania Rubens* (Linnaeus) J.V.Lamouroux, *Pterocladiella capillacea* (S.G.Gmelin) Santelices & Hommersand, *Spyridia filamentosa* (Wulfen) Harvey and *Ulva Clathrata* (Roth) C.Agardh. The greater number was taken in the warmer stations, especially in pool 4. It was observed how the level of epifitism is greater when the area and biomass of the tallus in the warmer months and, on the contrary, they were present in fewer quantity during the colder months where *Gracilaria cervicornis* was found growing, offering a smaller area susceptible to be colonized (Mateo-Cid and Mendoza-González, 1991; Ortuño-Aguirre and Riosmena-Rodríguez, 2007; Menezes de Széchy and Faria de Sá, 2008).

COMPANION SPECIES

With the objective of characterizing, with the ecological view in the zone in which the species *Gracilaria cervicornis* was found, other species were identified also present in the four pools. They were collected and identified for a total of 31 species, of which 14 pertained to the Rhodophyta division, 10 to the Chlorophyta division and 8 to the Ochrophyta division (Fig. 14).

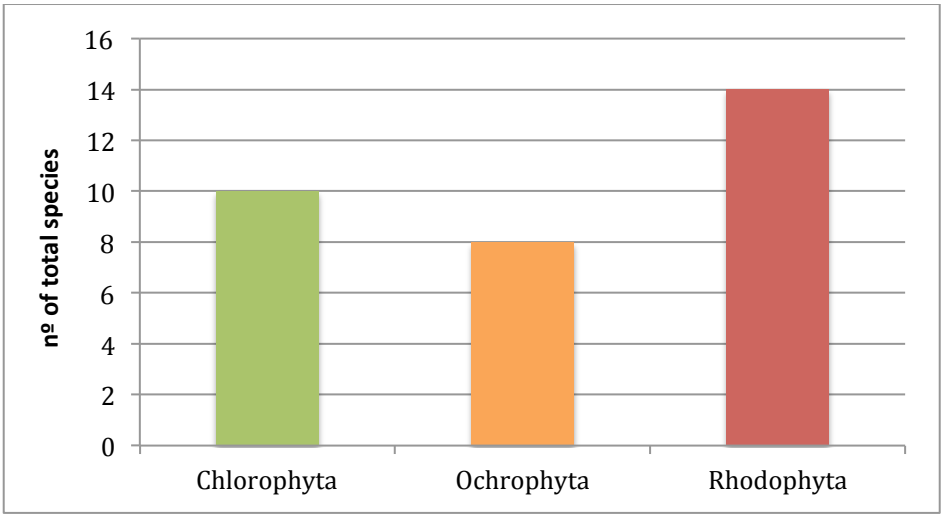

Figure 14. Total species present in the intertidal pools of Puertillo in Bañaderos, Gran Canaria from January to July, 2016.

The group with the greater number of species is Rhodophyta, and within that division, the most diverse families are: Corallinacae with 4, Rhodomalaceae with 3 and Ceramiacea with 2. As it relates to Ochrophyta *Phaeophyceae class (the largest group is Sargassacea with 4 species, while in the Chlorophyta, the most important was Ulvacea with 3.

5. DISCUSION

For species in Gracilariales order, specifically Gracilaria genus, various authors report Polysiphonia life cycle type Ogata *et al.* 1972, Bird *et al.* 1977, Mc Lachlan & Edelstein 1977, Oliveira & Plastino, 1984, Plastino & Oliveira, 1988). The presence of gametophytic and tetrasporophytic phases in natural environment suggest that Gracilaria possess the typical life cycle of Polysiphonia, in which phases haploid gametophytic and diploid tetrasporophytic are free living and morphologically identical, while the diploid carposporophytic depends on female gametophyte, in other words, it presents a three-phase isomorphic life cycle. Bird *et al* (1977), the same as Hurtado-Ponce (1993) showed that germination of carpospore and tetraspore in Gracilaria is of the Dumontia type, in which a spore divides forming a multicellular disk which serves as an fixation organ for the development of the erect canopy from its central region. This same type of development was observed in *Gracilariopsis tenuifrons.* (Brito L. & Silva, 2005).

In this study, we were able to distinguish all of *Gracilaria cervicornis* life cycle phases, highlighting this in male gametophyte for the first time in Gran Canaria Island. In previous studies completed in Canarias, (Sosa, 1991, Sosa *et al.*, 1996) the female gametophyte and tetrasporophyte were identified, and, before the absence of male gametophytes, the dominating reproduction type is concluded to be asexual. Individual female gametophytes are easily recognized when they present cistocarps, however male gametophytes and tetrasporophytes could be reported as vegetative due to the difficulty to recognize them, including under the stereoscopic microscope, for that reason we believe they have disappeared over time. In our case, the great difference between the number of female gametophytes and the rest of the phases is due to the impossibility of recognizing them in the coast and the inability to take an intensive simple to find the species in danger of extinction in Canarias, for that reason the female gametophyfical phase will always be overvalued.

The obtained results with respect to the phenology of the species coincide with those found by Hoyle (1978) in *Gracilaria bursa-pastoris* and *G. coronopifolia*, Pinheiro-Joventino and Frota-Bezerra (1980) in *G. domingensis* , White *et al.* (1981) in *Gracilaria* (tipo "*verrucosa* "), Hay & Norris (1984) in *Gracilaria* sp and *G. domingensis,* Pinheiro-Joventino (1986) in *G. cervicornis.* Pacheco-Ruiz *et al.*

Showed that the influence of biotic factors (like the grazing) and abiotic (like the abrasive action of particles in suspension, the sinking of the reproductive structures and the lime or even some hydrologic variations like salinity, temperature and pH), could explain the seasonal variations in the number of the tetrasporophyte and gametophyte individuals in the sample sites.

The salinity, temperature, irradiation, as well as the provision of nutrients are the principal factors that influence in the development of the cycle of life of the marine algae, like we observed in the evolution of *Gracilaria cervicornis*, from the colder months to the warmer. But as it is proven by various authors, and for the obtained results, the temperature seems to be the most influential factor in the vital cycle of life (Brito & Silva, 2005).

Bird et al. (1977) indicate that the temperature was the determining factor for the germination of the spores, since light and temperature influence in the rapidity development of these. Moller and Westermeier (1988) proved that temperature is decisive for the formation of reproductive structures in *Gracilaria chilensis*. Bellorín y Lemus (1997) studied the effect of temperature and irradiance in the in vitro growth of *G. Tenuifrons* demonstrating that a synergetic energy does not exist between these factors. Rabanal *et al.* (1997) found that in Gracilariopsis bailinge, the photoperiod, temperature, salinity and nutrients are the most critical factors that affect the growth of spores and levels of light studied are the least important.

With respect to the evolution of the populations in the locality of the Bañaderos where *Gracilaria cervicornis* exists, we can affirm that the trend is positive, and we can affirm that its presence in a greater number of pools and the number of individuals has increased significantly with respect to the reviewed in the previous Works by Haroun & Viera (2014 & 2015). As it is noted in the cited Works, the disappearance of the mobile home zones, we believe has been facilitated by the recovery of the species and the zone in general, as we can deduce the greatest number of algal species found. However, this coastal zone continues to be visited by fisherman, pedestrians and dogs, which could prove a danger to the species.

6. CONCLUSION

The analysis and integration of these previous studies and the results obtained in the current study allow us to understand the importance of taking on a phonological tracking of one single population of *Gracilaria cervicornis* in Canary Islands, as our knowledge, until now, has been very limited. We propose as an autonomous administration the undertaking of a phonological study of two years duration where adequate information could be provided for the management of these species. Equally as important is the monitoring of these environmental factors that influence the coast where these species were found with the objective to detect, as quickly as possible, the circumstances that are potentially dangerous to the survival of them.

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PERSONAL OPINION

- **Detailed description of the activities developed during the TFT materialization**

  The activities developed have been, on one hand, being a field work, on the sampling site (Bañaderos coast), and, on the other hand, in a subsequent study in the Marine Ecophysiology group laboratory of ULPGC, EOMAR, (ECOAQUA Institute), specifically in the taxonomy plant laboratory, located on the Campus of Tafira, Gran Canaria. Mainly keys have been used for the identification of individuals.

- **Training (courses, computer programs, etc.)**

  I have not done any specific course for the realization of the activities, but training during these months at same Department has allowed me to learn different taxonomic features of macroalgae to identify them by using keys, as well as perform herbarium sheets.

- **Integration and implication level of the department as well as relationship with the employees.**

  My integration level has been very good. I felt very comfortable and whenever I have had a doubt, they have helped me.

- **The most significant pros and cons related to the TFT development**

  The study results have been positive, with better results than expected. In addition, the TFT work was linked to my external practices, so I have been able to devote much more time.

  As a negative aspect should highlight the difficulty of sampling because of tides and bad sea given problems in more than one occasion.

- **Personal valuation of what I learned along the TFT materialization**

  My learning these months has been very satisfying personally, since I've been able to learn to work in a laboratory approaching closer to a professional work experience and learning methodology and techniques necessary for this purpose.

Appendix 1. Legal and administrative framework

State regulation:

This species is not protected by the current state regulations.

However, as provided in Article 30.2. Of Law 4/1989, the Autonomous Communities, in their respective territorial areas, may establish catalogs of threatened species. This rule of the aforementioned law is basic in virtue of the Fifth Additional Provision of the same.

Autonomous regulation:

In Canary Islands Catalog of Protected Species (Law 4/2010) is in Annex I, with the category "in danger of extinction". Law 4/2010, Article 3.2 (a), states that the inclusion of a taxon in categories of endangered or vulnerable species will determine the application of those established for these categories in Article 56 (a) and (b) Respectively of Law 42/2007, of 13 December, on Natural Heritage and Biodiversity.
The necessary delimitation of critical areas for the protection of the species is expressly included, in the same sense as that contemplated in Article 56 of Law 42/2007, Article 5.2.e) of Decree 151/2001, of 23 July, which created the Catalog of Threatened Species of the Canary Islands, modified by Decree 188/2005, of 13 September (BOC nº 187, of September 22, 2005), which indicates as a minimum content of the plans the Delimitation, if any, of the critical habitats of the species.

Likewise, the Single Transitional Provision, in its paragraph 2, states that, as long as there is no specific regulation, the content and procedure for processing recovery plans for endangered species and plans for the conservation of vulnerable species will be the one contemplated for these categories in articles 5.2, 5.3 and 5.4 of said Decree 151/2001, which regulates the procedure to be followed for the approval of the Plans for Recovery of endangered species. For its part, Additional Provision Three of Law 4/2010 provides that "the maximum period for processing the procedure for approval of plans for recovery and conservation of protected species shall be twelve months, counted from the date of agreement Approval of progress".

International and Community regulations:

Gracilaria cervicornis is not found in any of the European directives protecting habitats or species, nor in any agreement for the protection and conservation of Community or non-Community species.

Nature and linkage:

The present plan has the nature of an instrument for the planning and management of a natural resource, the legal right being protected, both material and immaterial, which is effectively protected by law, that is, it seeks to establish a regulatory framework that protects biodiversity, Emphasizing above all the protection of nature avoiding the loss of native biodiversity.

For this reason, this plan prevails over the instruments of territorial and urban planning.

Appendix 2. Accompaning species present in the intertidal puddles of Bañaderos (January-July 2016)

Classification/Specie

RHODOPHYTA

***Class* Florideophyceae**

***Order* Corallinales**

Corallinaceae

1. *Amphiroa rigida* J.V.Lamouroux

2. *Ellisolandia elongata (J.Ellis & Solander) K.R.Hind & G.W.Saunders*

3. *Jania capillacea* Harvey

4. *Jania rubens* (Linnaeus) J.V.Lamouroux

***Order* Ceramiales**

Ceramiaceae

5. *Ceramium diaphanum* (Lightfoot) Roth

6. *Spyridia filamentosa* (Wulfen) Harvey

Delesseriaceae

7. *Acrosorium venulosum* (Zanardini) Kylin

Rhodomelaceae

8. *Palisada perforata* (Bory) K.W.Nam

9. *Polysiphonia sertularioides* (Grateloup) J.Agardh

10. *Rytiphlaea tinctoria* (Clemente) C.Agardh

***Order* Gelidiales**

Gelidiaceae

Gelidium arbusculum Bory ex Børgesen

Pterocladiaceae

11. *Pterocladiella capillacea* (S.G.Gmelin) Santelices & Hommersand

***Order* Gigartinales**

Cystocloniaceae

12. *Hypnea musciformis* (Wulfen) J.V.Lamouroux

***Order* Rhodymeniales**

Lomentariaceae

13. *Gelidiopsis intricata* (C.Agardh) Vickers

OCHROPHYTA

***Class* Phaeophyceae**

***Order* Dictyotales**

Dictyotaceae

14. *Dictyota dichotoma* (Hudson) J.V.Lamouroux

15. *Lobophora variegata* (J.V.Lamouroux) Womersley ex E.C.Oliveira

16. *Padina pavonica* (Linnaeus) Thivy

***Order* Ectocarpales**

Scytosiphonaceae

17. *Colpomenia sinuosa* (Mertens ex Roth) Derbès & Solier

***Order* Fucales**

Sargassaceae

18. *Cystoseira humilis* Schousboe ex Kützing

19. *Cystoseira tamariscifolia* (Hudson) Papenfuss

20. *Sargassum cymosum* C.Agardh

21. *Sargassum vulgare* C.Agardh, nom. illeg.

CHLOROPHYTA

***Class* Ulvophyceae**

***Order* Bryopsidales**

Caulerpaceae

22. *Caulerpa cylindracea* Sonder

23. *Caulerpa racemosa* (Forsskål) J.Agardh

Codiaceae

24. *Codium taylorii* P.C.Silva

***Order* Cladophorales**

Boodleaceae

25. *Cladophoropsis membranacea* (Hofman Bang ex C.Agardh) Børgesen

Cladophoraceae

26. *Chaetomorpha aerea* (Dillwyn) Kützing

27. *Cladophora prolifera* (Roth) Kützing

Valoniaceae

28. *Valonia utricularis* (Roth) C.Agardh

Order Ulvales

Ulvaceae

29. *Ulva clathrata* (Roth) C.Agardh

30. *Ulva compressa* Linnaeus

31. *Ulva rotundata* Bliding, nom. inval.