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How a Sustainable Way of Collecting Bivalves Becomes Unsustainable: Case Study in Ria de Aveiro

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Abstract. Ria de Aveiro *is a popular place where professionals and the population who lives nearby go to collect bivalves (the population does that as an economic complement). The species collected are: cockle (Cerastoderma edule), grooved razor shell (Solen marginatus), pullet carpet shell (Venerupis senegalensis) and grooved carpet shell (Ruditapes decussata).*
This work study is based on the observation which has been carried out for the last 10 years in the area and concludes that:
The legislation applied to this activity was and is thought in order to keep the sustainability of Ria de Aveiro. In this context, the majority of the capture of these bivalves is being performed by hand or with small tools, according to the law. Although the impact is thought to be almost none (both in the environment and with the species), compared to some other capture techniques, the reality shows that these bivalves are being collected far below the legal size by adulterating the tools used in the process. Also, some legal tools are not the best to use in the collection of bivalves because they cause damage to the intertidal bottom of Ria de Aveiro. Both situations endanger the sustainability of the biodiversity of bivalves in the area.

Keywords. Collection cockle, bivalves, clam.

1. The study area

1.1. Ria de Aveiro

Ria de Aveiro is a barrier-lagoon system, located along the Portuguese northwest Atlantic coast. It could be considered an estuarine complex which receives water from the rivers Vouga (more than 50% of the freshwater input), Antuã, Caster, Boco and a series of drainage channels although all the hydrology in this area is dominated by the tides [1].

1.2. Mira Channel

Our work here was developed taking into consideration the Mira channel which gets more influence from the drainage channels and this is showed in Fig. 1.
A study conducted by Freitas *et al.* (2014) reported that in the Mira channel the grain size is 1.86 ± 0.15; the percentage of total organic matter content is 4.46 ± 3.15; salinity is 31.00 ± 4.76 g/L. Concerning heavy metals the values are: Cd - 0.04 ± 0.02 µg/g, Pb - 3.69 ± 1.24 µg/g, Hg 0.01 ± 0.01µg/g [2].
The majority of people that collect bivalves in the area do that on foot and not by boat so, in this work, we are focusing essentially on this kind of collection which is also performed in the intertidal zone which is composed by mud and some mixed kinds of sand. (Fig. 2)

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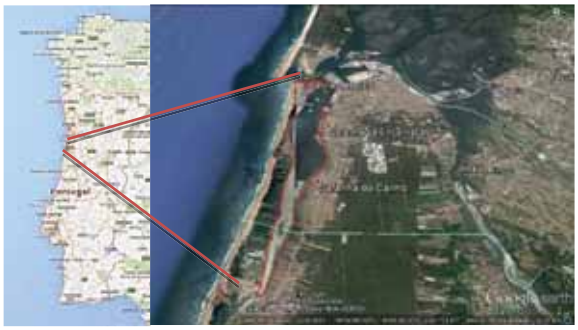

Figure 1. Localization of the study area. (Source: Google Maps)

The collection [11] of bivalve mollusks in the Mira channel (Ria de Aveiro), on foot, begins when the intertidal zone allows people to walk on it and also when specific holes, typical from this kind of mollusks, can be found in the bottom (allowing people to explore them in order to find out what kind of mollusk is in it). All of this occurs before the low-tide peak and can finish [13] some time after that peak, when the water level rises and the tide does not allow anymore the collection of the bivalve mollusks on foot.

Figure 2. One of the intertidal zones where some samples of bivalves were collected for this study

1.3. Classification and legislation

The classification given to the Mira channel by IPMA (Instituto Português do Mar e da Atmosfera – the Portuguese Institute for the Sea and the Atmosphere), namely Class B zone [7], allows that the bivalve mollusks can be collected but they can only be put on the market for direct human consumption [8], after depuration or transposition, because in these areas the quantity of the *E.coli* by 100 grams of meat and intravalvar liquid exceeds 230 and is less than or equal to 4600, in at least 90% of the samples tested [9].

The last classification of the bivalve mollusks production areas, which is currently in force, was established by the Despacho n.º 14515/2010 of INRB (National Institute of Biological Resources), IP and published in the Decreto-Regulamentar n.º 182, II série of September, 17th, based on the data collected during the last two/three years. [7].

Depuration is one process to which the bivalve mollusks are subjected in order to reduce the microbiological contamination levels to legally accepted ones (the quantity of *E.coli* by 100 grams of meat and intravalvar liquid of the bivalve mollusks cannot exceed 230) with the goal of cleaning them, using their own natural filtering ability.

Depuration can be natural in transpositional areas, which are not defined/established in our country, or it can be performed in depuration centers, accredited for this purpose [6].

In the depuration centers, the bivalve mollusks are put inside tanks which are filled with clean sea water, or water that was cleansed through appropriate methods during the amount of time needed to reduce the contaminants.

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The transposition process consists in transferring the bivalve mollusks to marine areas (estuarines or lagoons) during the time needed to reduce the contaminants.
This is a natural depuration process which can only be performed in approved areas for this purpose, where the bivalves ought to be in for a minimum of two months and according to the policy "all in, all out", this way avoiding the mixture of different lots.

2. Bivalves' collection in Mira channel

The species collected in here are mainly four. The cockle (*Cerastoderma edule*), locally called as "*berbigão",* is one of the most common species in the intertidal zone.
The grooved razor shell (*Solen marginatus*) locally called as "longueirão" is also very common, even today.
The grooved carpet shell (*Ruditapes decussata*) locally called as "*amêijoa rainha"* is the most valued species collected in this area. In the past this species was collected very often on foot and nowadays it became very rare to find. During the last 10 years it has been verified that people on foot and by boat collect these four species below the legal size. The first author of this study had the experience of working in a bivalves' wholesale warehouse in the area, and many times they had to sift the bivalve mollusks in order to guarantee that those that were sent to the depuration center had the minimum legal size approved. It was very common place for these bivalves to be below the legal standard. So whenever the entire collection of one fisherman in a specific day was below the legal size, the entire lot would be sent back and then, instead of being returned to the water, it would be consumed by the fisherman, himself, and it would never return to the water again. So nowadays, for example, the grooved carpet shell is very rare, mainly in areas with access only on foot.
The pullet carpet shell (*Venerupis senegalensis*), is a native species that is locally called as "*amêijoa macha",* it used to be abundant in the area but it started to have the same problems mentioned above becoming rarer and rarer to find.

3. The collection tools used

The fishing arts/methods authorized and the characteristics of the handicraft tools used to the collection of bivalves, on foot or by boat, is defined by the Fishing Regulation in Ria de Aveiro [12] (Portaria n.º 563/90 of July, 19th, changed by the Portaria n.º 575/2006 of June, 19th), complemented by the Portaria 1102-B/2000 of Novembrer, 22nd, which approves the Regulation of the Collection for commercial purposes, changed by the Portaria n.º 477/2001 of May, 10th, re-published by the Portaria n.º 144/2006 of February, 20th, which establishes the Judicial Regime of the collection of marine animals in oceanic waters, interior maritime waters and the ones that are not maritime but are under the jurisdiction of the coast guards/port authorities, and changed by the Portaria n.º 1228/2010 of December, 6th.
The fishing arts/methods mentioned in the bibliography [3], [4] and [5] do not match with what has been observed in the field for the last 10 years, in the Mira channel.
The handicraft tools that are used the most when collecting bivalves on foot are the rakes and the "nassas" (kind of a net fishing bag), the "berbigoeiras", salt bottles and sometimes they use the sticks.

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When collecting cockle and clams by boat it is a common illegal error to use the "ganchorra de arrasto" (a big rake with a net bag attatched to it that is released until it reaches the bottom of the sea and then is trailed and finally pulled back at the end).
The rake used when collecting specially cockle and clam on foot consists of a pole (of wood or metal) with a metal or wooden toothed crossbar at the end which is used to stir the soil in order to find the buried bivalves in the intertidal area. (Fig. 3)
Regularly, the people who collect bivalves on foot use not only the rake but also a "nassa", independent of the rake, which is used exclusively for the transportation of what is collected. (Fig. 4)

Figure 3. Hand rake

The "berbigoeira" (Fig. 5) consists of a long metal pole with a toothed crossbar at the end and it is connected to a bow-shaped net bag. In this tool all the dimensions of each part is established in the legislation in force concerning the fishing in Ria de Aveiro. [12]
The "berbigoeira" is defined in the Fishing Regulation in Ria de Aveiro [12] and it can be used from a boat (with longer poles) or on foot (with shorter poles).

Figure 4. Hand rake and net bag

The way it is used is very similar to the rake (being its main function to stir the intertidal area to collect cockle and clam) but the size of this tool is bigger than the rake and it has a net bag attached to its metal structure, they are not independent from each other. It is very common for the coast guards to apprehend illegal "berbigoeiras" because the dimensions of each part is normally adulterated, the number of teeth in the crossbar and the space between them is also adulterated and the size of the net bag or the kind of net used can be also adulterated. In all these situations the legislation in force is not being respected. [12].

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The “ganchorra” is a fishing art that is not laid down in the authorized arts of the Fishing Regulation of Ria de Aveiro [12], being very similar to the “berbigoeira”, the main difference is that it is trailed by a cord and not by a metal or wooden pole.

Figure 5. Berbigoeira

Concerning the collecting tool “adriça”, locally called “vareta” in Ria de Aveiro, although is it not laid down in the Fishing Regulation of Ria de Aveiro, it is laid down in the collecting Regulation for commercial or professional purposes. (Fig. 6)

Figure 6. Stick

The stick is a collecting tool used when collecting on foot only which consists on a long metal rod with one sharp end.

In cases of lack of financial or material resources to manufacture this tool, the fishermen use the central rod of an umbrella removing everything else and then they use this just like a collecting stick.

The way the stick works is very simple, the men stick it in the holes which show the presence of the bivalve mollusks buried in the intertidal bottom, in this case the grooved razor shell (*Solen marginatus*) and they pull it out as soon as the stick touches the bivalve valves because these close immediately when touched. So the stick touches the bivalve, it immediately closes around the stick and they easily pull it out to collect it. This technique has become more and more obsolete because it hurts the bivalve mollusks and so they do not survive much longer from the moment they are collected and there is only a short period of time since that moment until they are presented in the markets to be sold with enough quality. [10]

Besides, there is another problem for the gastronomic consumption of this bivalve when collected using this technique. The stick makes the bivalve close when it is hurt and the soil grains stay inside the shells getting all over the meat. Even though the meat is washed many times, it is not enough to remove totally the grains and the restaurant customers do not appreciate this. So the gastronomic experience is not the most pleasant. Not to mention the looks of it, taking into consideration that the animal is hurt and so the meat is kind of smashed.

To avoid these situations, there is another technique which is being used by the majority of the fishermen replacing the stick. They are using salt; this technique consists of introducing the salt (sodium chloride) or brine (this is a saturated mix of sodium

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chloride and water) in the holes of these bivalves. The salt forces the bivalves to come up to the surface. (Fig. 7)
This method of collecting the grooved razor shell is a lot less harmful to the animal than the stick method. This allows to increase the survival time of this bivalve from the collecting moment until it reaches the market stands with the quality desired and without any soil grains inside after it goes through the depuration process, as it is mandatory to do in this study area.

Figure 7. Collecting grooved razor shell by the salt method

4. Problems of collecting bivalves

One of the problems existing in the area is the collection of samples below the legal size [14]. The legal sizes are:

- cockle – 2.5 cm
- grooved razor shell – 10 cm
- pullet carpet shell – 3.0
- grooved carpet shell - 4.0 cm

What happens is that people collect bivalve mollusks in all sizes as Fig. 8 is showing.
But the main problem in here is not this kind of collection itself, but not putting the small samples back to the water and instead, cooking them to their own consumption (as the sale of it would be prohibited).

5. Conclusion

Although the collecting of bivalves on foot is thought to be better quantity-wise because it is collected one by one and not in large amounts at once, we conclude that it is not that sustainable as it is thought because the units collected are of all sizes, being the majority below the legal size. This reduces significantly the stocks of bivalve mollusks in all this study area. This impact is already visible in the specific case of the grooved carpet shell, which is already very rare.

Figure 8. A grooved razor shell and a cockle, both below the legal sizes

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It is essential that urgent environmental sensibilization measures are implemented with professionals and also with the local population, complementing that with supervision reinforcement and the improvement of the management of the existing natural resources in the Mira channel.

6. Acknowledgements

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Novembro, a Portaria n.º 254/79, de 31 de Maio e o Decreto-Regulamentar n.º 11/80, de 07 de Maio (o artigo n.º 85-B foi revogado pelo Decreto-Regulamentar n.º 7/2000, de 30 de Maio, sem que tal signifique o renascimento da lei que este revogará, nos termos do nº 4 do artigo n.º 7º do Código Civil). Revoga o artigo n.º 3.º da Portaria 305/89, de 21 de Abril; Retificada pela Declaração Retificativa n.º 16-L/2000, de 30 de Novembro; Alterada pela Portaria 477/2001, de 10 de Maio; Alterada e Republicada pela Portaria n.º 144/2006, de 20 de Fevereiro, aqual revoga o artigo n.º 11.º e os anexos I, II, III, IV e V; Alterada pela Portaria n.º 1228/2010, de 6 de Dezembro).

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