Identification the species of *Crassotrea* cultured in Lap An Lagoon, Phu Loc District, Thua Thien Hue Province, Vietnam

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**Abstract**

Oyster farming is the main livelihood of many households in Lap An lagoon, Lang Co town, Thua Thien Hue province, Vietnam. Fingerlings were mainly collected from the wild. From March to April each year, farmers put substrates into the lagoon, then many oyster fingerlings clung on there and grew up. Oysters were harvested after 10 to 12 months of culture. At the harvest time, many oyster species were found on the same substrates. In this study, five species were identified: Jinjiang oyster (*Crassostrea rivularis*), Pacific Oyster (*Crassotrea gigas*), American cupped oyster (*Crassostrea sp1*), *Crassotrea sp2*, and Hooded oyster (*Saccostrea cucullata*). Among five species, three were dominant (100%), available at all research areas, including *Crassostrea rivularis*, *Crassotrea sp2* and *Saccostrea cucullata*. The other two species only accounted for 50 - 60%.

**Key words:** Oyster; *Crassotrea*; *C. rivularis*; *C. gigas*
1. Introduction

Lap An lagoon, Lang Co town, Phu Loc district, Thua Thien Hue, Vietnam has the total area of 1600 square hectares, being known as a long-standing oyster farming area. Oyster farming is the main livelihood of many households there. These days, the oyster farming is mainly taking place in 5 villages: Lap An, An Cu Tan, Loan Ly, Hoi Dua, An Cu Tay. In 2016, the area was 119 hectares/224 households, the output was about 400 tons/year, the average income was 80-120 million / year / household (Thua Thien Hue Department of Agriculture and Rural Development, 2016; Lang Co Town People’s Committee, 2014, 2015, 2016).

Oyster farming of Lap An lagoon mainly use natural fingerlings. Therefore, this research identified the species composition of oysters in Lap An lagoon, showed the high economic value and easy-farming species in order to complete the farming process and prioritize development, contributed to sustainable development of oysters farming in the study area.

2. Materials and Methods

2.1. Research targets: Oysters Crassotrea

2.2. Study area: Lap An lagoon, Phu Loc District, Thua Thien Hue Province, Viet Nam. The sample collection and survey were conducted in five villages (Lap An, An Cu Tan, Loan Ly, Hoi Dua và An Cu Tay) (Figure 2.1).

2.3. Study duration: 01/2017 – 03/2018

2.4. Study methods

2.4.1. Method of primary data collection

- Venue survey: 5 villages (Lap An, An Cu Tan, Loan Ly, Hoi Dua và An Cu Tay)
- Number of households: 70 households
- Selecting principle: the households were randomly selected in the study areas.
- Survey methods: Field visit, using questionnaires, collecting information from local oyster households

- Survey contents: the species composition of oysters in Lap An lagoon, Phu Loc district, Thua Thien Hue province, Viet Nam

2.4.2. Method of secondary data collection

The secondary data was collected from available documents, reports of specialized agencies, scientific reports, study results on newspapers and magazines, and annual local economic reports, etc. Some tools were used to search for information: Google scholar and the pages that have checked namespace: *.gov; *.edu; *.mil…

2.4.3. Method of collecting and fixing samples

Samples were collected directly from the wild in various sizes and shapes, oysters collected directly from the substrates in the study area. The samples had to be in maturity stage, remain intact and retain its natural color. Samples after collection were photographed, measured in length, width and height by a Panme clamp. Samples were soaked in the formalin of 5%, labeled, numbered and recorded in terms of time, venue, weight and length. Dried samples were packed in plastic bags, labeled and preserved in a dried place to prevent being mold.
2.4.4. Method of classification

- Classification was done by basing mainly on the curriculum classification of Xuyfeng Shan (1997), Takashi Okutani (2000), Nguyen Van Chung & Ton That Chat (2013) and some in references.

After collecting, samples were observed, their external appearance was identified, the characteristics of their shell were analyzed, then anatomized, recorded, photographed and fixed… The results of first-hand classification were rechecked in laboratories to identify species composition.
3. Results and Discussion

During six sampling periods (January, March, July, September, November in 2017) on five study sites: Lap An, An Cu Tan, Loan Ly, Hoi Dua and An Cu Tay of Lap An Lagoon, Thua Thien Hue, Viet Nam (Figure 2.1). The research team identified five oyster species with the characteristics shown in Table 3.1

**Table 3.1** Species composition of oyster in Lap An lagoon, Phu Loc, Thua Thien Hue, Viet Nam

| Special point | (Crassotrea rivularis)/(Crassotrea ariakensis) | (Crassotrea gigas) | (Crassotrea sp<sup>1</sup>) | (Crassotrea sp<sup>2</sup>) | (Saccostrea cucullata) |
|---------------|---------------------------------------------|---------------------|-----------------------------|-----------------------------|------------------------|
| Ancient       | ![Ancient Configuration](image1.png)         | ![Ancient Configuration](image2.png) | ![Ancient Configuration](image3.png) | ![Ancient Configuration](image4.png) | ![Ancient Configuration](image5.png) |
| Configuration in | ![Configuration in](image6.png)           | ![Configuration in](image7.png) | ![Configuration in](image8.png) | ![Configuration in](image9.png) | ![Configuration in](image10.png) |
| Road major    | ![Road major](image11.png)                | ![Road major](image12.png) | ![Road major](image13.png) | ![Road major](image14.png) | ![Road major](image15.png) |
| Special point | (Crassotrea rivularis)/(Crassostrea ariakensis) | (Crassotrea gigas) | (Crassotrea sp\(^1\)) | (Crassotrea sp\(^2\)) | (Saccostrea cucullata) |
|---------------|---------------------------------------------|-------------------|------------------------|------------------------|---------------------|
| physical hanging | Piles, wire, old wheel cover, stone… | Nanoparticles when giving birth, oyster shells … etc | Boulders, wooden stakes, old wheel covers, etc. | Gastropoda shell in the sand | cement piles, stone piles, wooden piles, etc. |
| Layout | Middle floor, bottom floor | Middle floor, | Bottom floor | The shore sandy lagoon | up floor, bottom floor, river bank |

3.1. Jinjiang oyster *(Crassotrea rivularis)* (Gould, 1861)

| Regnum   | Animalia |
|----------|----------|
| Phylum   | Mollusca |
| Class    | Bivalvia |
| Ordo     | Ostreoida |
| Familia  | Ostreidae |
| Genus    | Crassostrea |
| Species  | *C. rivularis* (Gould, 186) |
Figure 3.1. External and Internal appearance of Jinjiang oyster (*Crassotrea rivularis*).

Figure 3.2. External and Internal appearance of Jinjiang oyster (*Crassotrea rivularis*).
**Figure 3.5** External appearance of Jinjiang oyster (*Crassotrea rivularis*)

Looking from the bottom

(Source: Figure research group 3-2018)

**Figure 3.6** Egg and sperm of oysters

(Source: Figure research group 12-2017)

**Figure 3.7** Hinge of Jinjiang oyster (*Crassotrea rivularis*)

(Source: Figure research group 3-2018)

**Figure 3.8** The growth line form of Jinjiang oyster (*Crassotrea rivularis*)
Description:

- Jinjiang oyster (*Crassotrea rivularis*) is distributed in the estuaries. They have the lower shell (left shell) with the attached surface which occupies more than half of the lower shell.

- They have an oval body shape and the development of shape depends much on clinging materials. Their height is 1.5 times and three times as much as their length and width, respectively.

- Their outside colors depend on the color of the substrate. There are the parasites of the algae and clay on their shell.

- Their shells have a layer of growth overlap in layers from hinges to the shell.

- Muscle closure occupies the minority of intestine, their hinges are 2-4 mm in length.

- The growth of sinus membranes occupies three-quarters of the intestinal perimeter, with tentacles, sinus membranes that are yellowish brown.

- Because of the demand of large clinging area, this species depends much on the substrate.

- The fingerlings of Jinjiang oyster (*Crassotrea rivularis*) appear dispersedly after thunderstorms, in early rainy seasons, from February to March every year. Due to the favorable living conditions, age and maturity are relatively early.

In Lap An lagoon, Lang Co town, Phu Loc district, Thua Thien Hue province, Vietnam, Jinjiang oyster (*Crassotrea rivularis*) is dominant, appearing in all collecting sites. Jinjiang oyster (*Crassotrea rivularis*) is found in 5 villages of the study area (Lap An, An Cu Tan, Loan Ly, Hoi Dua và An Cu Tay), highly frequently appeared in the process of harvesting. This species lives in the bottom, middle and top layers. The thickness of Jinjiang oyster in Lap An lagoon is quite developed, with high meat contents.
When observing, Jinjiang oysters’ beautiful yellow meats are its eggs and sperms. This species has high economic value and become more popular with farmers.

### 3.2. Pacific Oyster (*Crassotrea gigas*) (Thunberg, 1793)

Pacific Oyster (*Crassotrea gigas*) is not the natural species of the local area. This species is bought from hatchery by local people to farming (*Research result in 2018*). The scientific names of Pacific Oyster (*Crassotrea gigas*) are identified below:

| Regnum   | Animalia          |
|----------|-------------------|
| Phylum   | Mollusca          |
| Class    | Bivalvia          |
| Ordo     | Ostreoida         |
| Familia  | Ostreidae         |
| Genus    | Crassostrea       |
| Species  | *Crassotrea gigas* (Thunberg, 1793) |

![Image of Pacific Oyster](image)

**Figure 3.9** Pacific Oyster (*Crassotrea gigas*)

(Source: Figure research group 12-2017)
Figure 3.10 External appearance of Pacific Oyster (*Crassotrea gigas*)

Figure 3.11 Instectine of Pacific Oyster (*Crassotrea gigas*)

Figure 3.12 Hinge of Pacific Oyster (*Crassotrea gigas*)

Figure 3.13 The growth line form of Pacific Oyster (*Crassotrea gigas*)

(Source: Figure research group 3-2018)

Description:

- Most of this species have blue shells, long oval body, being artificially controlled fingerlings. Therefore, they have homogeneous appearances and are less impacted by the substrate.

- The body height is often twice and three-to-four times as much as their length and width, respectively.
- Growth lines are the longitudinal veins which extend from the hinges to the end of the shells, their muscle closure is quite large and their hinges long 3-5mm.

- Their sinus membranes are small and short, occupying one-thirds of the intestinal perimeter, and the tentacles of sinus membranes are black.

- The full of "milk" of oysters’s guts are their sex products. Their internal organs cover most of the left shell. Oysters bring "milk" around the year, during in all their development stages.

- This species requires a large number of natural food sources. The water depth is at least 2m.

- Due to the carrying eggs around the year, Pacific oyster (Crassotrea gigas) can reproduce the year around.

Pacific Oyster is single clinging oyster. In artificial reproduction, when the larvae are prepared for cling, we can use the substrates made of chains of old oyster shell in order to hold them. This species only clings in a small area; their clinging surfaces are close to their hinges. In fact, Pacific oyster should be only bred in low density, and it is easy for farmers’ management.

The results of survey show that Pacific Oyster (Crassotrea gigas) is the only artificial species in Lap An lagoon, Phu Loc town, Thua Thien Hue province, Viet Nam. This is a high economic value species. However, their farming costs are much higher than those of other species because of buying artificial fingerlings from other places, being lack of initiative and limited survival rate. Therefore, this species are only raised in some households in An Cu Tan, An Cu Tay and Hoi Dua villages, accounting for 60% of local oyster households (Survey results in 2017).
3.3. American cupped oyster (*Crassotrea. sp*)

Regnum Animalia
Phylum Mollusca
Class Bivalvia
Ordo Ostreoida
Familia Ostreidae
Genus *Crassostrea*
Species *Crassotrea. sp*¹

**Figure 3.14** American cupped oyster (*Crassotrea. sp*¹)
(Source: Figure research group 3-2018)

**Figure 3.15** Inner side of left shell of American cupped oyster (*Crassotrea sp*¹)
(Source: Figure research group 3-2018)

**Figure 3.16** Inner side of left shell of American cupped oyster (*Crassotrea sp*¹)
Figure 3.17 External form of left shell of American cupped oyster (*Crassotrea* sp$^1$)

(Source: Figure research group 3-2018)

Figure 3.18 External form of right shell of American cupped oyster (*Crassotrea* sp$^1$)

Description:  
- American cupped oyster (*Crassotrea* sp$^1$) usually appears in the bottom, a kind of muddy bottom.
- American cupped oyster looks like duck bills, their height is twice and four times as much as their length and width, respectively.
- American cupped oyster has attached surface in the lower shell which is divided into two parts: the grip and growth shell. The rate of the attached shell is lower
than those of other species.

- The growth line of lower shell is stemming from the last edge of the graft to the end of the shell whereas that of upper shell extends from the hinges to the end of the shell.
- This species has undeveloped guts due to the limit of their width and length.
- American cupped oyster has fairly large shells, their hinges are 5-7 mm in length.
- American cupped oyster’s gut is green, not strong, especially after the thunderstorm. The commercial value of this species is not high.
- Mucosal membranes occupy 1/2 perimeter of gut; the tentacles are brown as mud color.
- American cupped oyster often breeds at the end of March of lunar calendar, especially after the rain

The results of sampling collection and survey in Lap An lagoon, Phu Loc district, Thua Thien Hue province, Viet Nam indicates that this species is found in five villages of study area (Lap An, An Cu Tan, Loan Ly, Hoi Dua và An Cu Tay), accounting for 100%.

In fact, local people in Lang Co town do not like American cupped oyster because this species is not delicious. However, the majority of households using natural fingerlings, it is impossible to take the initiative in selecting fingerlings. Moreover, this species also occupies a large number of outputs at harvesting.

3.4. *Crassotrea. sp*²
Regnum    Animalia
Phylum    Mollusca
Class    Bivalvia
Ordo    Ostreoida
Familia    Ostreidae
Genus    Crassostrea
Species    Crassotrea. sp²

**Figure 3.22** External appearance of *Crassotrea* sp² looking from the top
(Source: Figure research group 3-2018)

**Figure 3.23** External appearance of *Crassotrea* sp² looking from the bottom
(Source: Figure research group 3-2018)

**Figure 3.24** Internal organs of American cupped oyster (*Crassotrea* sp²)
(Source: Figure research group 3-2018)
Figure 3.25 Hinge of *Crassotrea* sp²

Figure 3.26 The growth line form of *Crassotrea* sp²

Description:

- *Crassotrea*. sp² has small size, lozenge and long shape.

- *Crassotrea*. sp² is similar to Pacific Oyster (*Crassotrea gigas*), being single clinging oysters. When caught in nature, this species often live in the sandpace and cling themselves to small snails. When oysters begin clinging to snails, oysters move along with snails. However, when *Crassotrea*. sp² grows, snails will die because they are pressed down by oysters, being unable to get food and can not move. Therefore, *Crassotrea*. sp² is also known as killer oyster.

- This species have quite thick shells due to frequent exposure to sand at low tide. The thick shells can help them keep water in their body well. The tolerance of *Crassotrea*. sp² in natural changes is higher than that of other oysters found in the study area.

- Matured oysters has the same length, width and height. Their hinges are 2-3 mm when growing up.

- The lower shell of *Crassotrea*. sp² has a strange shape, the growth lines are wavy veins which are parallel with their height and do not stack in layers compared to other species. The upper shell is divided into two parts, the smooth shell extending from the hinge to the middle is nutritious value and inner intestine. It has been
traditionally believed that looking at the smooth shell can identify how the intestine is.

- The sinus membranes are quite developed, occupying about 3/4 of the intestinal peritoneum, the tentacles of sinus membranes are yellowish brown.

- Their muscle closure is small and the intestines are larger than their shells. The intestines are yellowish-white due to the full of milk and good meat.

- This species often reproduce at the end of May lunar calendar. Due to the lack of food and extreme habitats, their maturity is quite late.

In Lap An lagoon, Phu Loc district, Thua Thien Hue province, this species is found in sandy beaches of five study areas (Lap An, An Cu Tan, Loan Ly, Hoi Dua and An Cu Tay), accounting for 100%. Although *Crassotrea* sp₂ are the smallest in all of five species, they have high nutritional benefits and economic value.

3.5. **Hooded Oyster** (*Saccostrea cucullata*)

| Regnum      | Animalia                  |
|-------------|---------------------------|
| Phylum      | Mollusca                  |
| Class       | Bivalvia                  |
| Ordo        | Ostreoida                 |
| Familia     | Ostreidae                 |
| Genus       | Saccostrea                |
| Species     | *Saccostrea cucullata*    |
**Figure 3.27** Hooded Oyster (*Saccostrea cucullata*)

(Source: Figure research group 3-2018)

**Figure 3.28** Intestine of Hooded Oyster (*Saccostrea cucullata*)

(Source: Figure research group 3-2018)
**Figure 3.29** External appearance of Hooded Oyster (*Saccostrea cucullata*)
Looking from the top

(Source: Figure research group 3-2018)

**Figure 3.30** External appearance of Hooded Oyster (*Saccostrea cucullata*)
Looking from the bottom

**Figure 3.31** Hinge of Hooded Oyster (*Saccostrea cucullata*)

(Source: Figure research group 3-2018)

**Figure 3.32** The growth line form of Hooded Oyster (*Saccostrea cucullata*)

Description:

- This species does not have a certain form, their shape totally depends on clinging materials. They often live in cliffs, piers, damaged boats, concrete piles, wooden piles...

- Hooded Oyster is completely clinging species because of the grasping on the substrate of their lower shell. The more their body grows, the more their clinging...
surfaces are.

- The lower shell of Hooded Oyster is less developed, thin and does not grow. Therefore, after harvesting and exploiting, the actual rate of wastage is high because their shells are not intact, the upper shells have small growth lines which are adjacent to the shell edge.

- The height of matured oysters is 1.5 and five times as much as their length and width, respectively. Therefore, their content is insignificant, only 10% of their totally weight.

- The gut contents are white and blue, the sinus membranes occupy three-quarters of the intestinal perimeter, their muscle closure is small. Their hinges are thin and small, being only 2-3 mm in height.

- Hooded Oyster often reproduce in early May of lunar calendar. Due to the shortage of food and the extended period time of sunbathing, this species is less developed.

The results survey in Lap An lagoon, Phu Loc district, Thua Thien Hue province show that this species highly frequently appears in nearshore oyster piles, occupying 60% of the proportion of oysters in the study area, concentrating on lagoons, namely Lap An, Loan Ly, An Cu Tan.

The benefits of Hooded Oyster are limited: low commercial effectiveness, low economic value, and also cause serious damage to oyster piles and restaurant piles in Lap An lagoon. This is also the species of oysters that local people would like to limit their appearance.

4. Conclusions

In this study, five species were identified: Jinjiang oyster (Crassostrea rivularis), Pacific Oyster (Crassotrea gigas), American cupped oyster (Crassostrea sp1), Crassotrea sp2, and Hooded oyster (Saccostrea cucullata). Among five species, three were dominant
(100%) available at all research areas, including Jinjiang oysters (*Crassostrea rivularis*),
(*Crassotrea* sp²) and Hooded oyster (*Saccostrea cucullata*).

The other two species Pacific Oyster (*Crassotrea gigas*) and Hooded oyster
(*Saccostrea cucullata*) only accounted for 60%. Because *Crassotrea gigas* was bought
from hatchery by local people, this species only appeared in the stocking area. Hooded
oyster (*Saccostrea cucullata*) was native species whose favorite substrate is solid ones,
rocks and they prefer attaching to those substrates without the presence of others.
Therefore, the distribution of Hooded oyster (*Saccostrea cucullata*) was narrower than that
of the other species. Additionally, due to the low economic value, famers do not
concentrate on this species.

In short, we should culture mainly two species of *Crassotrea rivularis* and
*Crassotrea gigas*. For *Crassotrea rivularis*, it is necessary to determine the reproductive
season for putting substrates in order to harvest more natural fingerlings. For *Crassotrea
gigas*, because of their large size and high economic value, we should use source of
artificial fingerlings for farming.

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