Title: A Study of the Relationship Between Water Quality, Soil Quality affecting the propagation of *Scylla serrata* in the Kok Ok Mangrove Forest, Hadsamran District, Trang Province.

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Abstract

This study of the relationship between water quality, soil quality, and Scylla serrata reproduction in the Kok Ok Mangrove Forest, Hadsamran District, Trang Province, aims to: 1) compare water quality at different times in the Kok Ok Mangrove Forest, Hadsamran District, Trang Province; 2) compare soil quality at different times in the Kok Ok Mangrove Forest, Hadsamran District, Trang Province; 3) investigate the relationship between water quality and egg development in Scylla serrata in the Kok Ok Mangrove Forest, Hadsamran District, Trang Province; and 4) investigate the relationship between water quality and soil quality and egg development in Scylla serrate. The study was conducted in two phases. Phase 1 examined water quality in areas where Scylla serrata were raised for internal egg development in female crabs. Phase 2 examined water quality and soil quality during Scylla serrata reproduction in the external egg development stage. The study period was divided into two periods: Period 1, August-October 2024, and Period 2, November 2024-January 2025. The study found that water quality and soil quality affect Scylla serrata reproduction in the Kok Ok Mangrove Forest. During November 2024-January 2025, crabs were able to develop eggs better than during August-October 2024.

Keywords: Mangrove forest, Scylla serrata reproduction, water quality, soil quality

Introduction

Mangrove forests are vital ecosystems that support a wide range of aquatic biodiversity and the livelihoods of coastal communities. They serve as nurseries for various aquatic animals, including the mud crab, Scylla serrata, a crucial resource for both economic and ecological purposes. Especially in mangrove areas that function as natural habitats and breeding grounds for Scylla serrata, such as the Khok Ok mangrove forest, these ecosystems are highly productive and play a significant role in supporting coastal aquatic life. However, there has been a decline in the natural population of Scylla serrata in this area, impacting local communities that rely on these crabs for food and income. The Khok Ok Community Enterprise has initiated a Scylla serrata hatchery project to restore the natural population, but the number of crabs has not increased as expected. Therefore, our research team is interested in investigating the relationship between water and soil quality and the propagation of Scylla serrata in the Khok Ok mangrove forest. Understanding the environmental factors that influence the growth and reproduction of Scylla serrata is essential for developing effective conservation and management strategies. This will help maintain the ecological balance of the ecosystem and ensure long-term food security for the community, while also creating employment opportunities and generating income for residents of Khok Ok Village, Hadsamran District, Trang Province.

This study aims to examine the correlation between water and soil quality and the propagation of Scylla serrata in the Khok Ok mangrove forest, Hadsamran District, Trang Province.

Research Question

1. Does water quality vary over time in the Khok Ok mangrove forest, Hadsamran District, Trang Province? If so, how?
2. Does soil quality vary over time in the Khok Ok mangrove forest, Hadsamran District, Trang Province? If so, how?
3. Is there a relationship between water quality and the internal egg development of female Scylla serrata in the Khok Ok mangrove forest, Hadsamran District, Trang Province? If so, how?
4. Is there a relationship between water and soil quality and the external egg development of female Scylla serrata in the Khok Ok mangrove forest, Hadsamran District, Trang Province? If so, how?

Research Hypotheses

1. Water quality varies over time in the Khok Ok mangrove forest, Hadsamran District, Trang Province.

2. Soil quality varies over time in the Khok Ok mangrove forest, Hadsamran District, Trang Province.

3. Water quality over time is related to the internal egg development of female Scylla serrata in the Khok Ok mangrove forest, Hadsamran District, Trang Province.

4. Water and soil quality over time are related to the external egg development of female Scylla serrata in the Khok Ok mangrove forest, Hadsamran District, Trang Province.

Materials and Methods

Variables Involved

Hypothesis 1: Water quality at different times in the Kok Ok mangrove forest,Hadsamran District, Trang Province, varies.

ndependent Variable: Time of data collection.

Dependent Variable: Water quality in the mangrove forest area.

Control Variable: Size of the study area, date of survey, equipment used for surveying.

Hypothesis 2: Soil quality at different times in the Kok Ok mangrove forest, Hadsamran District, Trang Province, varies.

Independent Variable: Time of data collection.

Dependent Variable: Soil quality in the mangrove forest area.

Control Variable: Size of the study area, date of survey, equipment used for surveying.

Hypothesis 3: Water quality at different times is related to the amount of eggs within female Scylla serrata in the Kok Ok mangrove forest, Hadsamran District, Trang Province.

Independent Variable: Water quality at different times.

Dependent Variable: Amount of eggs within female Scylla serrata.

Control Variable: Size of the study area, date of survey, equipment used for surveying.

Hypothesis 4: Water quality and soil quality at different times are related to the external egg development of female Scylla serrata in the Kok Ok mangrove forest, Hadsamran District, Trang Province.

Independent Variable: Water quality at different times.

Dependent Variable: Amount of external eggs of female Scylla serrata.

Control Variable: Size of the study area, date of survey, equipment used for surveying.

Equipment

1.Thermometer
2.Dissolved oxygen test kit
3. Secchi Disk
4.Conductivity meter
5.Salinity meter
6.Universal Indicator
7.pHmeter
8.Flashlight
9. Weighing Scale
10.Vernier caliper
11.Crab rearing box
12. Scylla serrata
13. Ambassis spp.
14. Straw Rope

Research Methodology

Study Site Selection

The study site was selected in the Khok Ok mangrove forest at latitude 7.48948 and longitude 99.480147. The research was conducted in two phases:

Phase 1 – Studying the development of eggs inside female mud crabs (Scylla serrata). Female crabs weighing 150-200 grams were kept in containers near the mouth of the canal to allow them to fully develop internal eggs.

Phase 2 – Studying external egg development. The female crabs with developed internal eggs from Phase 1 were released into natural enclosures within the mangrove forest, allowing them to lay eggs externally and propagate. The released crab larvae were allowed to enter the sea naturally.

Throughout the study, various environmental factors affecting the reproduction of *Scylla serrata* in the Khok Ok mangrove forest, Hat Samran District, Trang Province, were monitored and analyzed.

Part 1: Study of Water Quality at Different Time Periods in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province

Water quality was measured at the mouth of the canal during the period when female mud crabs (*Scylla serrata*) with internal eggs were kept, and in the mangrove forest when female crabs with external eggs were raised. Measurements were taken during the highest tide periods as follows:

1.1 pH Measurement The acidity or alkalinity of the water at the canal bank and in the mangrove forest was measured using universal indicator paper. The color of the test strip was compared with a standard color chart. Measurements were taken three times.

1.2 Temperature Measurement The water temperature in the study area was measured using a thermometer. Readings were recorded accordingly.

1.3 Dissolved Oxygen Measurement The amount of dissolved oxygen in the water at both the mangrove forest and the canal bank was measured using a test kit following the GLOBE protocol.

1.4 Water Transparency Measurement The water transparency was assessed using a Secchi disk.

The experiment was repeated three times, and results were recorded.

1.5 Salinity Measurement Water salinity was measured using a digital salinity meter (pen-type). The readings were taken three times, and results were recorded.

1.6 Electrical Conductivity Measurement The water's electrical conductivity was measured using a Conductivity Meter. The test was repeated three times, and results were recorded.

Part 2: Study of Soil Quality at Different Time Periods in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province Soil quality was measured in the mangrove forest during

the lowest tide period. Measurements were taken during the highest tide periods as follows:

2.1 Soil Sampling Sites – Soil samples were collected from three locations within the Khok Ok Mangrove Forest, Hat Samran District, Trang Province, in areas subject to tidal flooding. The soil structure, texture, color, and aggregation were analyzed using the GLOBE methodology, and results were recorded.

2.2 Soil Temperature Measurement – Soil temperature was measured at depths of 5 cm and 10 cm using a soil thermometer. Measurements were taken three times, and data were recorded.

2.3 Soil Moisture Measurement – Soil moisture was measured at depths of 5 cm and 10 cm using a multipurpose soil meter. Readings were taken three times, and results were recorded.

2.4 Soil pH Measurement – Soil pH was measured using universal indicator paper.

Part 3: Study of the Relationship Between Water Quality and the Internal Egg Development of Female Mud Crabs in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province

3.1 Water Quality Measurement – The following water quality parameters were measured at the canal mouth during the period when female mud crabs with internal eggs were kept: temperature, salinity, electrical conductivity, pH, and water transparency. Measurements were conducted during the highest tide period.

3.2 Internal Egg Development Monitoring – A flashlight was used to illuminate under the crab's carapace to observe egg development. A vernier caliper was used to measure the width of the light passing through the carapace every 7 days, and the results were recorded.

Data Analysis – The relationship between water quality and internal egg production in Scylla serrata was analyzed.

Part 4: Study of the Relationship Between Water and Soil Quality at Different Time Periods and the External Egg Development of Female Mud Crabs in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province

4.1 Water and Soil Quality Measurement Water quality was measured in the mangrove forest during the highest tide period.Soil quality was measured during the lowest tide period in the area where female mud crabs with external eggs were kept.were taken in two phases: **Phase 1**: August - October 2024 **Phase 2**: November 2024 - January 2025

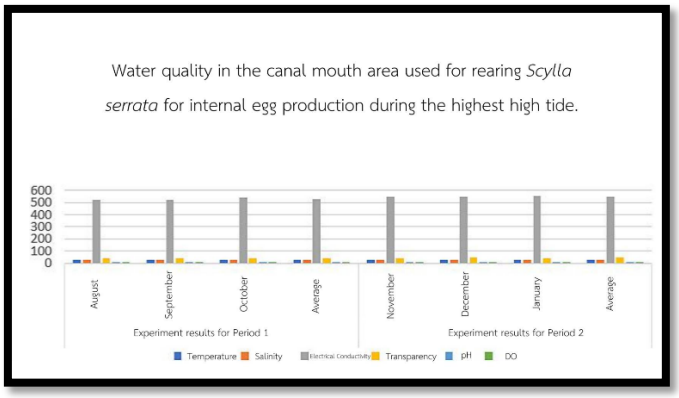
4.2 Observation of External Egg Development – A total of 10 female mud crabs were caught using traps to observe their external egg development. Observations were recorded accordingly.

4.3 Data Analysis – The relationship between water and soil quality and the external egg production of Scylla serrata was analyzed.

Research Results

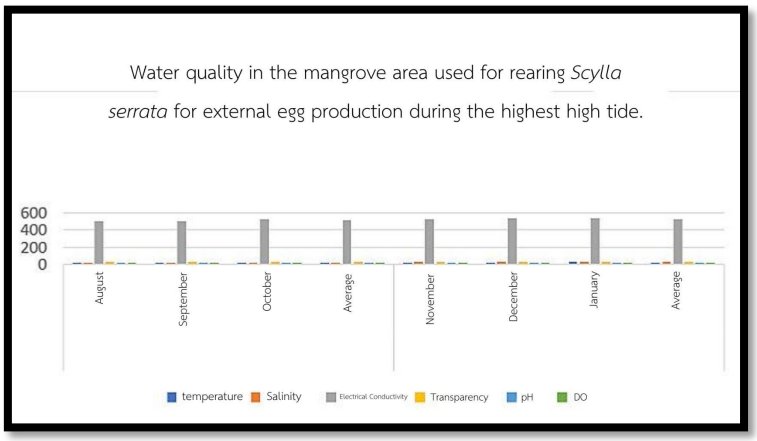
Part 1: Study of Water Quality at Different Time Periods in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province.

Chart 1: Water quality at the canal mouth where female mud crabs with internal eggs were raised during the highest tide period.



From the study, it was found that the average pH, temperature, water transparency, electrical conductivity, salinity, and dissolved oxygen levels in the second phase (November to January) were higher than in the first phase.

Chart 2: Water quality in the mangrove forest where female mud crabs with external eggs were raised during the highest tide period.



From the study, it was found that the average pH, temperature, water transparency, electrical conductivity, salinity, and dissolved oxygen levels in the second phase (November to January) were higher than in the first phase.

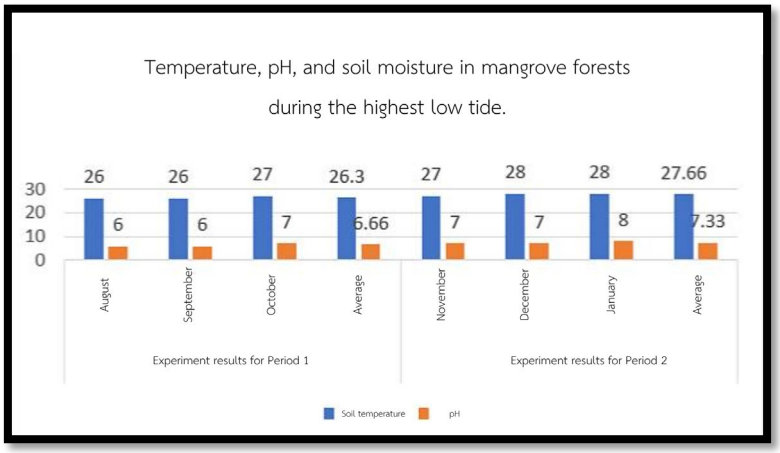
Part 2: Study of Soil Quality at Different Time Periods in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province

Table 1: Soil structure, texture, color, and aggregation in the mangrove forest during the lowest tide period.

Soil properties	Experimental resulf-Phase 1			Experimental resulf-Phase 2		
	August	September	October	November	December	January
Soil structure	Blocky sturcture	Blocky sturcture	Blocky sturcture	Blocky sturcture	Blocky sturcture	Blocky sturcture
Soil texture	Clay loam with sith silt and sand	Clay loam with sith silt and sand	Clay loam with sith silt and sand	Clay loam with sith silt and sand	Clay loam with sith silt and sand	Clay loam with sith silt and sand
Soil color	Grayish-black	Grayish-black	Grayish-black	Grayish-black	Grayish-black	Grayish-black
Soil aggregation	Compact	Compact	Compact	Compact	Compact	Compact

From the table, it was found that the soil structure, texture, color, and aggregation in the mangrove forest during the lowest tide period remained the same across both study phases: Soil Structure: Blocky ,Soil Texture: Clay loam mixed with silt and sand Soil Color: Grayish-black ,Soil Aggregation: Dense and compact

Chart 3: Temperature, pH, and moisture content of the soil in the mangrove forest during the lowest tide period.



From the chart, it was observed that the soil temperature and pH levels in the second phase (November to January) were higher than in the first phase.

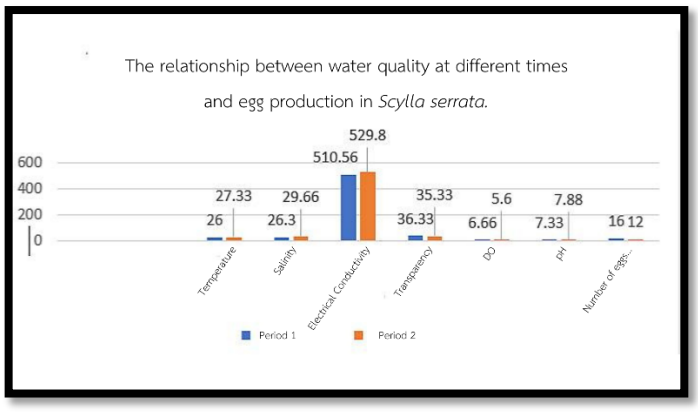
Part 3: Study of the Relationship Between Water Quality at Different Time Periods and the Internal Egg Development of Female Mud Crabs in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province.

Table 2: Duration of internal egg development in Scylla serrata in the Khok Ok mangrove forest, Hat Samran District, Trang Province, at different time intervals, measured every 7 days.

Trial	**Experiment Results (Aug - Oct)**		Experiment Results (Nov - Jan)	
	Observation of eggs inside the crab's carapace	Space in the carapace	Crab image	Space in the carapace
1	No eggs found in the crab's carapace	-	/	Less than 10%
2	/	10%-30%	/	20%-40%
3	/	40%-50%	/	50%-80%
4	/	60%-80%	/	90%-100%
5	/	90%-100%	-	-

From the study, it was found that the duration of internal egg development in female mud crabs during Phase 1 (August - October 2024) was slower than in Phase 2 (November 2024 - January 2025).

Chart 4: Relationship between water quality at different time periods and internal egg development in female mud crabs. The study revealed that water quality affects the duration of internal egg develoent in *Scylla serrata*, with the first phase experiencing slower egg development compared to the second phase.



Part 4: Study of the Duration of External Egg Development in Mud Crabs in the Khok Ok Mangrove Forest, Hat Samran District, Trang Province.

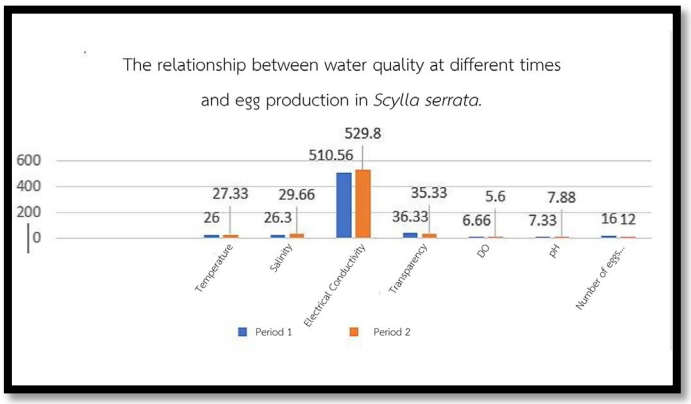
Table 3: Duration of external egg development in Scylla serrata in the Khok Ok mangrove forest, Hat Samran District, Trang Province.

Date	Experiment Results (Aug - Oct)				Experiment Results (Nov - Jan)			
	Crabs caught (individuals)	Egg-bearing crabs found (individuals)	%	Egg color of the crab	Crabs caught (individuals)	Egg-bearing crabs found (individuals)	%	Egg color of the crab
1	9	0	0	-	9	0	0	-
2	8	0	0	-	8	0	0	-
3	10	0	0	-	10	0	0	-
4	9	0	0	-	9	0	0	-
5	11	0	0	-	10	4	40	Yellow-orange
6	8	1	12.5	-	11	7	63.63	Yellow-orange
7	8	1	12.5	Yellow-orange	10	8	80	Yellow-orange, orange
8	10	4	40	Yellow-orange	9	9	100	Yellow-orange, orange
9	9	5	55.55	Yellow-orange	10	10	100	Orange-brown-black

10	10	8	80	Yellow-orange, Orange	9	9	100	Orange-brown-black
11	9	9	100	Yellow-orange, Orang	8	8	100	Brown-black
12	9	9	100	Yellow-orange, Orange	10	10	100	Brown-black, eggs disappeared
13	10	10	100	Orange-brown-black	-	-	-	-
14	9	9	100	Orange, Orange-brown-black	-	-	-	-
15	8	8	100	Orange-brown-black	-	-	-	-
16	9	9	100	Black, eggs disappeared	-	-	-	-

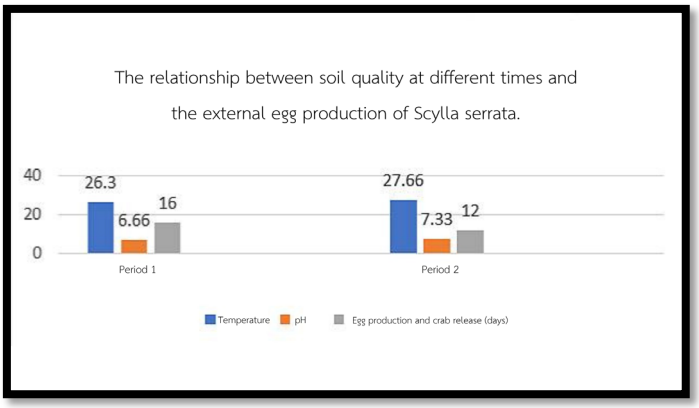
From the study, it was found that the duration of external egg development in female mud crabs during Phase 1 (August - October 2024) was slower than in Phase 2 (November 2024 - January 2025).

Chart 5: Relationship between water quality at different time periods and external egg development in female mud crabs.



From the study, it was found that water quality affects the duration of external egg development in female mud crabs. During Phase 1 (August - October 2024), the crabs developed eggs more slowly than in Phase 2 (November 2024 - January 2025).

Chart 6: Relationship between soil quality at different time periods and external egg development in female mud crabs.



From the study, it was found that soil quality affects the duration of external egg development in female mud crabs. During Phase 1 (August - October 2024), the crabs developed eggs more slowly than in Phase 2 (November 2024 - January 2025)

Conclusion and Discussion

From the study, it was found that both water quality parameters—including pH, temperature, transparency, electrical conductivity, salinity, and average dissolved oxygen—and soil quality indicators, such as soil temperature and acidity-alkalinity, were higher during Phase 2 (November to January) compared to Phase 1. This resulted in a shorter duration for internal and external egg development in mud crabs, which is consistent with the research project on enhancing mud crab populations through sustainable mangrove ecosystems in Ban Bang Tieb, Kuraburi District, Phang Nga, funded by the Support Fund for Research (SRF). The campaign promoting the conservation of mud crabs and sea crab farming by the Department of Fisheries also indicates that mud crabs have the highest egg production between November and December.

Recommendations

1. Safety measures should be taken when catching mud crabs, with expert supervision.
2. Study the types of food that affect the growth of mud crabs.

Acknowledgments

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