

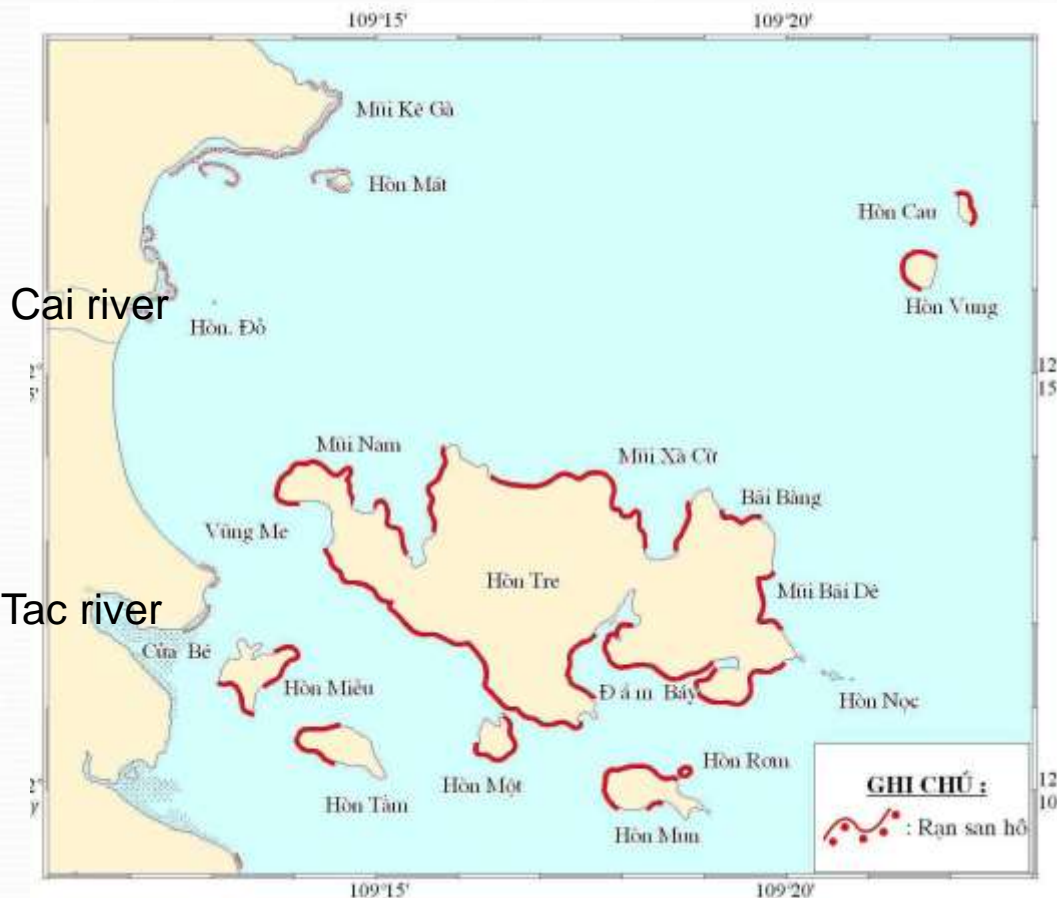


# Trend of coastal water quality at Nha Trang bay, Viet Nam

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# INTRODUCTION

❖ Nha Trang Bay, a well known tourism site in the south of the central region, is famous not only because of its beauty, but also of the biodiversity values.



❖ Cai river in the north (basin square # 3.000 km<sup>2</sup>, discharge # 5.6 m<sup>3</sup>/s in dry and 78 m<sup>3</sup>/s in rainy season).

❖ Tac river in the south (basin square # 120 km<sup>2</sup>, discharge # 0.6 m<sup>3</sup>/s in dry and 2.6 m<sup>3</sup>/s in rainy season).

❖ The economic activities, including tourism have caused certain impacts to the ecosystems, especially coral reefs and therefore water quality in Nha Trang Bay could more and more be polluted every day.

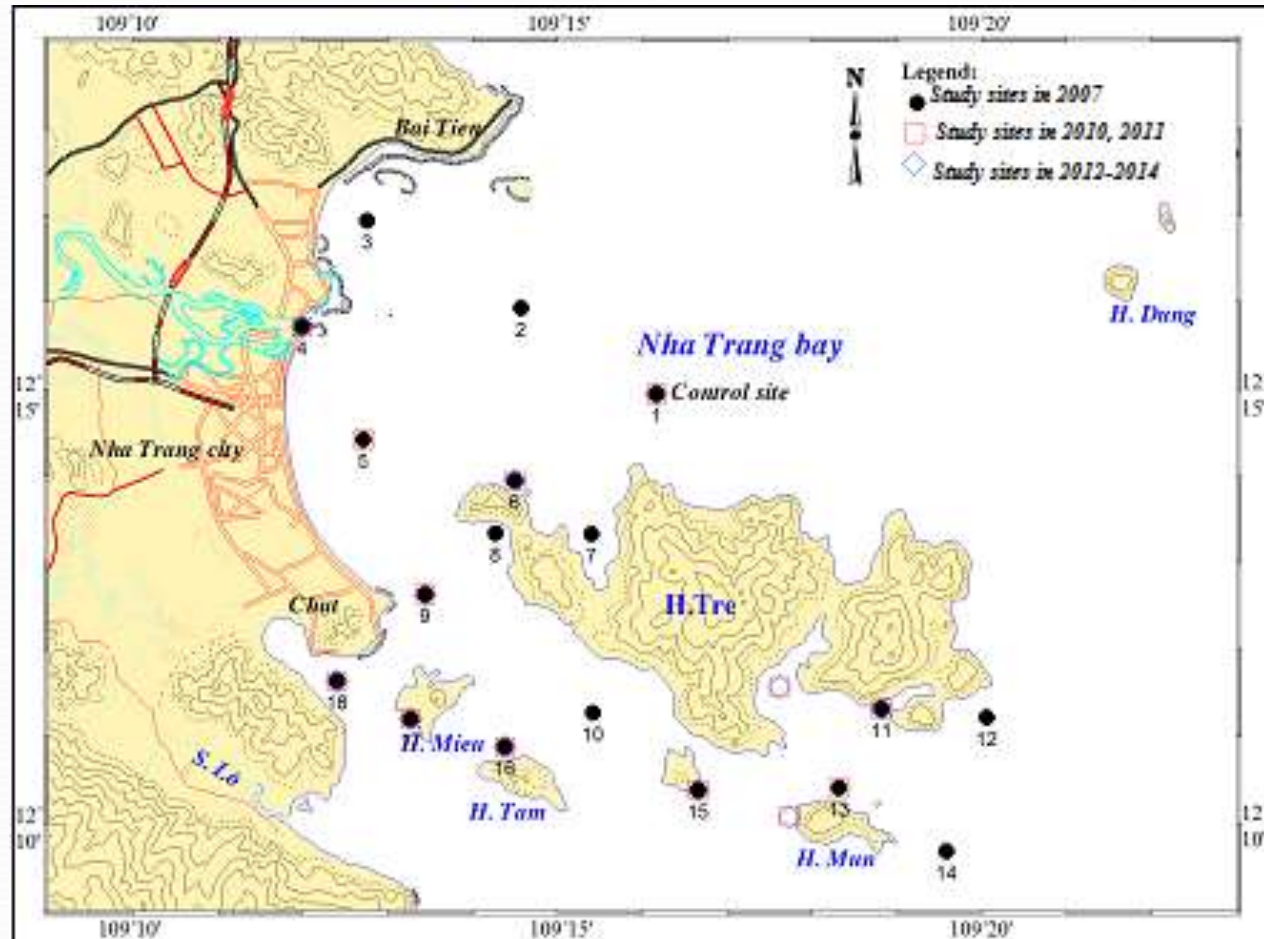
❖ For these reasons, the water quality monitoring is necessary for effective and valuable management to protect the ecosystems here and for sustainable development.

❖ In this paper, the monitoring data from 2007 to 2014 are reviewed and evaluated trends of water quality.

# METHODS

❖ The water samples collected at surface and bottom, using 5L plastic bathometer at selected sites.

❖ 308 samples in dry and rainy seasons had been collected through 6 years in 2007, and 2010 - 2014.





❖ Basic parameters, nutrient salts, heavy metals and hydrocarbon (HC) were analyzed.

❖ The samples were preserved, treated and analyzed following APHA 2005.

❖ Using trendline with linear regression to determine changes of the parameters from 2007 to 2014.



# RESULTS AND DISCUSSIONS

## □ Curently water quality (2014)

❖ Even in dry seasons, fresh water from rivers, especially, the Cai River had a marked effect on Nha Trang bay, which shown through the high silicate concentration.

| Giá trị                       | pH          | DO<br>(mg/l) | BOD <sub>5</sub><br>(mg/l) | TSS<br>(mg/l) | NH <sub>3,4</sub> -<br>N<br>(µg/l) | NO <sub>2</sub> -<br>N<br>(µg/l) | NO <sub>3</sub> -<br>N<br>(µg/l) | PO <sub>4</sub> -P<br>(µg/l) | SiO <sub>3</sub> -<br>Si<br>(µg/l) | Zn<br>(µg/l) | Cu<br>(µg/l) | Pb<br>(µg/l) | Fe<br>(µg/l) | HC<br>(µg/l) |
|-------------------------------|-------------|--------------|----------------------------|---------------|------------------------------------|----------------------------------|----------------------------------|------------------------------|------------------------------------|--------------|--------------|--------------|--------------|--------------|
| 6/2014 (Dry season) (n=22)    |             |              |                            |               |                                    |                                  |                                  |                              |                                    |              |              |              |              |              |
| TB                            | 8,07        | 6,81         | 1,00                       | 5,6           | 4                                  | 0                                | 35                               | 8,1                          | 193                                | 7,1          | 2,6          | 2,1          | 232          | 398          |
| CT                            | 7,82        | 6,44         | 0,50                       | 3,1           | 0                                  | 0                                | 32                               | 6,5                          | 154                                | 5,2          | 1,6          | 1,8          | 34           | 263          |
| CD                            | 8,21        | 7,14         | 1,54                       | 9,5           | 13                                 | 0                                | 41                               | 9,4                          | 227                                | 13,9         | 3,6          | 2,9          | 845          | 503          |
| 11/2014 (Rainy season) (n=22) |             |              |                            |               |                                    |                                  |                                  |                              |                                    |              |              |              |              |              |
| TB                            | <b>7,97</b> | 6,78         | <b>2,64</b>                | 5,2           | 4                                  | 0                                | 36                               | 7,2                          | <b>297</b>                         | 7,2          | 3,3          | 1,6          | 106          | 375          |
| CT                            | 7,54        | 6,44         | 1,36                       | 3,1           | 0                                  | 0                                | 32                               | 4,5                          | 154                                | 6,3          | 1,7          | 1,2          | 60           | 268          |
| CD                            | 8,22        | 7,24         | 5,01                       | 9,5           | 16                                 | 0                                | 43                               | 9,4                          | 1262                               | 8,8          | 4,1          | 2,7          | 216          | 470          |
| CV                            | 6,5-<br>8,5 | ≥5           | -                          | 50            | 100                                | 55                               | 60                               | 15                           | -                                  | 50           | 30           | 50           | 100          | ND           |

CV: Critical value; HC: hydrocarbon

❖ Generally, the sea water quality in both seasons was pretty good: DO was high, pH was within the limit of critical value, there were no contaminations of TSS, nutrient parameters and heavy metals, except Fe. Besides, coastal waters was contaminated by HC.

❖ However, compared to other coastal areas in Vietnam, Fe and HC concentration were not higher (even much lower than some). It might be explained that the criteria here is unrealistic.

❖ In rainy season, the effect of rivers, water was more obvious with lower value in pH and higher value in silicate and BOD<sub>5</sub>. Although a bit worse than in dry season, the water quality in rainy season was still in the controlled level.

# The trends of water quality in the Nha Trang bay

❖ From 2007 to 2014, the values of DO, BOD<sub>5</sub>, SiO<sub>3</sub>, NO<sub>2</sub>, and Fe were higher in the rainy season while pH, ammonia were lower.

❖ Similar to 2014, from 2007-2014, water quality in rainy season was a bit worse than in dry season, but the water quality in both seasons was still in the controlled level.

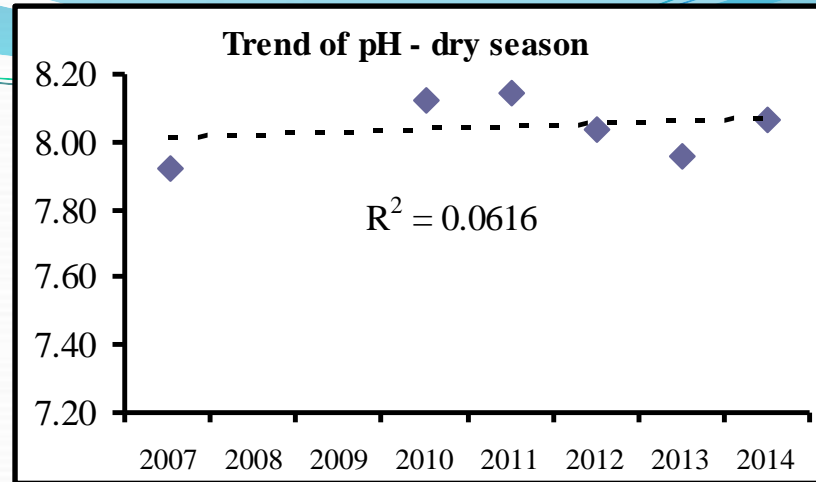
|                      | pH          | DO<br>(mg/l) | BOD <sub>5</sub><br>(mg/l) | TSS<br>(mg/l) | NH <sub>3,4</sub> -<br>N<br>(µg/l) | NO <sub>2</sub> -N<br>(µg/l) | NO <sub>3</sub> -<br>N<br>(µg/l) | PO <sub>4</sub> -P<br>(µg/l) | SiO <sub>3</sub> -<br>Si<br>(µg/l) | Zn<br>(µg/l) | Cu<br>(µg/l) | Pb<br>(µg/l) | Fe<br>(µg/l) | HC<br>(µg/l) |
|----------------------|-------------|--------------|----------------------------|---------------|------------------------------------|------------------------------|----------------------------------|------------------------------|------------------------------------|--------------|--------------|--------------|--------------|--------------|
| Dry season (n=154)   |             |              |                            |               |                                    |                              |                                  |                              |                                    |              |              |              |              |              |
| TB                   | 8.04        | 5.39         | 1.31                       | 16.2          | 7.9                                | 1.0                          | 33                               | 9.6                          | 275                                | 10.6         | 2.0          | 1.5          | 143          | 481          |
| CT                   | 7.48        | 4.60         | 0.10                       | 1.0           | 0                                  | 0                            | 24                               | 4.1                          | 69                                 | 4.9          | 0.6          | 0.3          | 34           | 233          |
| CD                   | 8.29        | 7.14         | 2.61                       | 53.0          | 108                                | 7.8                          | 80                               | 27.8                         | 2874                               | 24.9         | 4.6          | 3.3          | 845          | 808          |
| Rainy season (n=154) |             |              |                            |               |                                    |                              |                                  |                              |                                    |              |              |              |              |              |
| TB                   | 7.93        | 5.94         | 1.48                       | 17.2          | 2.9                                | 3.6                          | 36                               | 10.0                         | 606                                | 10.4         | 2.4          | 1.9          | 194          | 474          |
| CT                   | 7.65        | 5.32         | 0.11                       | 1.5           | 0                                  | 0                            | 23                               | 3.3                          | 154                                | 6            | 0.5          | 0.7          | 50           | 263          |
| CD                   | 8.22        | 7.96         | 5.01                       | 86.9          | 47                                 | 21.2                         | 86                               | 34.6                         | 3665                               | 20.6         | 5.2          | 4.4          | 2624         | 792          |
| CV                   | 6,5-<br>8,5 | ≥5           | -                          | 50            | 100                                | 55                           | 60                               | 15                           | -                                  | 50           | 30           | 50           | 100          | ND           |

CV: Critical value; HC: hydrocarbon

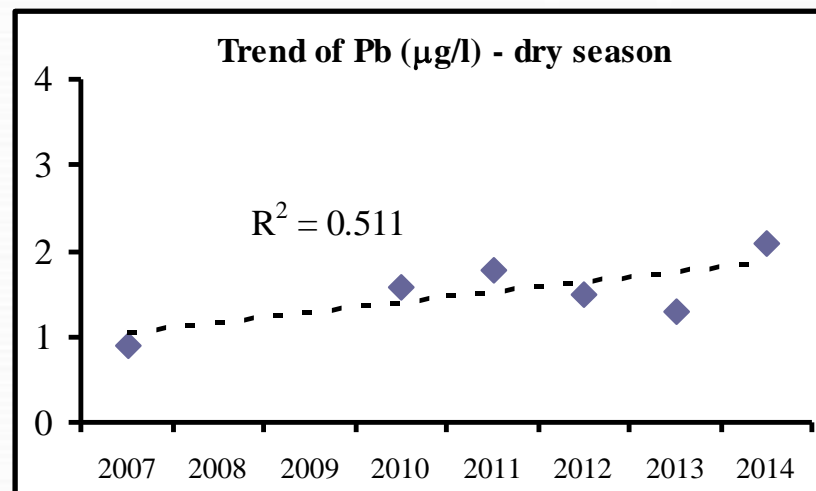
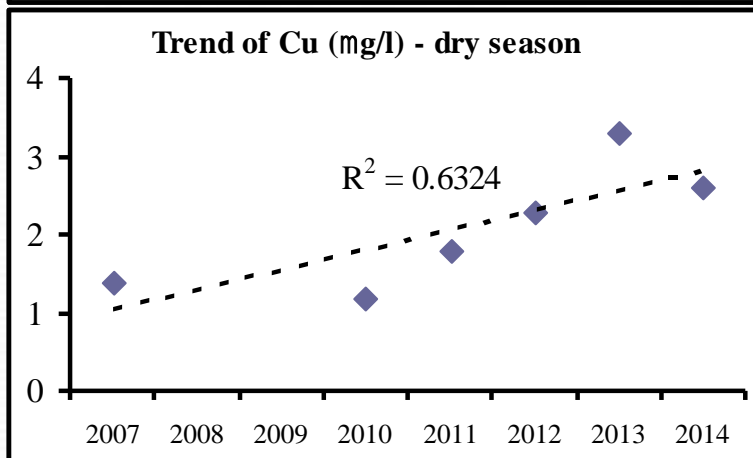
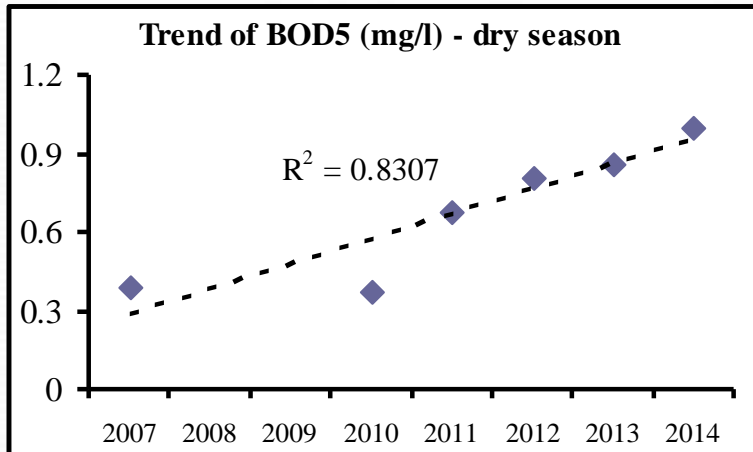


## Dry season:

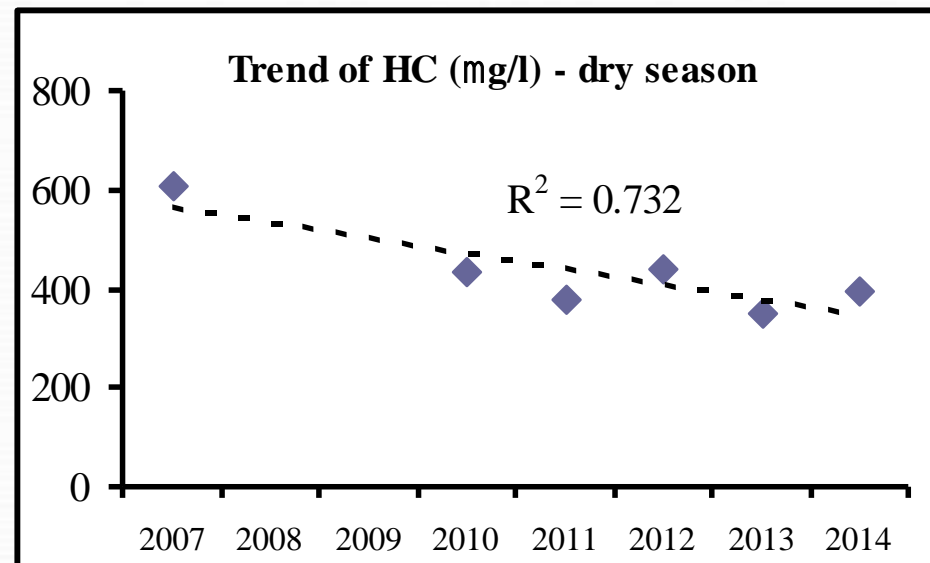
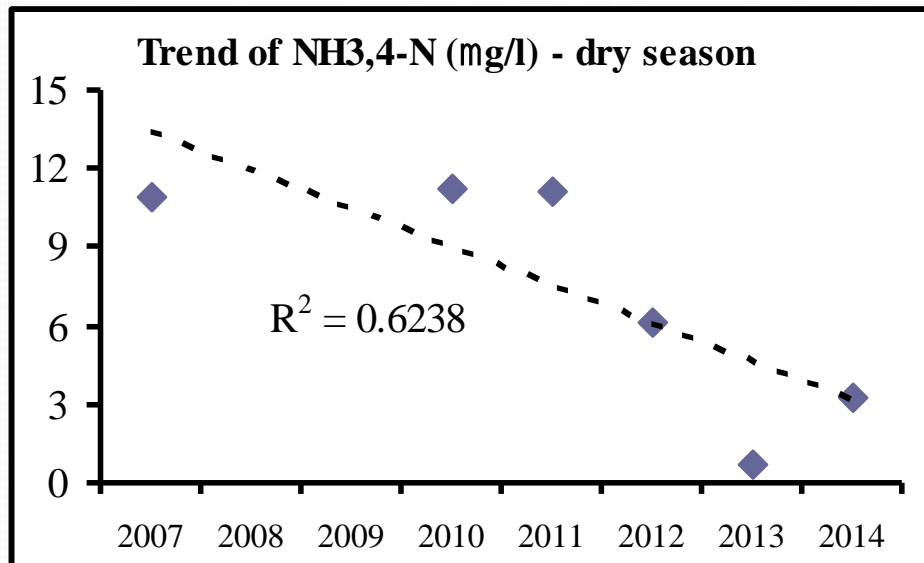
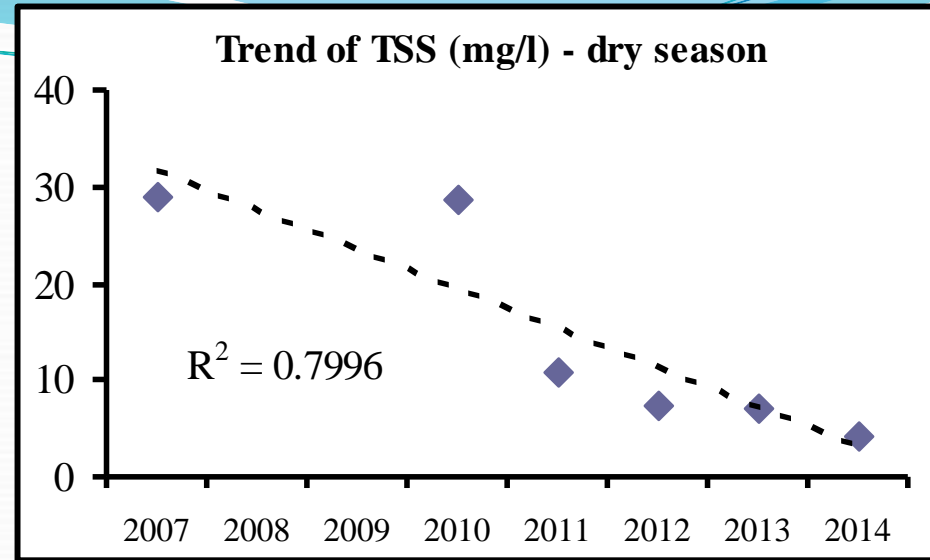
❖ The value of the basic parameters (pH, DO) and nutrient salts (nitrite, nitrate, phosphate, silicate), heavy metals (Zn, Fe, Pb) change insignificantly.



❖ There were the relatively clear trend of increasing in  $BOD_5$ , Cu and Pb

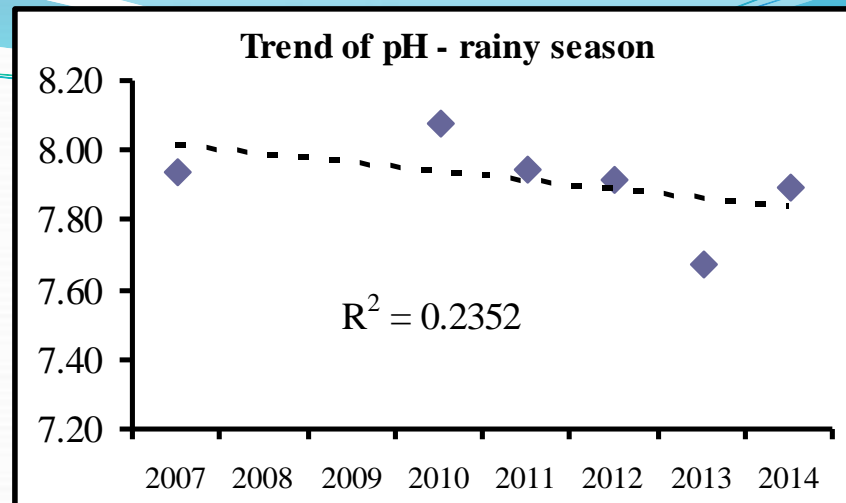


❖ There were the relatively clear trend of decreasing in TSS, ammonia and HC

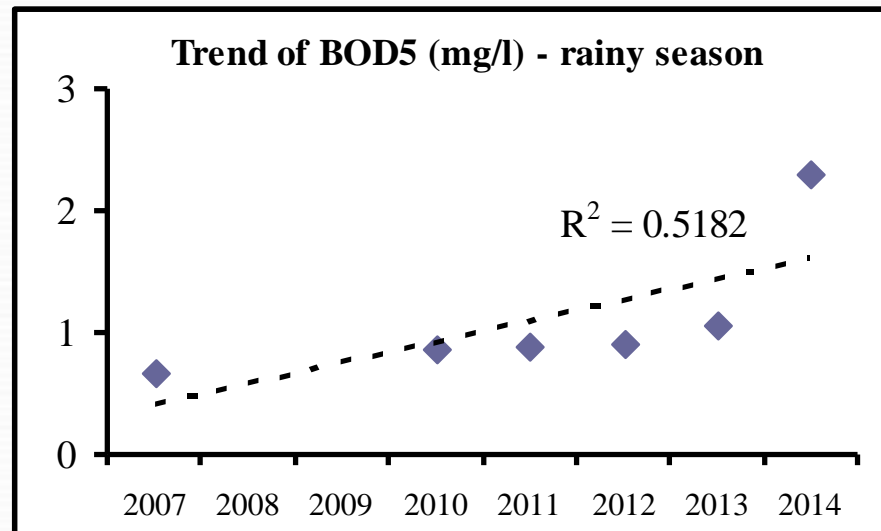
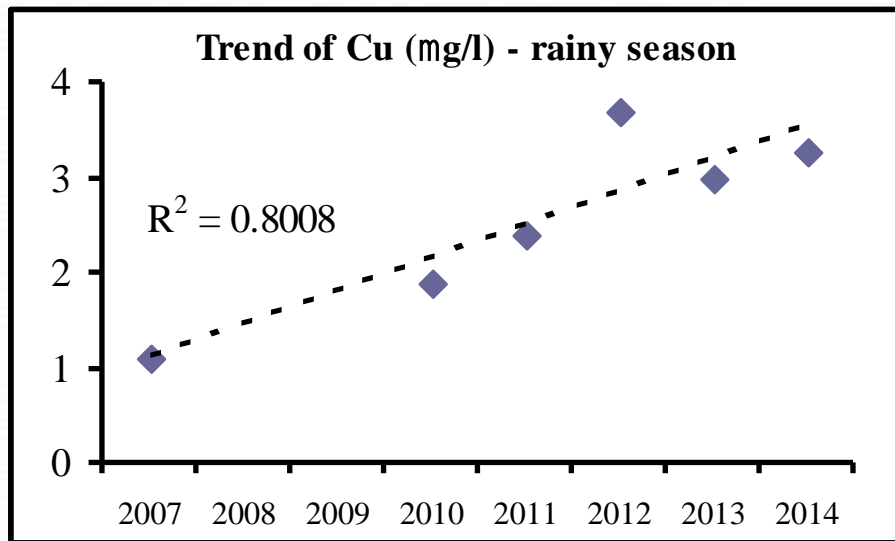


## Rainy season:

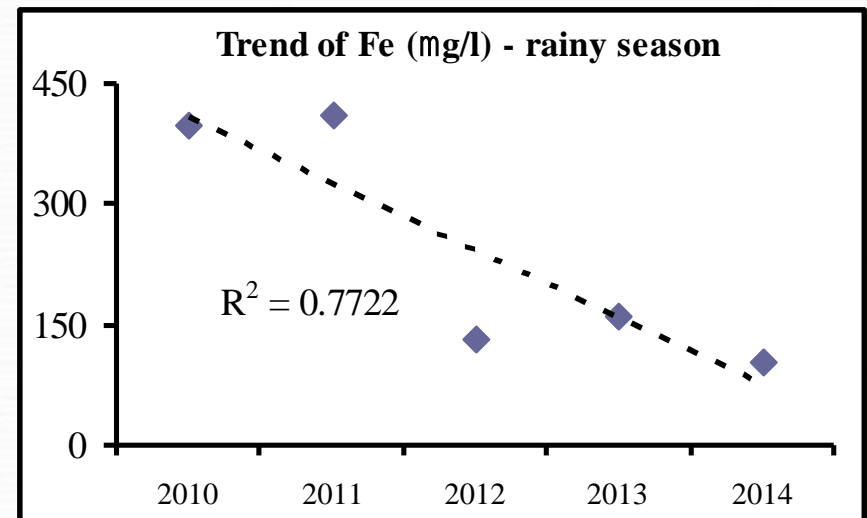
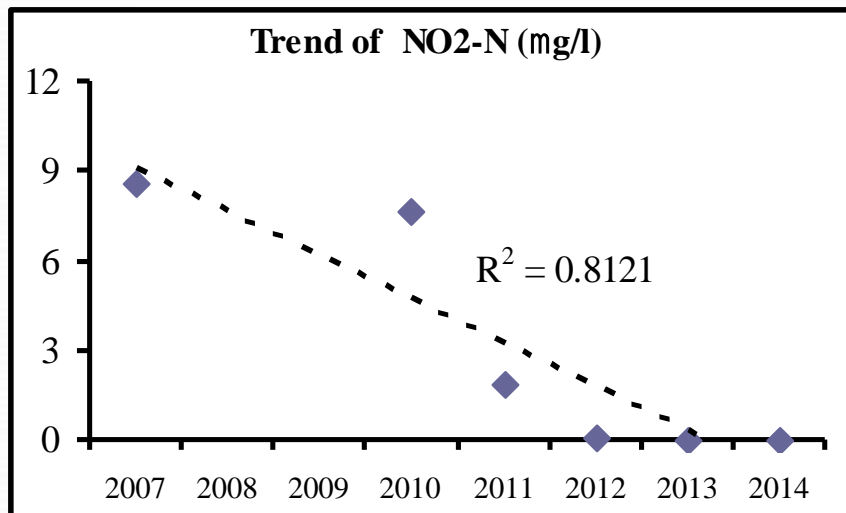
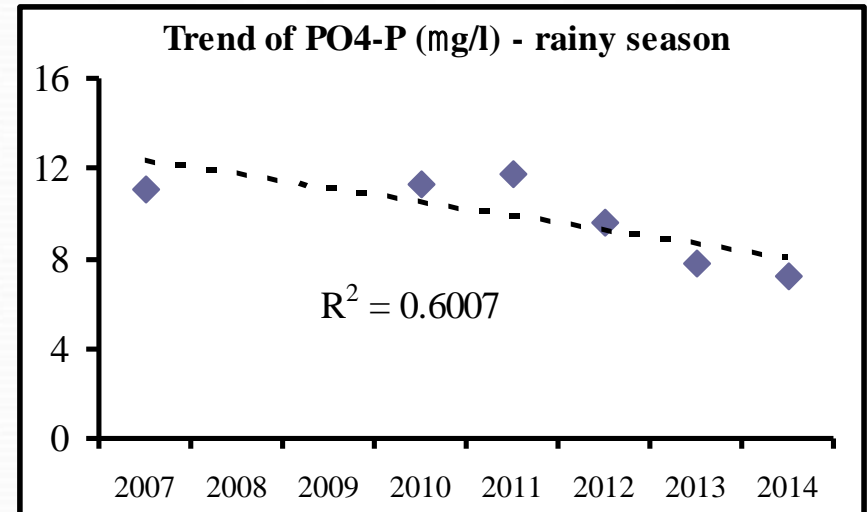
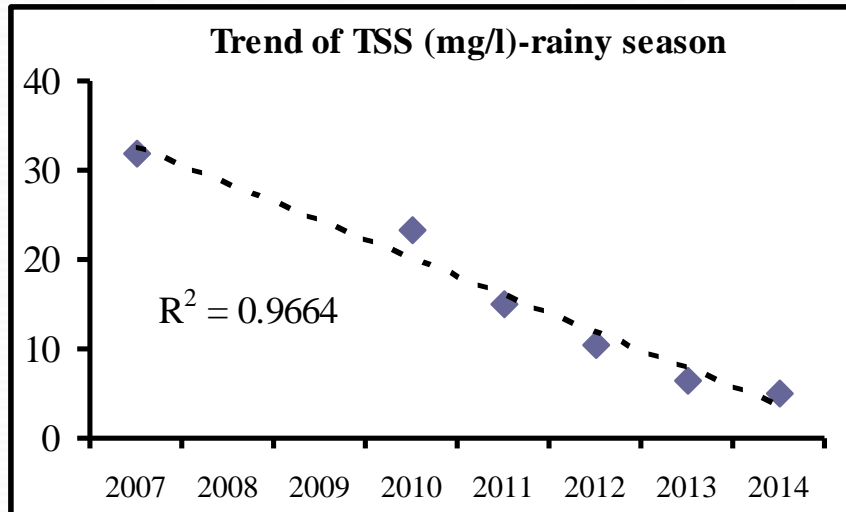
❖ The value of pH, DO and nutrient salts (ammonia, nitrate and silicate), heavy metals (Zn, Pb) change insignificantly.



❖ There were the relatively clear trend of increasing in Cu and BOD<sub>5</sub>

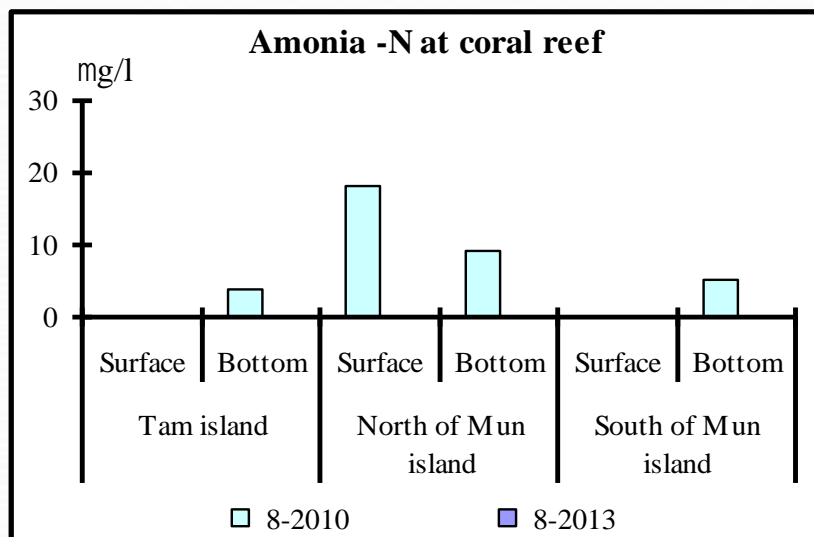
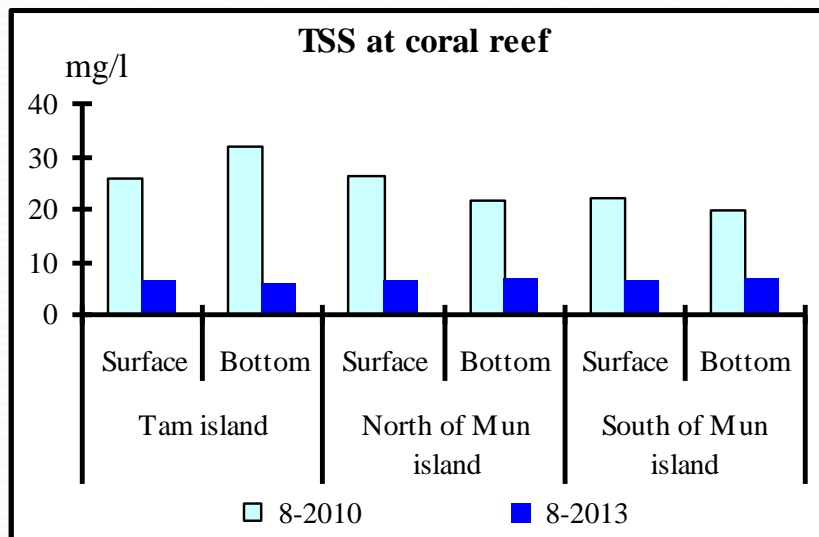
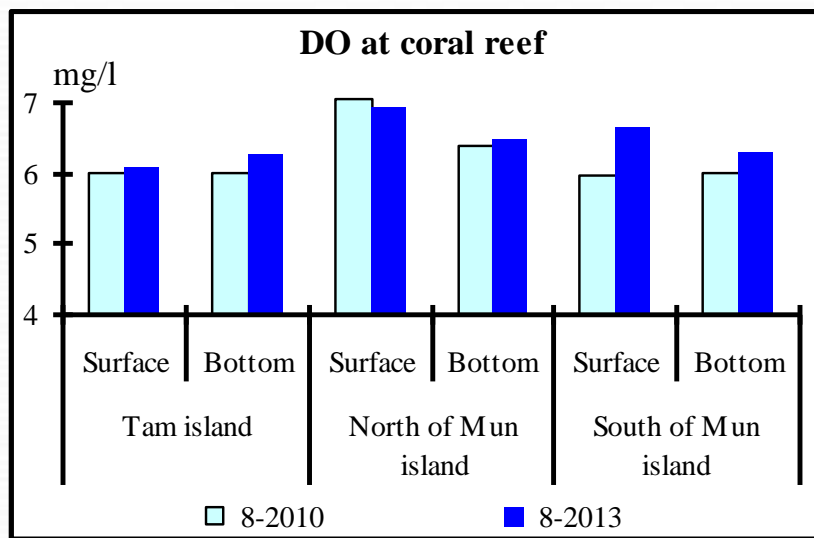
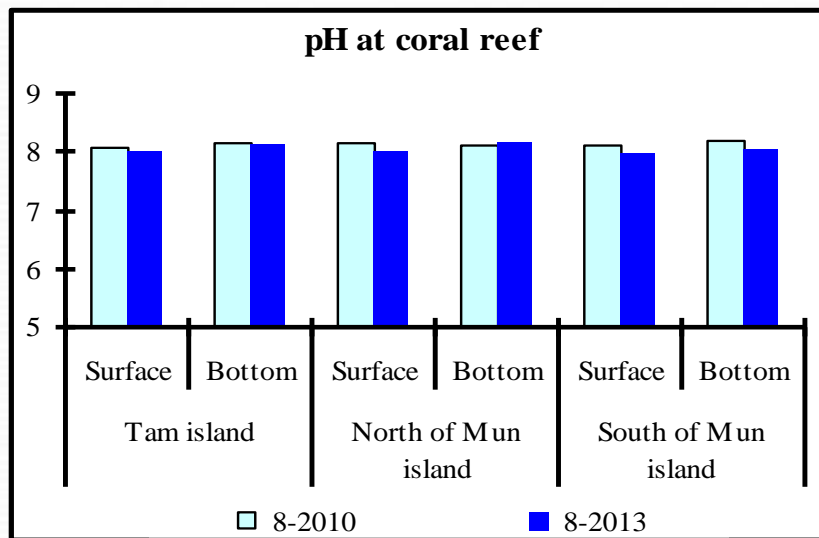


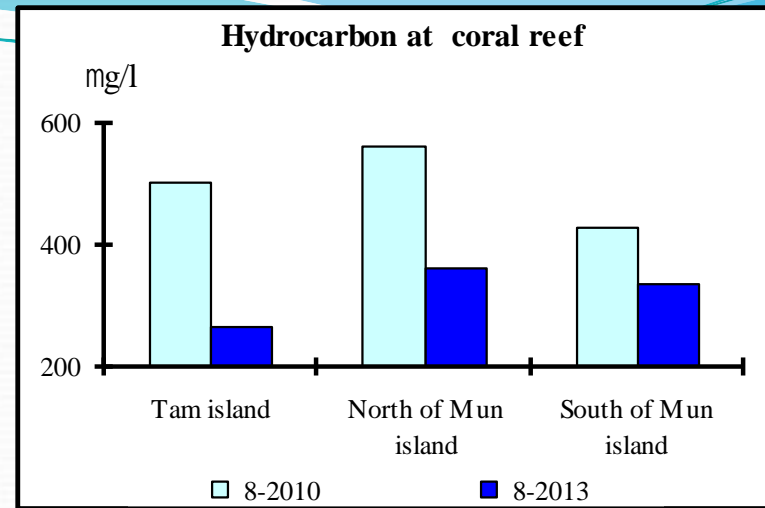
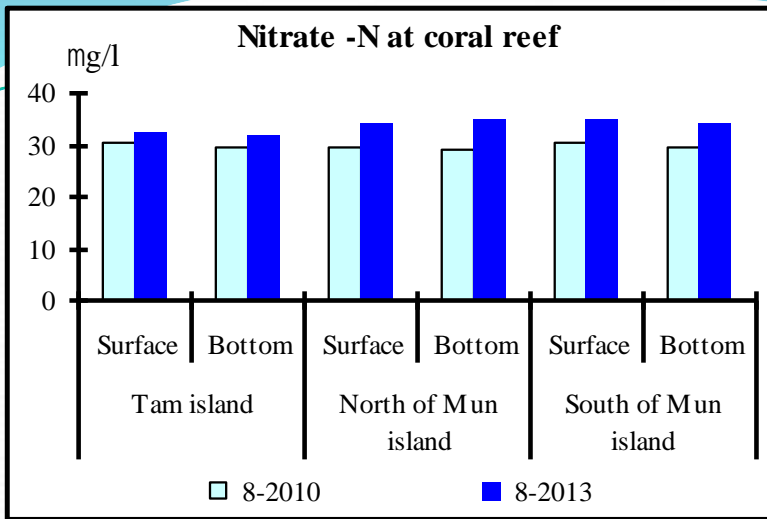
❖ There were the relatively clear trend of decreasing in TSS, phosphate, nitrite, Fe and HC.



# Water quality at coral reef

❖ There was no big difference in water quality between the two surveys in August 2010 and 2013.





❖ In overall, water quality in the coral reef was good for coral reef conservation and aquatic life protection.



# CONCLUSIONS

- ❖ The seawater quality of Nha Trang Bay, especially at coral reef was quite good at both seasons although there were some partial contamination of some parameters at few moments. Water quality in rainy season was a bit worse than in dry season.
- ❖ There were some changes over years such as decreasing (TSS, HC), increasing ( $BOD_5$  and Cu) or unobvious trends (pH, DO,  $NO_3$ ,  $SiO_3$ , Zn) at both seasons.
- ❖ There are some changes only in dry season (decreasing of ammonia and increasing of Pb) or rainy season (decreasing of nitrite, phosphare and Fe).
- ❖ However, the difference of seawater quality over yeas was not so much; there was not the clear sign of environmental degradation in the bay from 2007 to 2014.



**THANK YOU FOR YOUR ATTENTION**