

Environment Impact of Coastal Restoration with Used Car Tires as Breakwater at Chulachomklao Fort, Samutprakan Province

***Orawan Siriratpiriya**

The Environmental Research Institute, Chulalongkorn University, Bangkok 10330, THAILAND

ABSTRACT

At present, the used car tires left in the world around 190 million tons per year. While in Thailand, only 25,000 tons (29%) from 100,000 tons per year was utilized as artificial reef, dam, fuel source and breakwater. In the case of utilized the used car tires as breakwater to prevent coastal erosion and restore the coastal at Chulachomklao Fort. Clarification the environmental impact was done during monsoon seasons by measuring wave height, collecting the sediment, seawater and fouling organism from area where used car tires-breakwater constructed in 2004, in 2007 and outside the breakwater. Environmental quality parameters such as salinity, pH and dissolved oxygen were measured. The results showed that all of above were within the seawater quality standard. The breakwater also signified reduction energy of wave, increased soil sedimentation wherewith increased biodiversity.

KEYWORDS

environmental impact, Chulachomklao Fort, used car tires,

All of the collected samples were analyzed heavy metals (Cd, Cu, Pb and Zn) by GFAAS.



*FY 2012 Practical Research and Education of Solid Waste Management
Based on Partnership among Universities and Government in Asia and Pacific Countries*

Okayama University, Japan

February 2nd, 2013

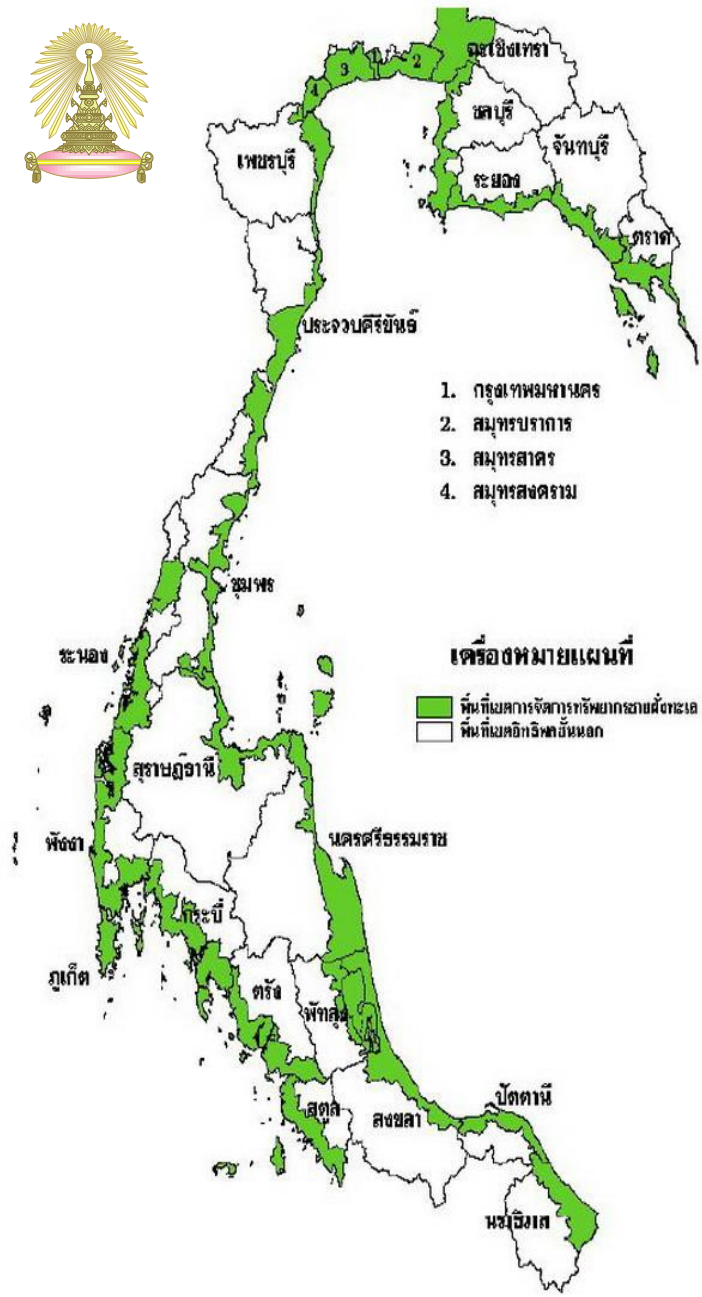


*Environmental Impact of Coastal Restoration with Used Car Tires as Break Water
at Chulachomklong Port, Samutprakarn Province, THAILAND*

Associate Professor Dr. Orawan Siriratpiriya, D.Sc.

*The Environmental Research Institute, Chulalongkorn University
Bangkok, THAILAND*





Coastal Area

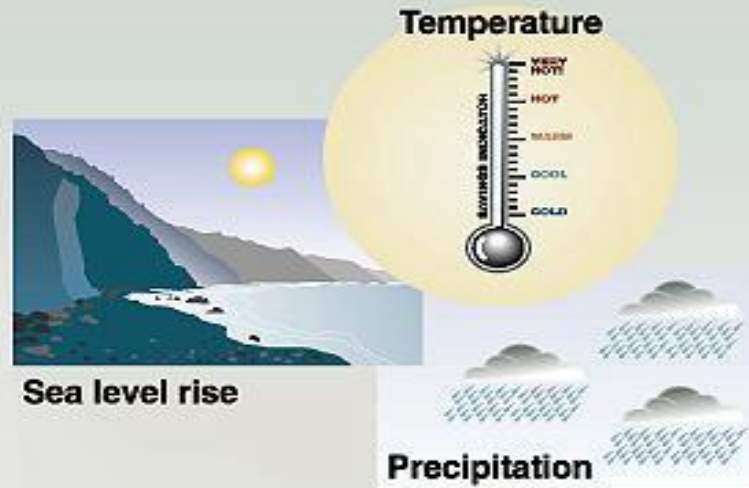
- 20,541, 810 rai
(1 ha= 6.25 rai)
- 32,866,880 km²
- Coastal erosion area
around 20%

(Department of Marine and Coastal Resource, 2010)

Coastal line

- 2,637 km long

Potential climate changes impact



Impacts on...

Health



Weather-related mortality
Infectious diseases
Air-quality respiratory illnesses

Agriculture



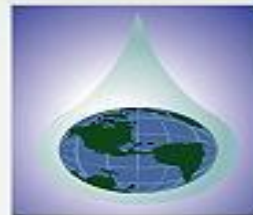
Crop yields
Irrigation demands

Forest



Forest composition
Geographic range of forest
Forest health and productivity

Water resources



Water supply
Water quality
Competition for water

coastal areas



Erosion of beaches
Inundation of coastal lands
additional costs to protect coastal communities

Species and natural areas



Loss of habitat and species
Cryosphere:
diminishing glaciers





How to Protect Coastal Area ???

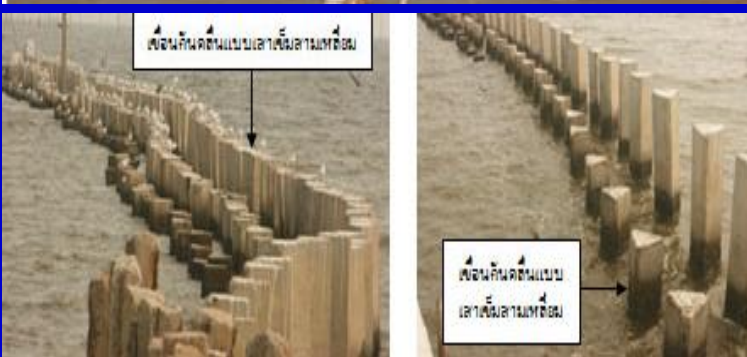
Natural Process





How to Protect Coastal Area ???

Man Made Process





Breakwater



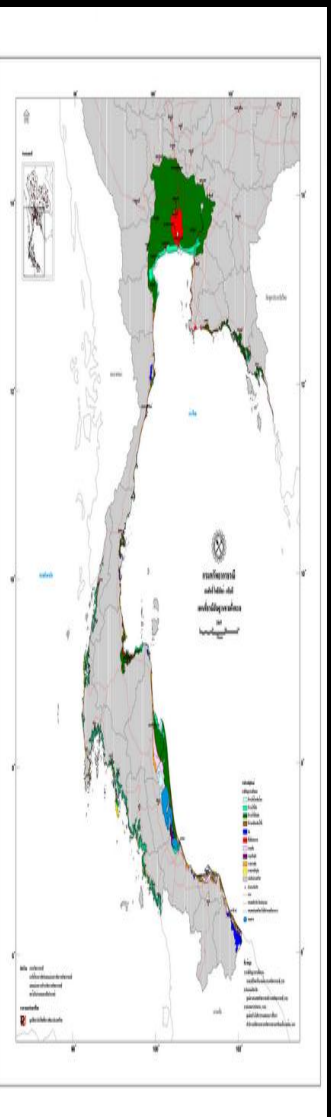


Coastal erosion

Samutprakarn Province

- Coastal area 50.21 km.
- Severe erosion (> 5 m/yr) 31.47 km.
- Moderate erosion (1-5 m/yr) 5.22 km.

(Department of Marine and Coastal Resource, 2010)

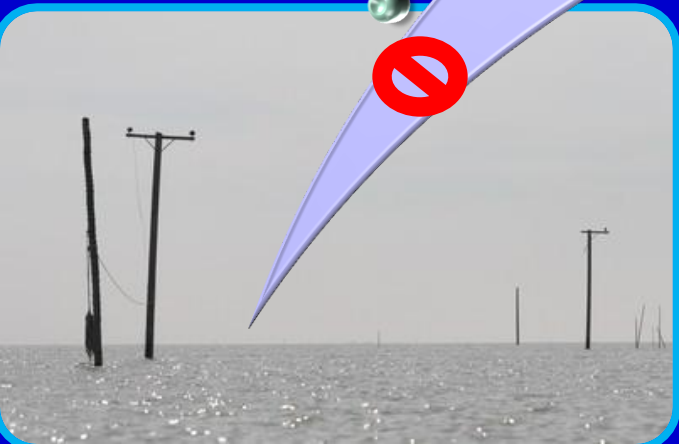




**Bangpree/Bang Bo
Sub-district
Samutprakarn
Province**



**Samutprakarn
Province**



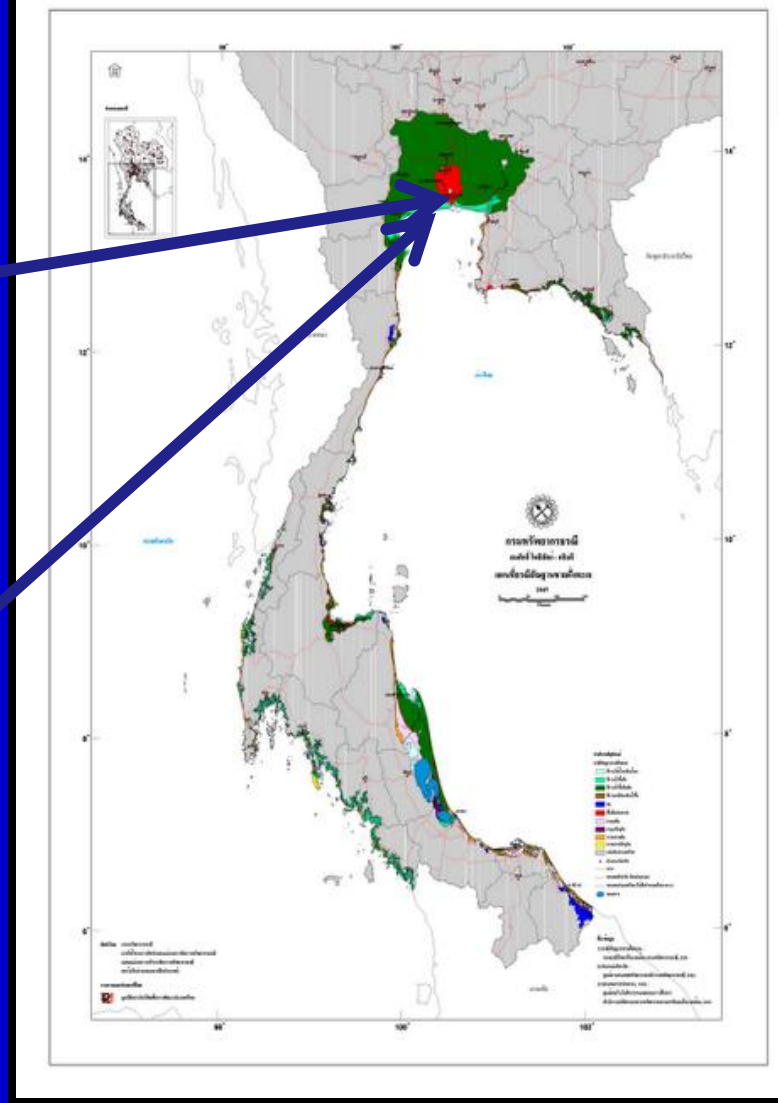
**coastal erosion rate
15-20 meters/year
with the distance
17.5 kilometers**

**Chulachomkiao fort
Eroded 700-800 m.**

**Coastal erosion rate
> 5 m/yr**

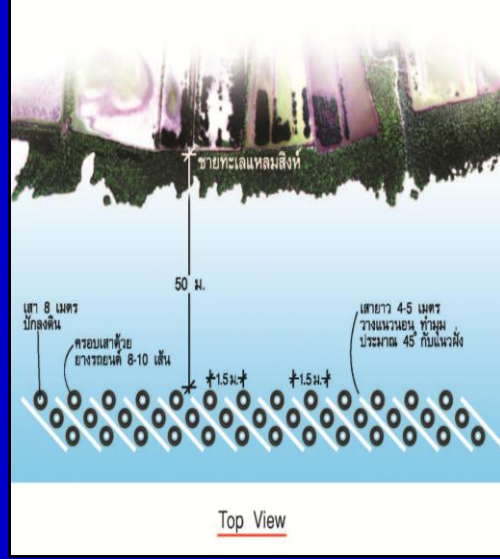
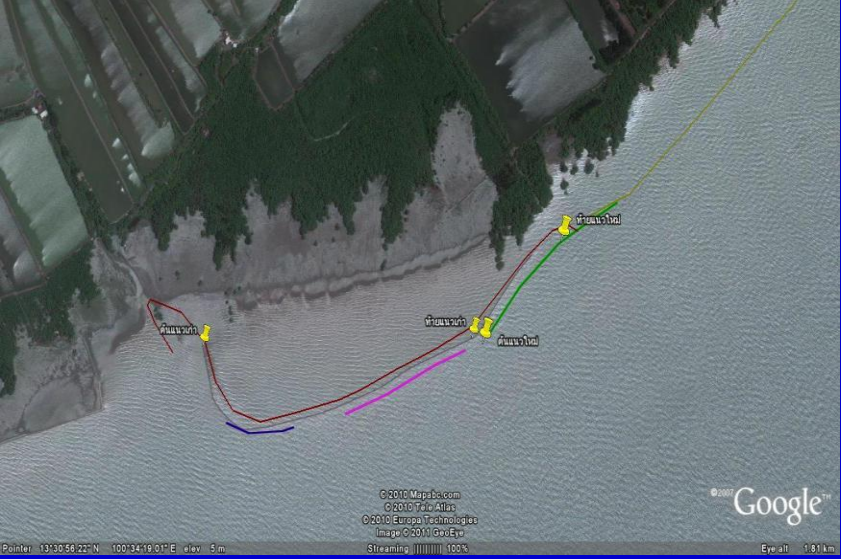


Chulachomkiao Fort



Coastal erosion rate > 5.0 meters/yr.

Erosion area around 30 kilometers







Utilization of Used Car Tired

Rayong Province



<http://www.saveoursea.net/boardsmf/index.php?topic=751.0>



http://tassz.multiply.com/photos/album/37/PLANET_OCEAN

Nan province



<http://www.nanlive.com/forums/topic/550-สร้างฝายกันน้ำด้วยยางรถยนต์เก่า ถวายในหลวง.html>

One of the Most Concern



Used Car Tire

- In 2011, used car tire around 25.5 million tons were left for the whole world to manage and expected the increasing amount and rate (IRSG, 2012)
- In England, production of new car tire around 37 million piece/yr and left as used car tire around 400,000 tons/yr
- In Thailand, each year the used car tire was left around 56-170 million pieces (1.7 million tons)

(pollution Control department. 2011)





Car Tire

- Toxicity occurs when it burns due to chemical composition (USEPA, 1993)
- Indicator pollutants: particulate, carbon monoxide: CO, sulfur oxides: SO_x , nitrogen oxides: NO_x , volatile organic compounds: VOCs
- Considered pollutants: PAHs, dioxins, furans, hydrogen chloride, benzene, polychlorinated biphenyls: PCBs and heavy metals such as Cd, Zn, Cu, Pb (USEPA, 1993)

Table 1: Heavy metals from car tired (ppm) (Legret and Pagotto, 1999)

Heavy metals	Concentration (ppm)	Heavy metals	Concentration (ppm)
Ag	0.08	Mg	32-106
As	0.8	Mn	2
Al	81-420	Mo	2.8
Ba	0.9-4.1	Na	610
Ca	113-562	Ni	0.9-50
Cd	0.28-4.96	Pb	1-160
Co	0.88-24.78	Sb	2
Cr	0.4-6.73	Se	20
Cu	1.8-29.3	Sr	1.16-3.13
Fe	2.12-533	Ti	195
K	180	V	1
Li	0.23-2.3	Zn	8378-13494

Chemical composition of car tired

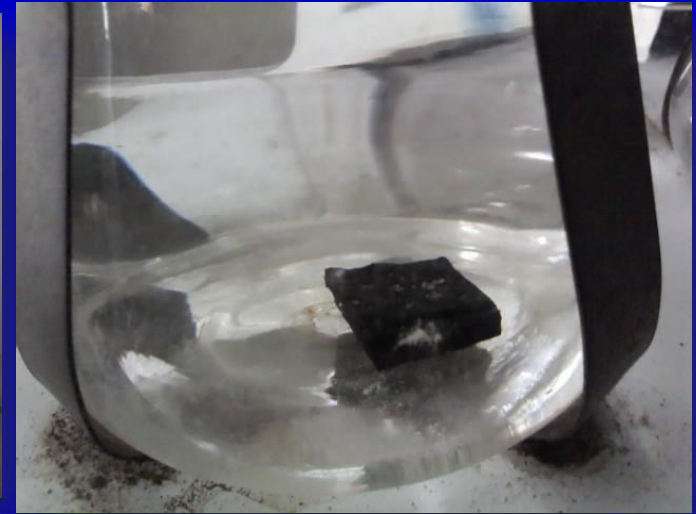
Table 3 – A compilation of published data for elements in vehicle tires

Metal	Tires							
	San Miguel et al. (2002)	Kennedy and Gadd (2000)	Legret and Pagotto (1999)	Homer (1996)	MoT (1996)	Hewitt and Rashed (1990)	Sadiq et al. (1989)	David and Williams (1975)
Al	956	20.5					64–3823	
As	<5.0	nd						
Ba		25.8						
Be		0.3						
Cd	2.9	<0.19	2.6	0–3.0	0.77	0.28–4.96		0.13–14.06
Co	38.7	1.05					10.0–997.1	
Cr	49.4	<1						
Cu	68.5	1	1.8			5.5–29.3	1.1–45.9	
Fe	2818	105					9.1–778.1	
Hg		<0.01						
Li		0.2						
Mg	444	11.2						
Mn	13.9	1.2					1.6–11.7	
Mo	10.0	1						
Ni	5.9	1					2.4–17.9	
Pb	59.0	2.72	6.3	8.1–22.3	0.84		2.1–518.6	
Rb		<0.2						
Sb		<0.2						
Se	4.0	nd						
Sn		<0.5						
Sr		0.6						
Tl		nd						
V		nd						
W		nd						
Zn	12,700	8310	10,250	2524–6012	5624			8400–16,600

Concentrations in mg/kg. nd: not detected.

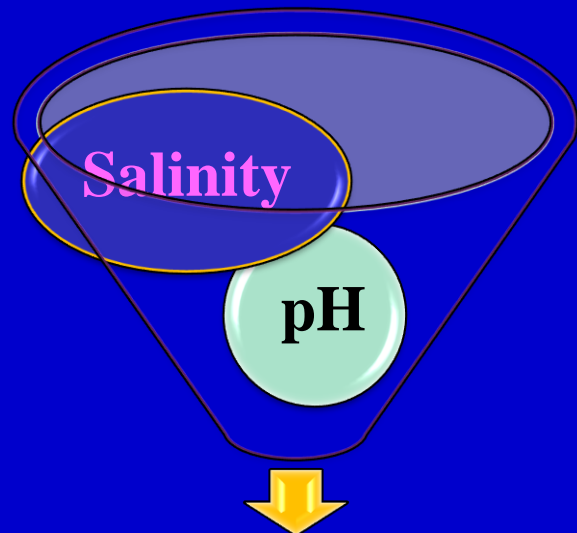


Heavy Metals



Sompop Rungsupa, 2011

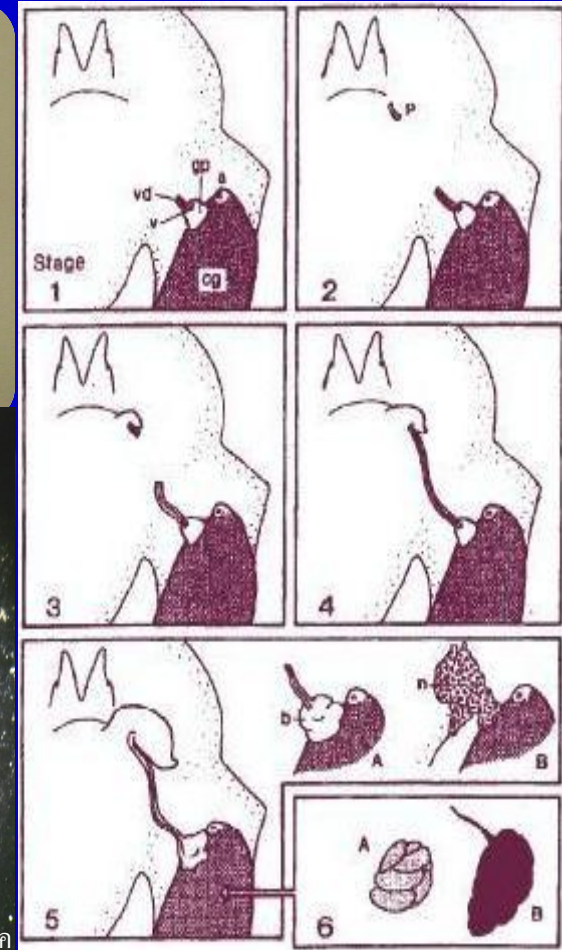
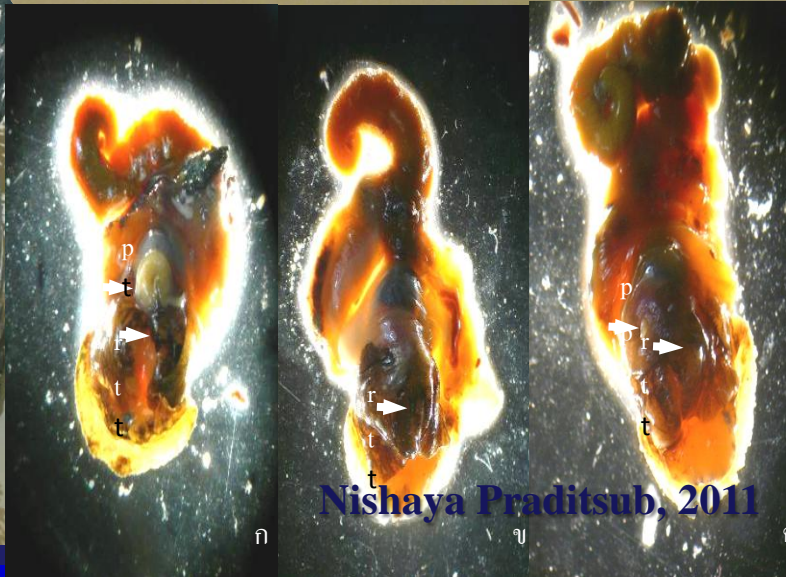
Heavy metal	2001-2004	2005-2010	2011	Breakwater area	Standard sea water
Cd (ppb)	<0.008-0.1	<0.001-0.1	<0.1-0.1	<0.01	≤ 5
Cu (ppb)	9.83-11.0	1.0-3.41	0.5-3.41	<0.01-0.256	≤ 8
Pb (ppb)	4.7-14.9	1.01-3.67	0.5-3.67	<0.03-0.381	≤ 8.5
Zn (ppb)	15.0-48.1	<2.0-359	7.43-8.7	<0.005-0.153	≤ 50



Factors affecting leachability of heavy metals



Imposex





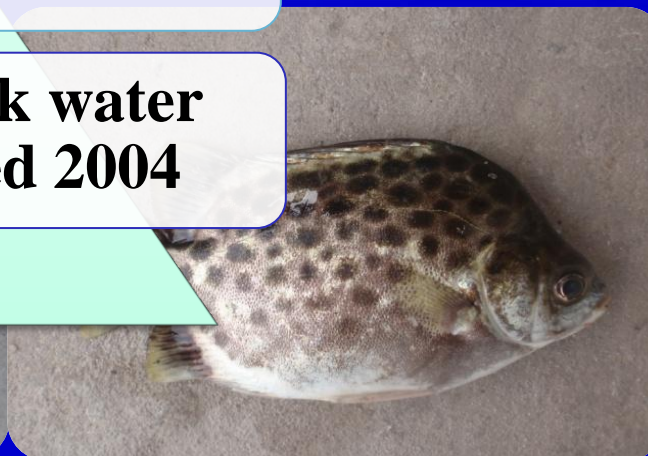
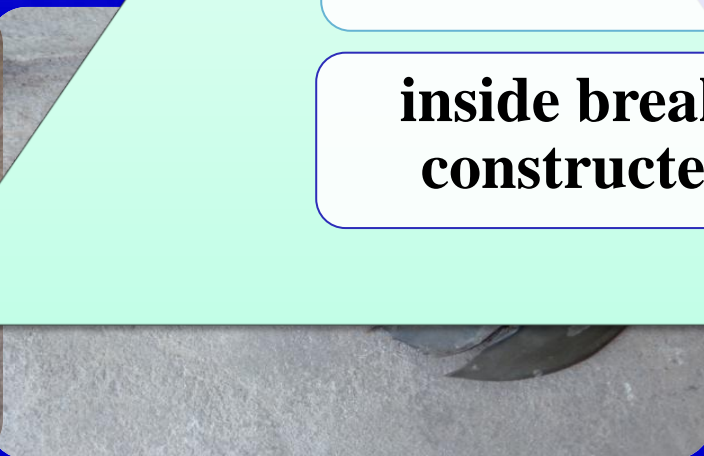
Biodiversity



Outside Break water

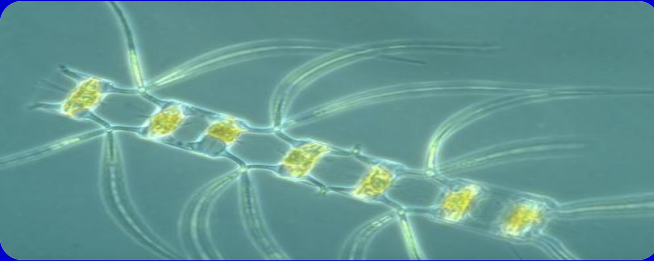
**inside break water
constructed 2007**

**inside break water
constructed 2004**





Environmental Quality



- phytoplankton (*Chaetoceros* sp.)
as food for young sea shrimp



- Zooplankton *Copepod* (holoplankton)
indicated good biodiversity

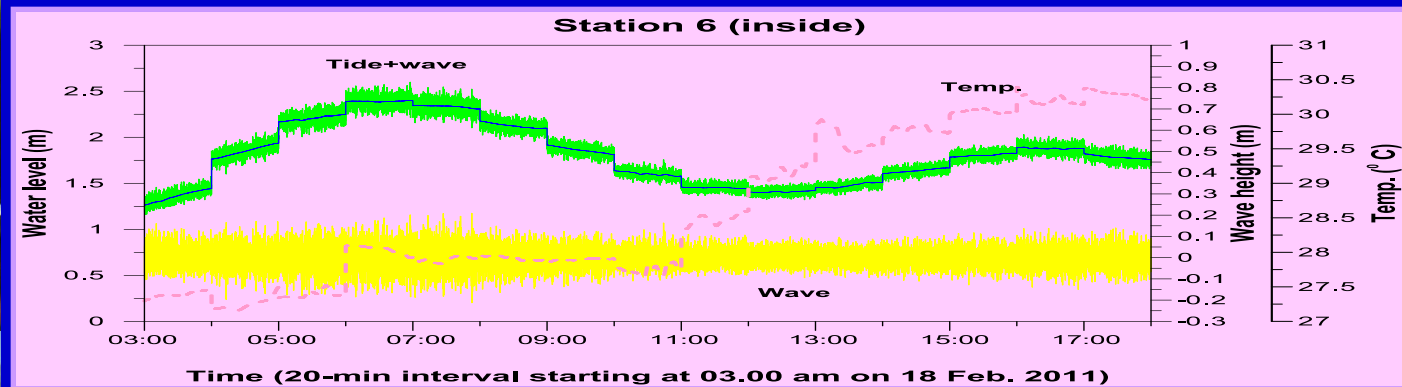
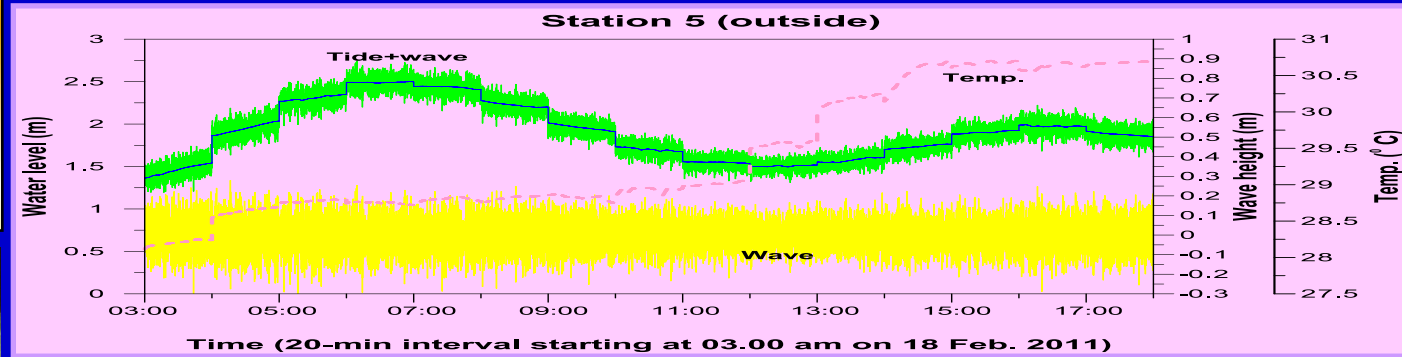


- Plankton indicated **red tides**



- polychaeta (least number)
indicated good environment

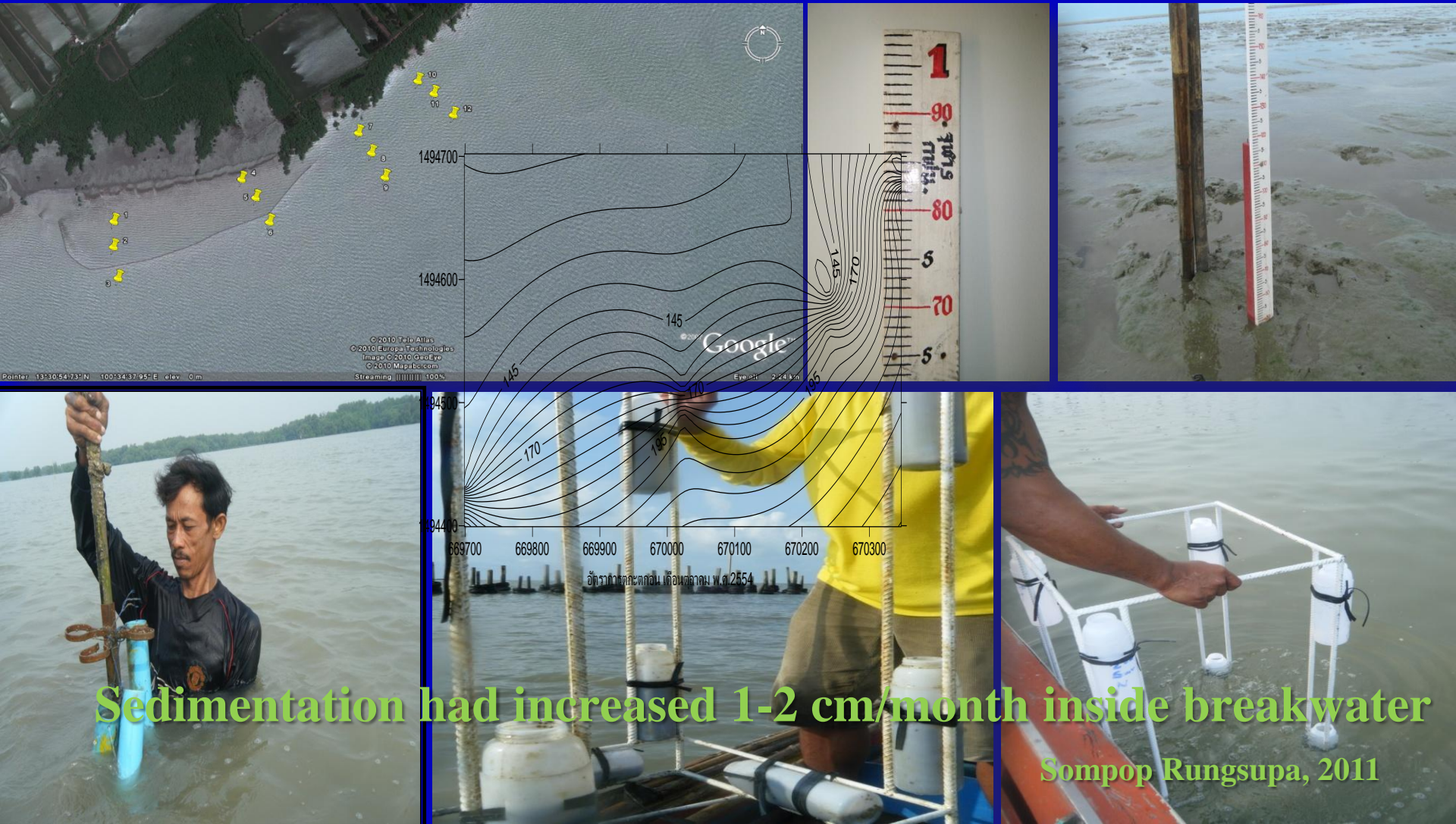
Wave Height



wave height outside break water (m)	wave height inside break water (m)	reduction of wave energy (%)
0.278	0.218	39
0.280	0.236	29
0.287	0.202	50



Sedimentation





People Participation/Acceptance

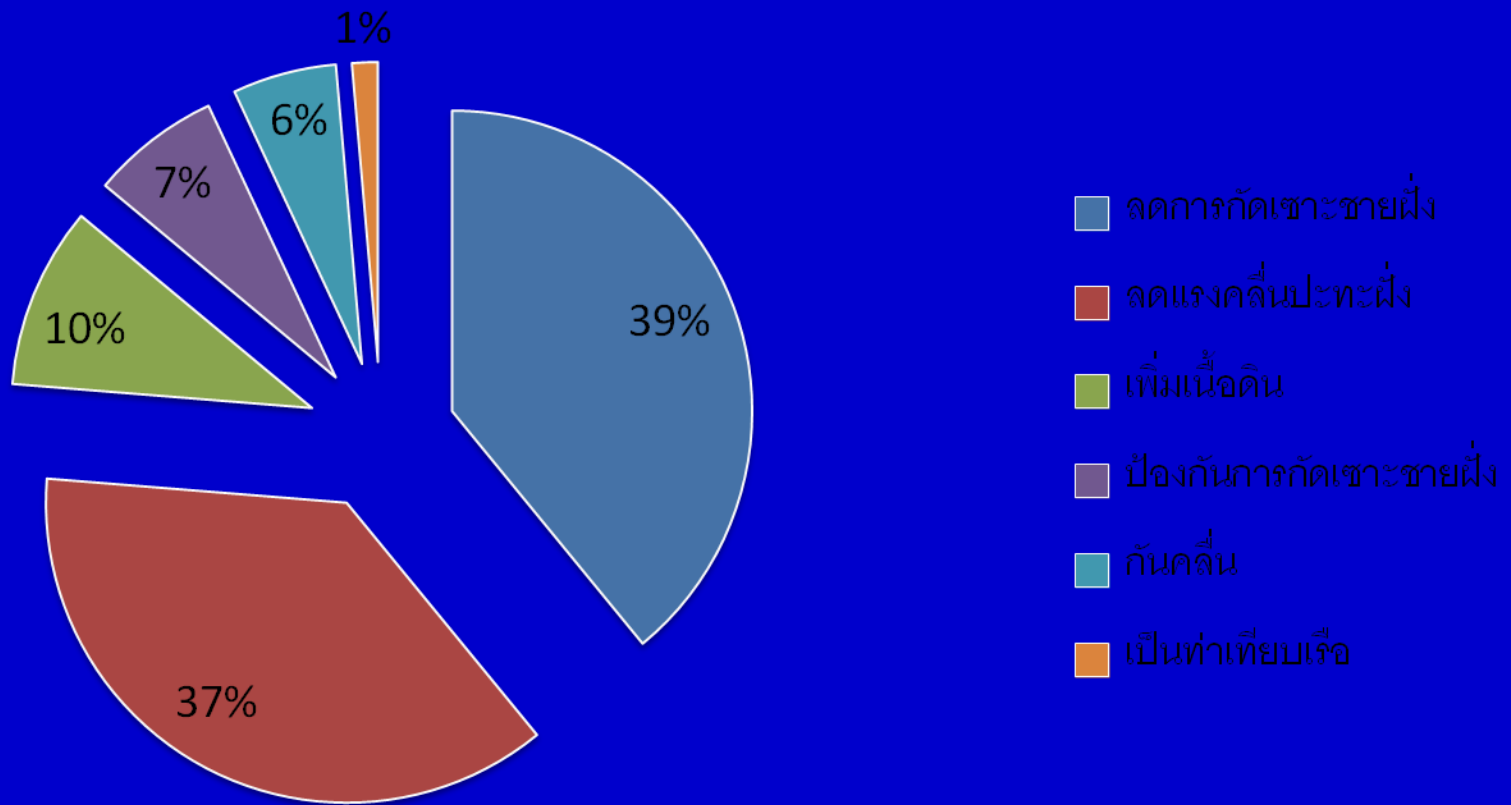


Orawan Siriratpiriya, 2011



People Participation/Acceptance

ความคิดเห็นผู้มีส่วนได้ส่วนเสียกรณีการมีแนวเสาไฟฟ้าชั่วคราวสวมยางรถยนต์ใช้แล้ว

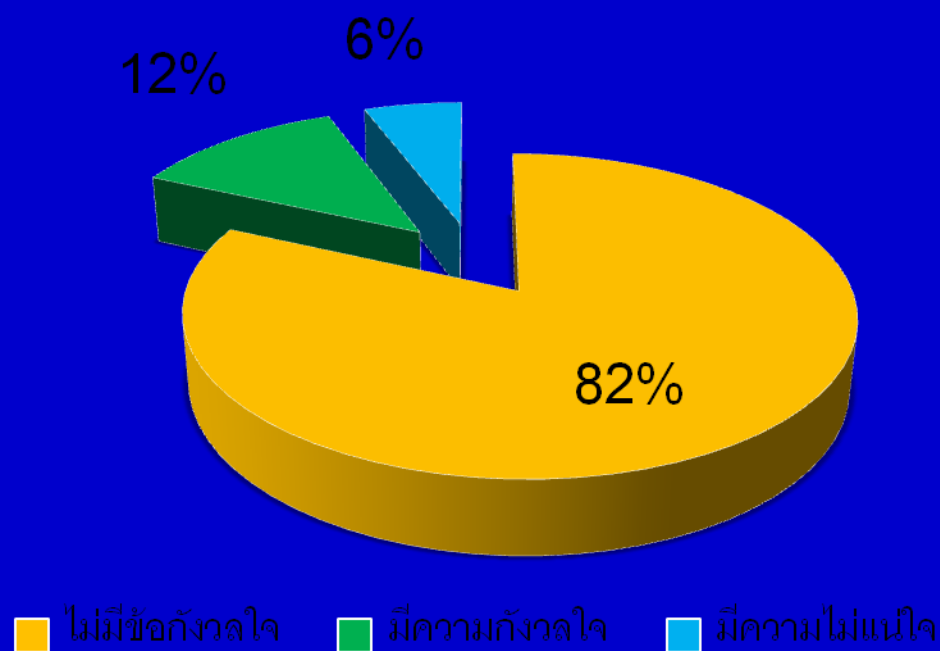


Orawan Siriratpiriya, 2011

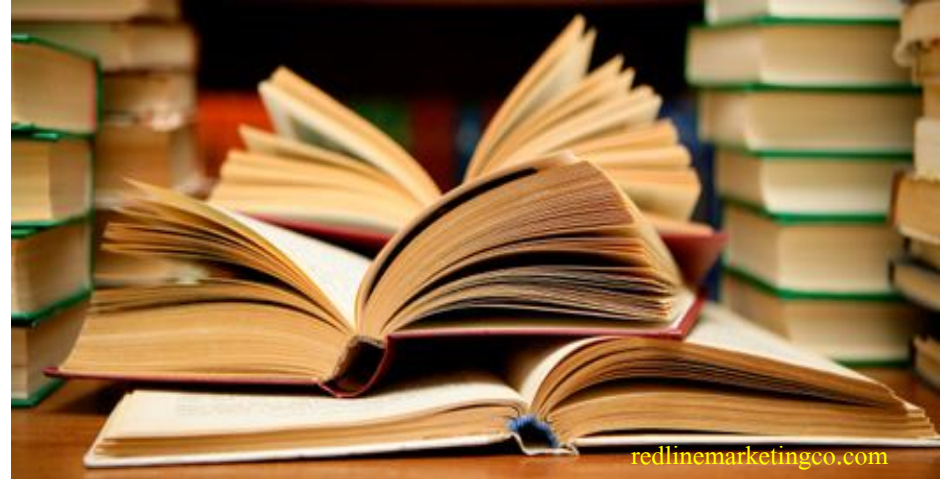


People Participation/Acceptance

ความไม่กังวลใจต่อการมีแนวป้องกันฯจากผู้มีส่วนได้ส่วนเสีย

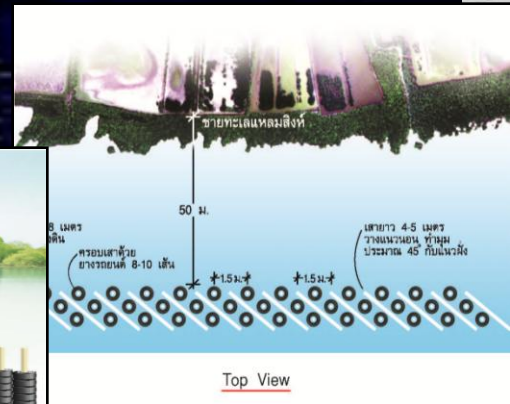
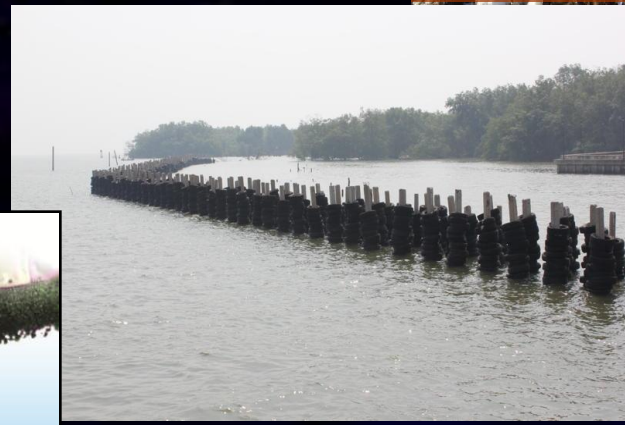


Orawan Siriratpiriya, 2011





www.thaigoodview.com/.../toxic/03.jpg



Top View



Perspective View



navy.mi.th



thesiamtharawalai.com



irrigation.rid.go.th



media.thaigov.go.th



Thank you