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# Results and lessons learned from joint beach debris surveys by Asian NGOs

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# ◆ Background & Purposes



# Background

- Asian region - Potential hot spot of marine debris pollution in the globe
  - Rapid growth in economy and population
  - Change in lifestyle which consumes single use products
  - Lack of systems and concerns to properly control marine debris



# Background

- Shortage of scientific evidences on pollution and sources
  - Asian International Coastal Cleanup coordinators experience limitations of scientific aspects in ICC method.
  - Need of a harmonized and scientific method of beach debris survey , especially in the Asian region



# Background

- Role of NGOs in addressing MD in the region is important.
  - Key persons in NGO sector - ICC coordinators
  - NGO network since 2010: East Asia Civil Forum on Marine Litter established
  - Capacity building is needed for NGOs to produce scientific data on marine debris pollution, especially using citizen science



# Purposes

- To share a harmonized protocol for beach surveys
- To determine abundances and types of beach debris in the Asian region
- To identify sources to be focused
- To raise capacities of NGOs to participate citizen science
- To move forward to address the issue in cooperative ways



◆ **Process to make a draft protocol  
("AMETEC protocol")**





# AMETEC 2013~2015: Marine Debris

## ● Purpose

- To build capacity of ICC coordinators in the region
- To build networks among scientists and NGOs

## ● Program

- Three-year training program organized by **KIOST and OSEAN**
- Theme: **Macro-Meso-Micro debris**

2013 - 2014 - 2015



# Process to make the AMETEC protocol

1. Based on UNEP/IOC Guideline
2. Draft made by researchers at Korea Marine Litter Institute, OSEAN in April, 2013
3. Classification system and beach survey methods decided after fiery discussion at the AMETEC workshop in June, 2013.
4. First surveys conducted in October~December, 2013
5. Second surveys conducted in May~July, 2014
6. Draft result of 1st surveys shared at the AMETEC workshop in July, 2014
7. AMETEC protocol amended and shared for upcoming surveys

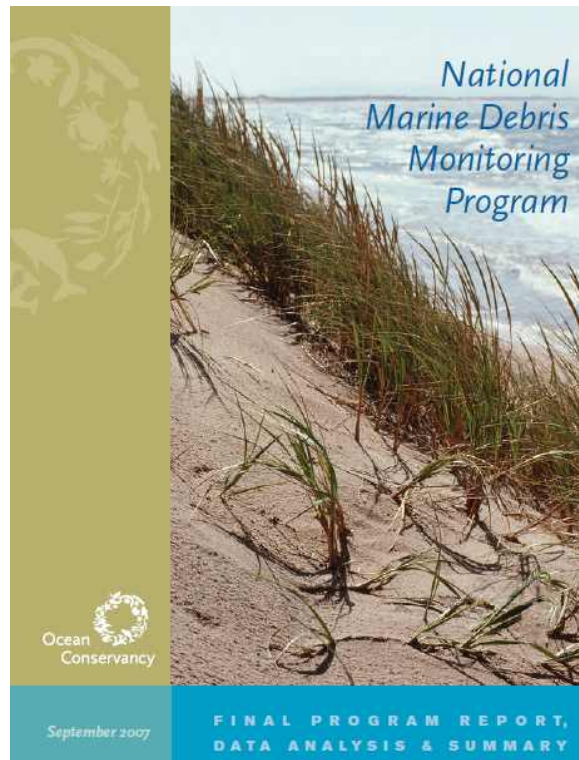
# National MD Monitoring Programs to Regional Programs

UK



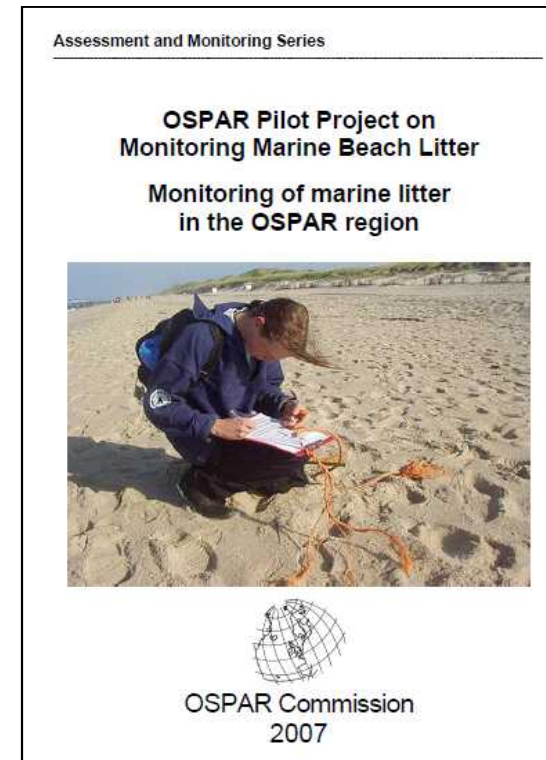
1994~

USA



1996~2007

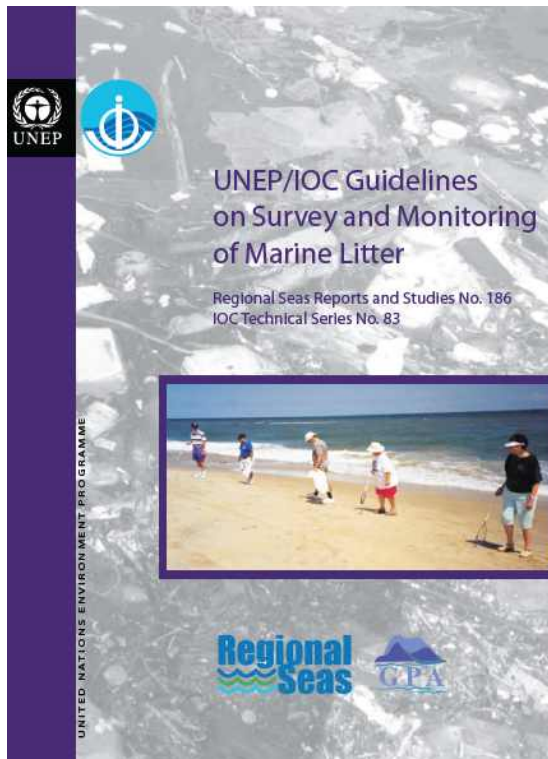
OSPAR (Europe)



2000~2006

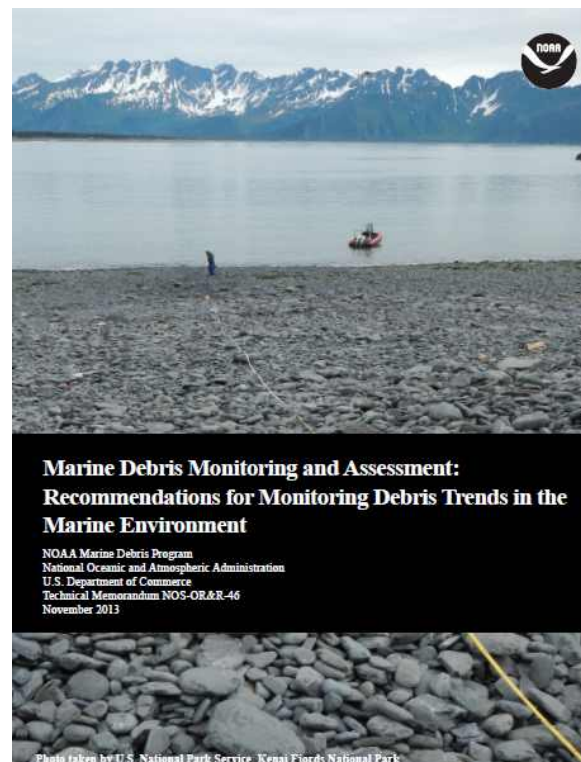
# Guidelines to Standardized Marine Debris Monitoring Protocol

## UNEP/IOC



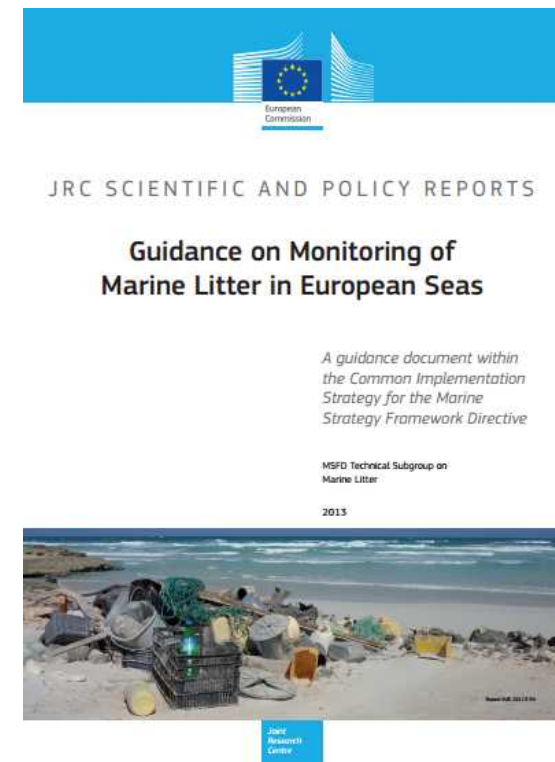
(Cheshire et al., 2009)

## USA



(Lippiatt et al., 2013)

## Europe

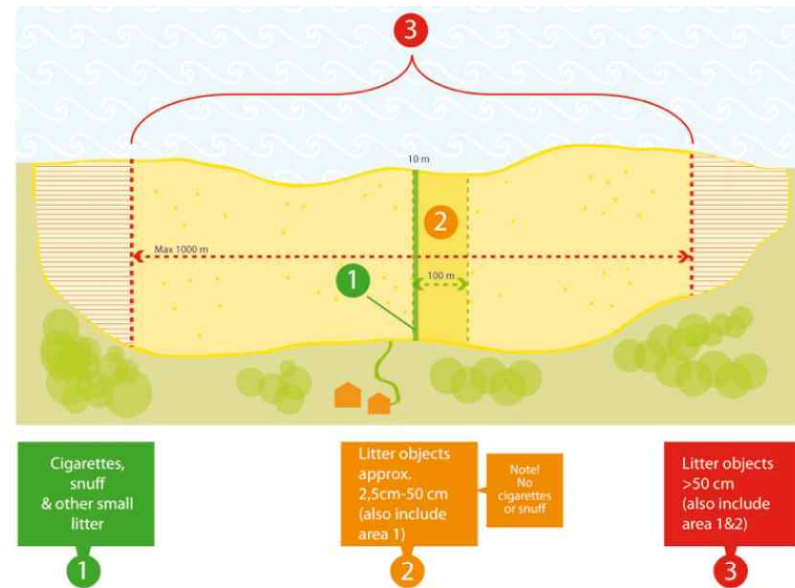


(EC, 2013)

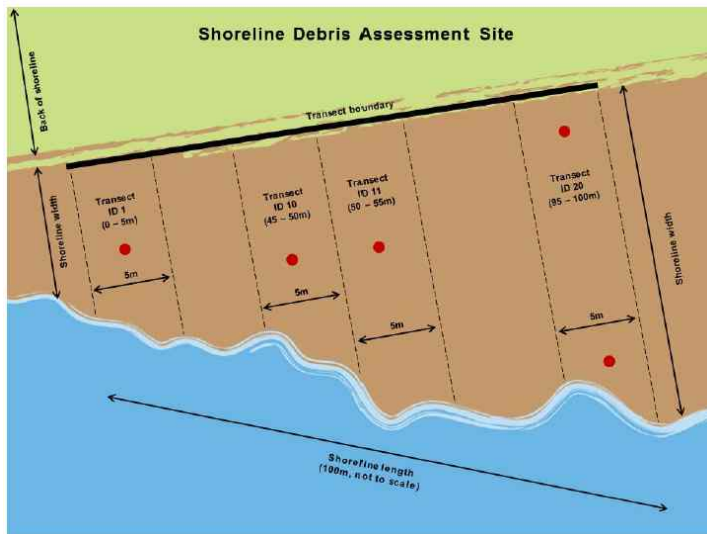
# Various Site Locations of Beach Debris Surveys



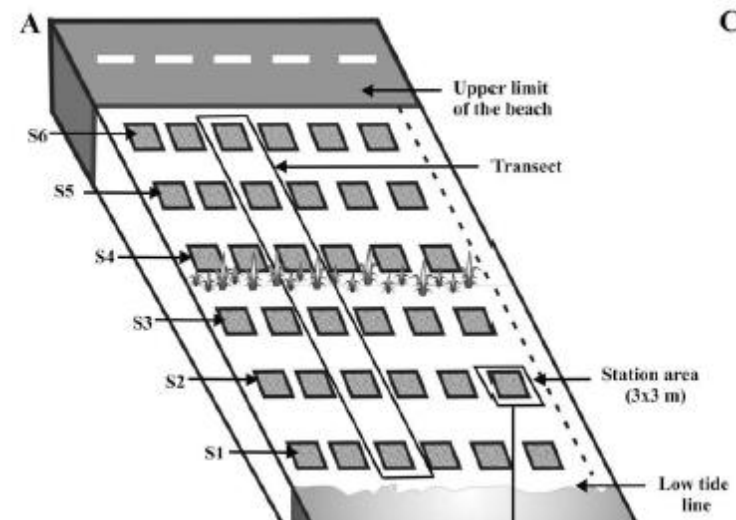
UNEP



OSPAR



NOAA



Chile

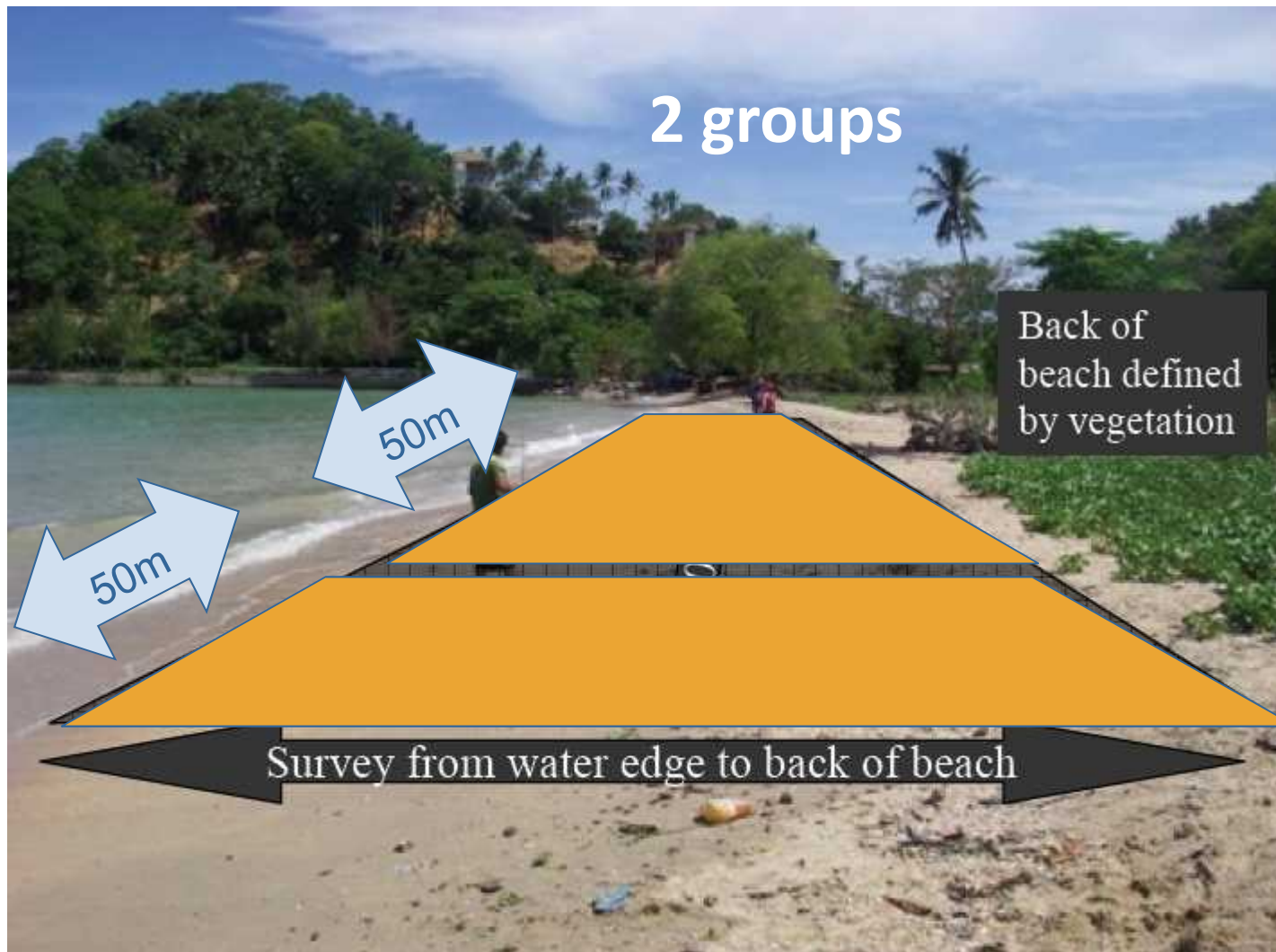
## Draft made by OSEAN

- By researchers at Korea Marine Litter Institute of OSEAN in April, 2013
- Proposal at the 10-day AMETEC training workshop (June 13, 2013)
- Discussion on the feasibility of the protocol



## Field experiment

- At a beach for testing the draft protocol









## Group presentation

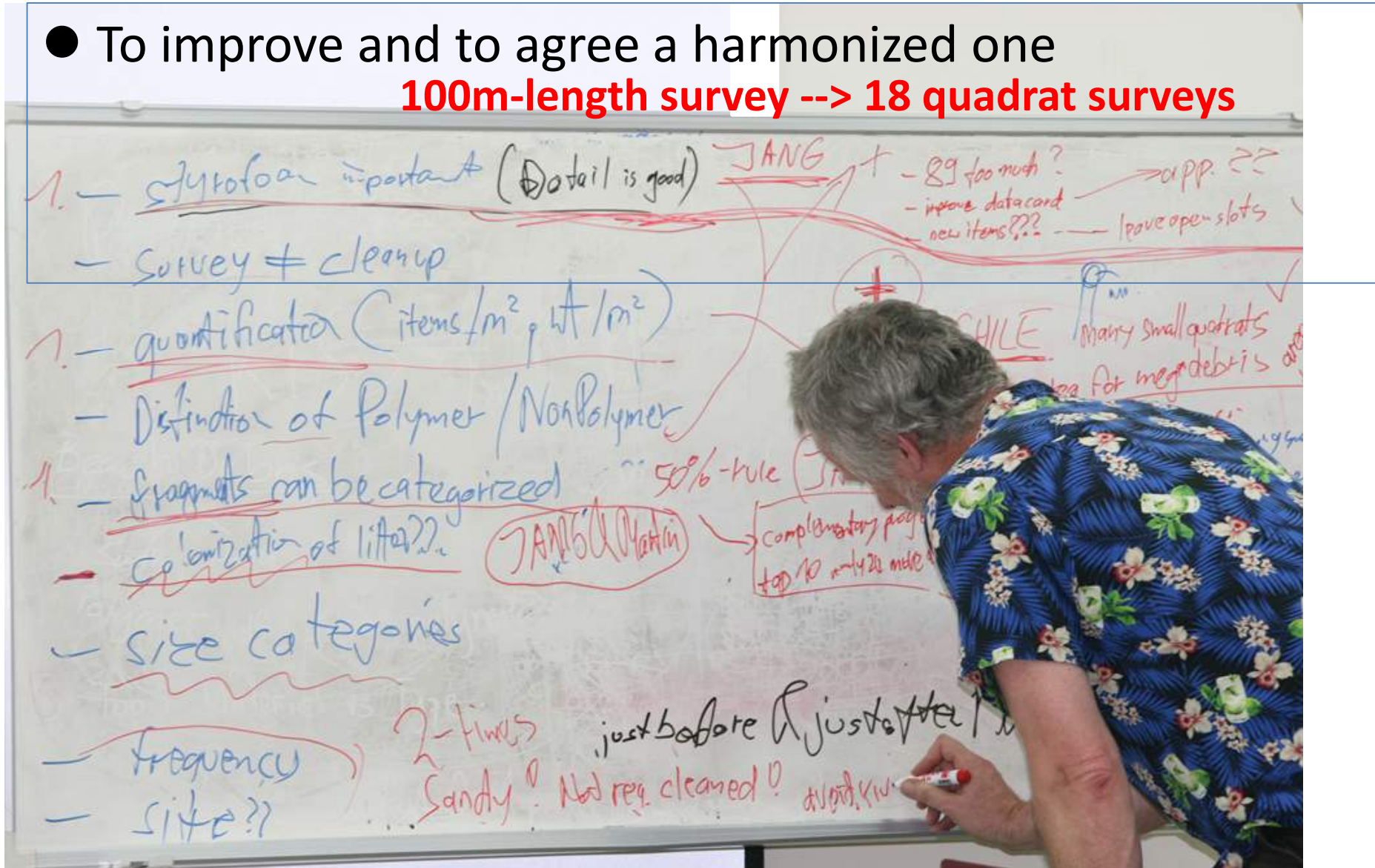
- On the survey results and experiences





# Discussion on the draft protocol

- To improve and to agree a harmonized one  
**100m-length survey --> 18 quadrat surveys**



# ◆ Features of AMETEC protocol



## **Features of the AMETEC Protocol compared to UNEP/IOC Guideline**

1. Clear classification by materials first
2. Clear differentiation of fragments and whole items of debris
3. 18 quadrats (3\*3m) survey instead of 100m-length survey at a beach
4. Survey on organisms attachment

## Beach selection

- Ideally, the selected beach should meet the following criteria:

- (1) not be regularly cleaned,
- (2) sandy beach,
- (3) at least 100 meter long,
- (4) outside of the influence of rivers

Beach Debris Data Card under AMETEC PROTOCOL

Year/month/date of survey		Check (✓) the Quadrat please	Transect						
Time of survey			T1	T2	T3	T4	T5	T6	
Name of the Beach		Quadrat	Q1						
Beach Location (latitude and longitude)	° °'N ° °'E		Q2						
Country			Q3						
Name of the surveyor									
<p>*1. When you look at the land from the sea, the transect at the first left side is Transect 1, and the last one (right side) is Transect 6.</p> <p>*2. The quadrat numbers 1, 2, and 3 are given to the quadrats for each transect. The upper quadrat near the road/embankment/vegetation is Quadrat 1, the quadrat on the strandline is Quadrat 2, and the quadrat near the sea-water is Quadrat 3.</p>									

# Beach Debris Classification

102 items

Type	Material and Structure	Weathering State	Class Code	Examples of pre-disposal use
Polymer	Hard Plastic	Whole	A	Bottle, toy
		Fragment	Af	
	Film	Whole	B	Plastic bag, gloves
		Fragment	Bf	
	Fiber and fabric	Whole	C	Net, Clothes, Cigarette butt
		Fragment	Cf	Rope, strapping
	Styrofoam	Whole	D	Styrofoam buys
		Fragment	Df	
	Other foamed plastic	Whole	E	Other foamed cups
		Fragment	Ef	
	Other polymer	Whole	F	Rubber balloon, tire
		Fragment	Ff	Burned items
	Pellet	Whole	G	Pellet
	Non-polymer	Glass and Ceramics	Whole	H
Fragment			Hf	
Metal		Whole	I	Aluminium can
		Fragment	If	
Paper and Cardboard		Whole	J	Books, paper cups
		Fragment	Jf	
Wood		Whole	K	fishing traps, pallet
		Fragment	Kf	
Other material		Whole	L	Battery, Bricks, Cotton cloth
		Fragment	Lf	

## Fragments added into each category

- What is "**whole item**"?

- If more than 50% of the original volume of an item is remaining, the item is classified as a "whole" item.

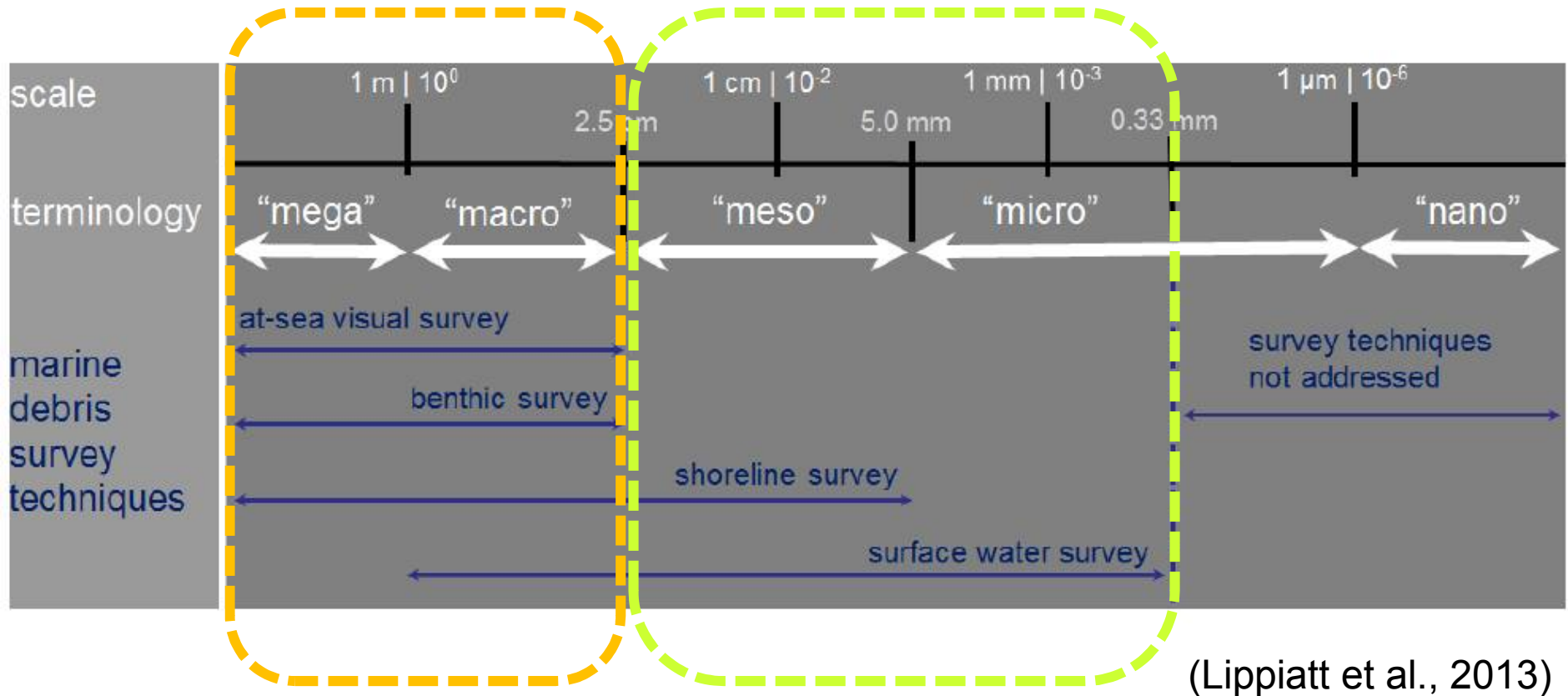
- What is "**fragment**"?

- If less than 50% of the original volume is present, the item is classified as "fragment".

- More than two types of materials

- If an item is composed of more than two types of materials, classify the item by following the main (volume) materials of the item.

# Marine debris by size ranges



- > 25mm in this study
- Applicable to smaller sizes



# Attachment of organisms

- As an indicator of long distance transportation

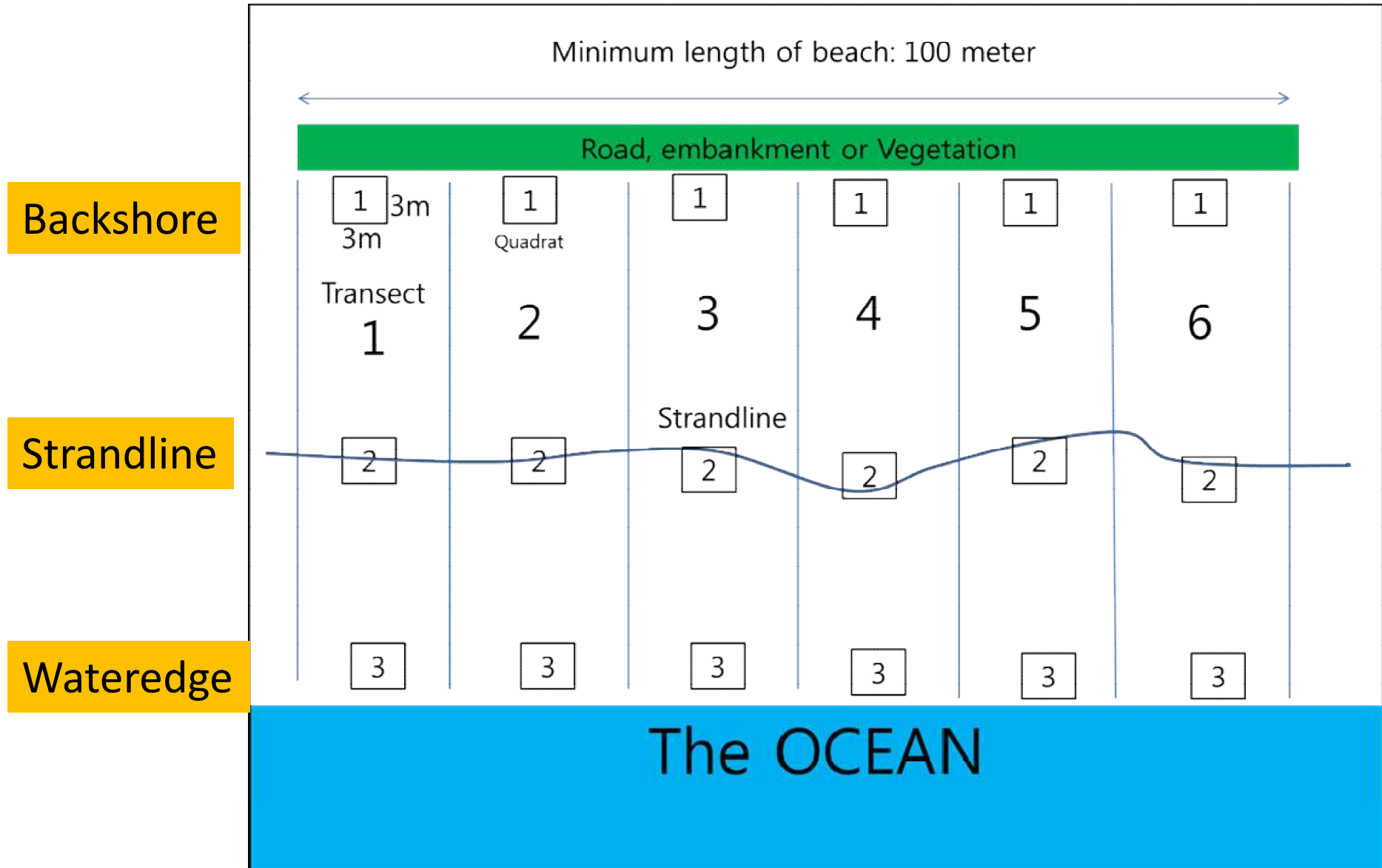


# Example of classification

- Comparable to ICC and UNEP/IOC results (count and weight /m<sup>2</sup>)










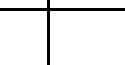
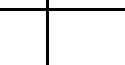


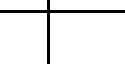
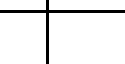
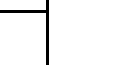



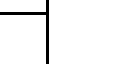



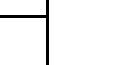



















Classification	Code	Debris type	Count with organism (a)	Count w/o organism (b)	Total count (c=a+b)	Weight (g)	UNEP Code	ICC Code
Hard Plastic (A)	A1	Bottle caps & lids					PL01	ICC 5, 7
	A2	Bottles < 2 L					PL02	ICC 10
	A3	Bottles, drums, jerrycans& buckets > 2 L					PL03	ICC 25
	A4	Knives, forks, spoons, straws, stirrers (cutlery)					PL04	ICC 8, 9
	A5	Drink package rings, six-pack rings, ring carriers					PL05	ICC 23, 24
	A6	Food containers (fast food, cups, lunch boxes & similar, including take out containers)					PL06	ICC 3, 17
	A7	Toys & party poppers					PL08	
	A8	Cigarette lighters					PL10	ICC 35
	A9	Syringes					PL12	ICC 30
	A10	Plastic baskets, crates & trays					PL13	
	A11	Hard plastic buoys					PL14	ICC 19
	A12	Hard plastic fishing gear (lures, traps & pots)					PL17	
	A13	Other hard plastic intact item					PL24	
	A14	Hard plastic Appliances & Electronics					OT03	ICC 32
	A15	Cigar tips						ICC 34
	Af	Hard plastic fragment (e.g. pipes)						ICC 41

# Location of 18 quarats for AMETEC survey



# Timing and Frequency of surveys

- **Before and after Monsoon season**  Twice a year

Country	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Korea					B					A		
Japan					B					A		
China					B					A		
Taiwan					B					A		
Vietnam					B					A		
Philippine					B					A		
India					B					A		
Bangladesh					B					A		
Thailand					B					A		
Brunei		A								B		
Singapore		A								B		

A: after B: before

## ◆ Survey results and discussion



# 1<sup>st</sup> surveys (Oct.~Dec. 2013)

- 4 countries
- 6 sites



# 2nd surveys (May~July 2014)



# 1st survey results using AMETEC protocol

Country	Beach	Month 2013	Monsoon
Korea	Wahyeon	Oct.	After
Vietnam	Giao Hai	Dec.	After
Thailand	Rajaman-gala	Nov.	After
Taiwan	Guo Sheng Pu	Nov.	After



Preliminary data analysis



**Rajamangala, Thailand**



Guo Sheng Pu beach, Taipei, Taiwan



Giao Hi beach, Vietnam



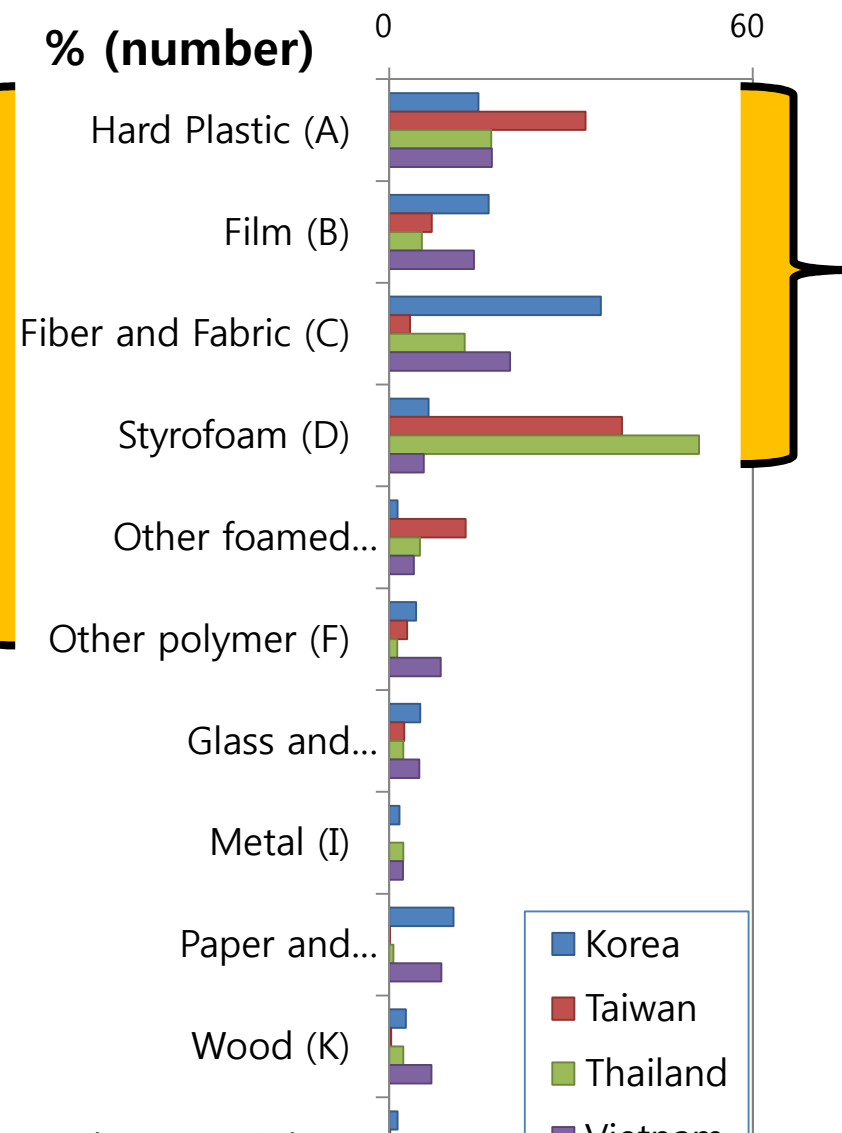
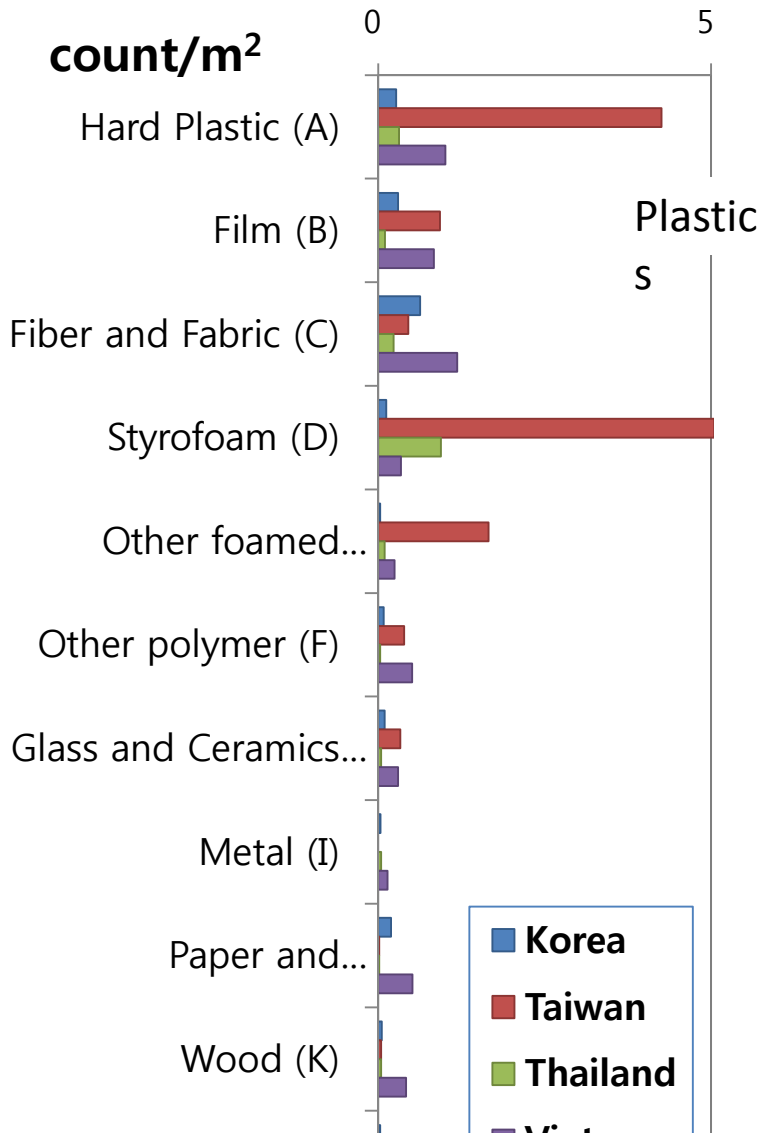
Rajamangala beach, Trang Province, Thailand



Wahyun beach, Geoje, Korea



# Abundance and composition at 4 beaches



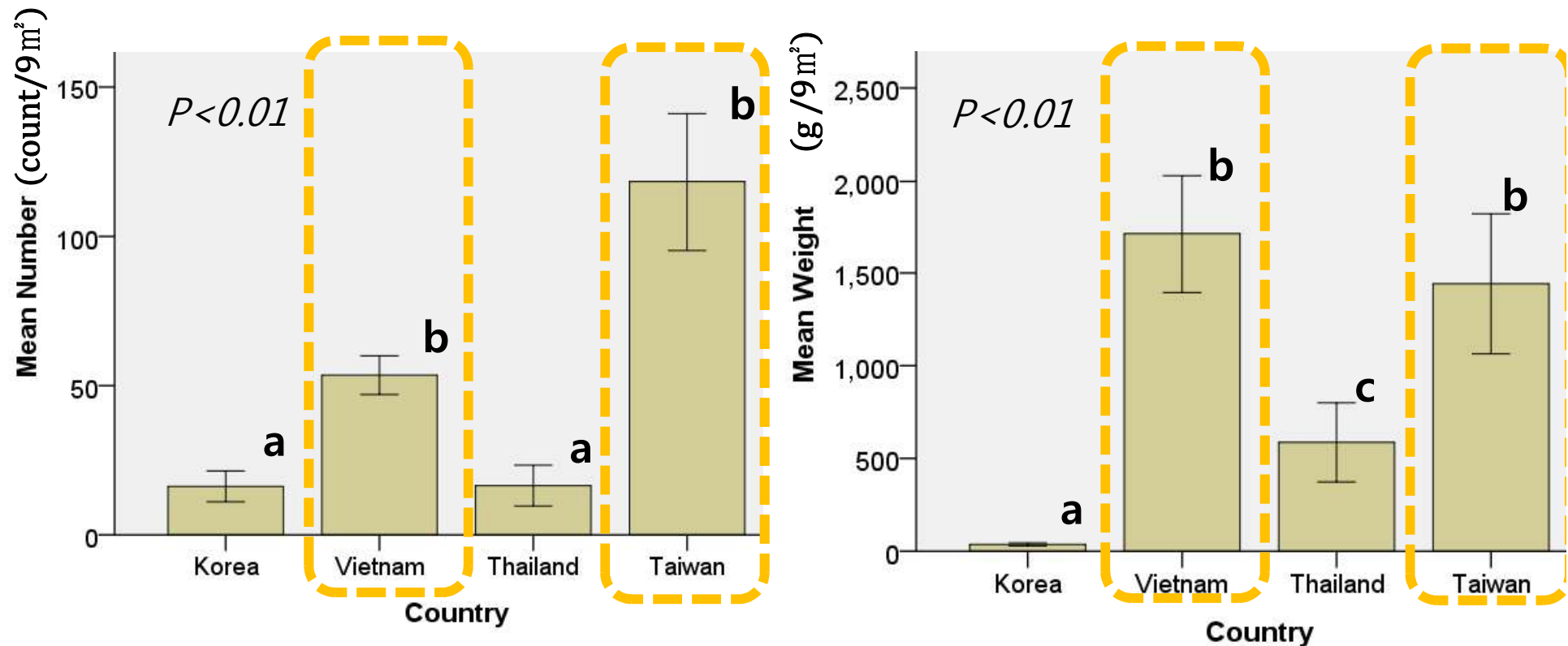
< 5 counts/m<sup>2</sup>

< 60g/m<sup>2</sup>

# Comparison in abundance among beaches

- By Kruskal-Wallis test

UNEP/IOC guideline: 1 data at one beach



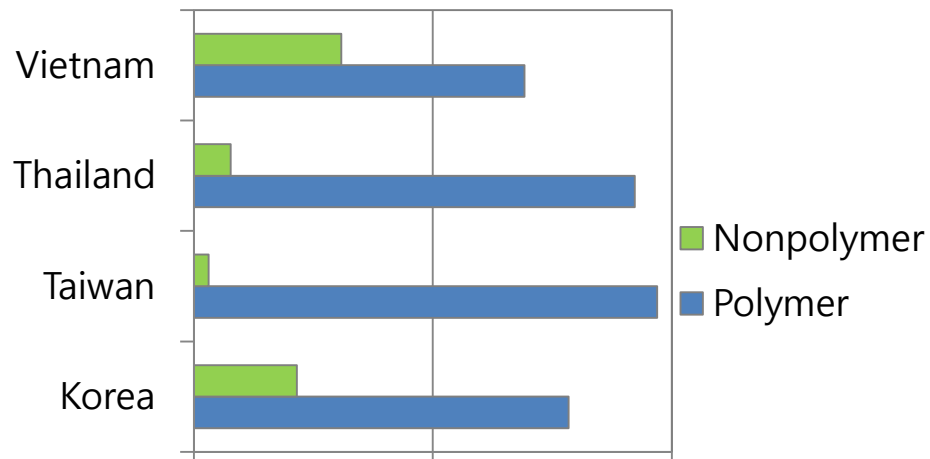
Post hoc test by Tukey/HSD with the rank variable

Beaches selected in Vietnam & Taiwan were highly polluted.

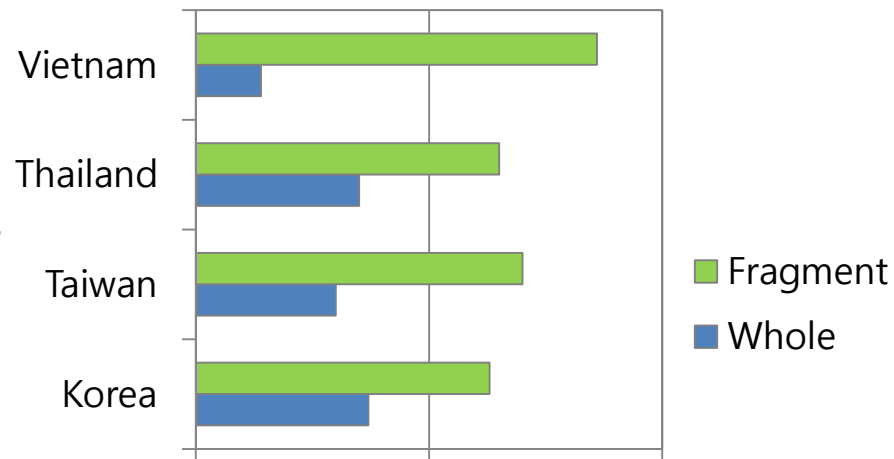
# Polymer vs nonpolymer

# Whole vs fragment

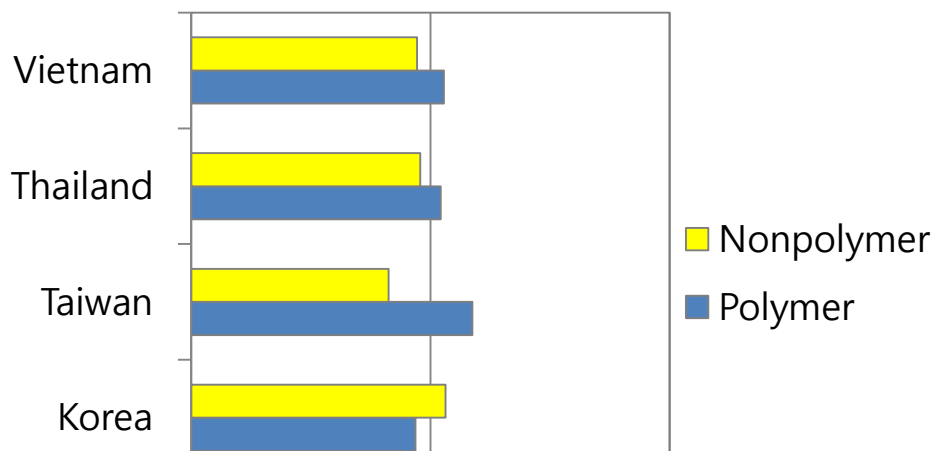
% number



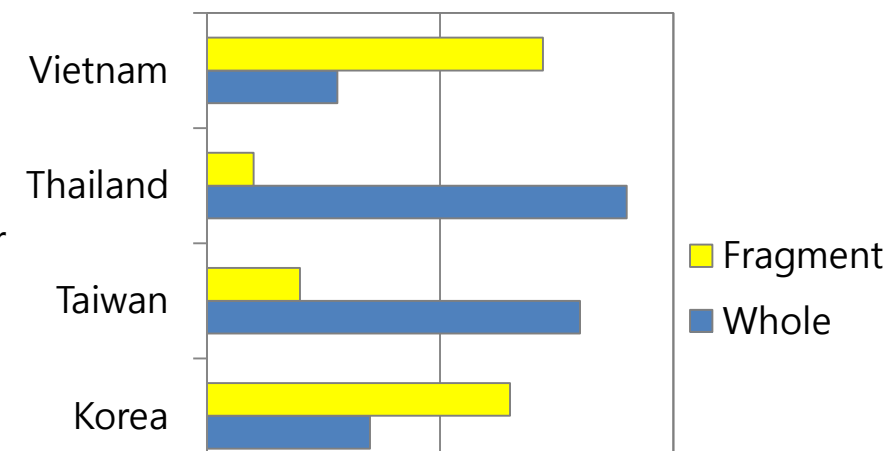
% number



% weight



% weight

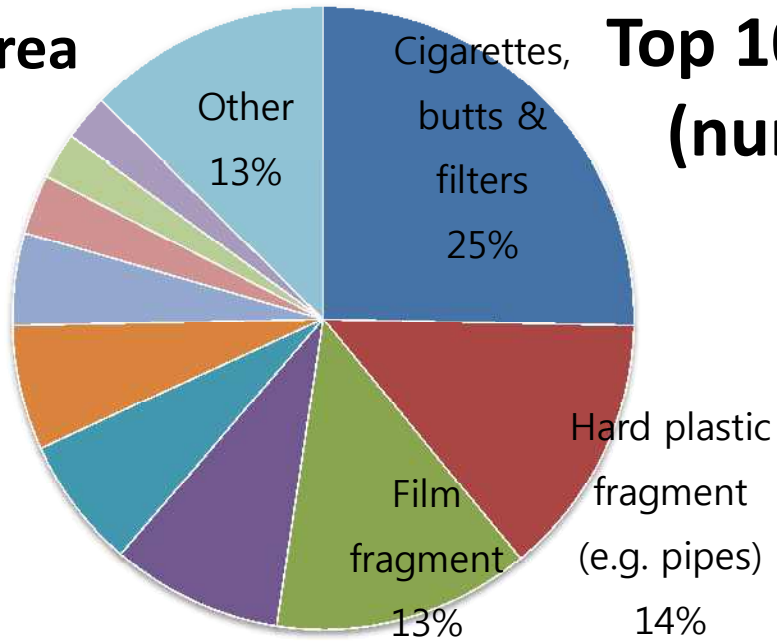


Polymer is much more abundant in number and similar in weight

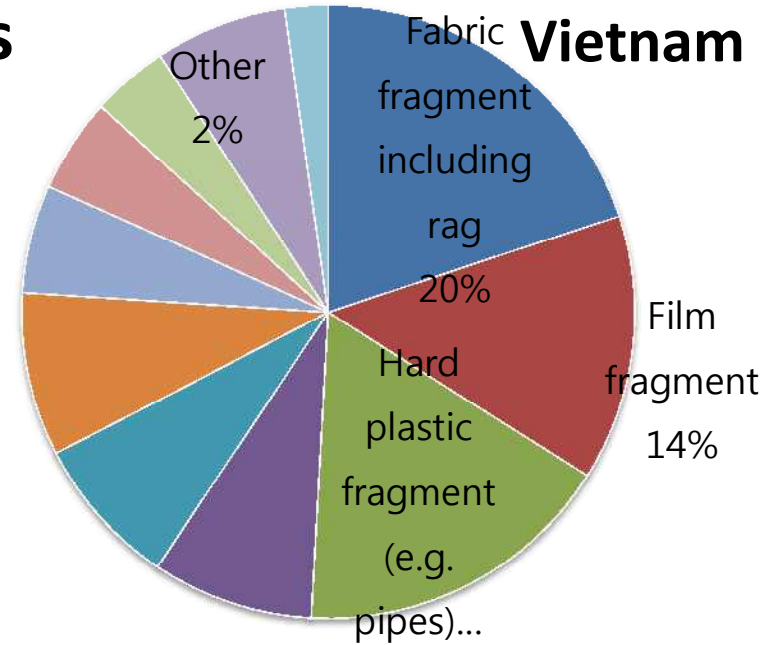
Fragment is more abundant in number and occasionally in weight.

## Top 10 debris (number)

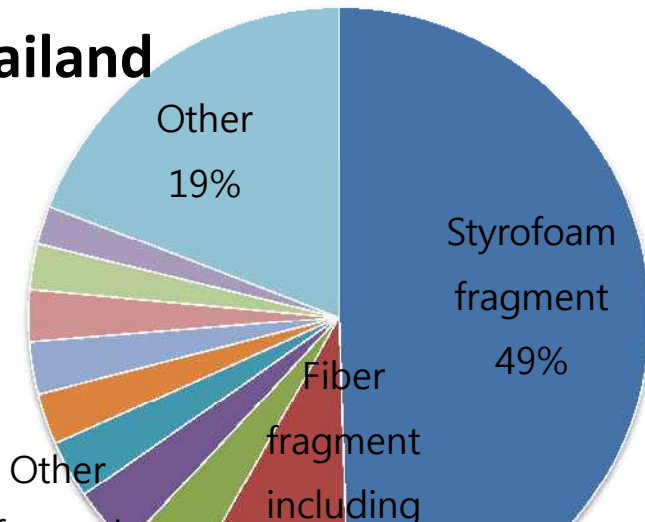
**Korea**



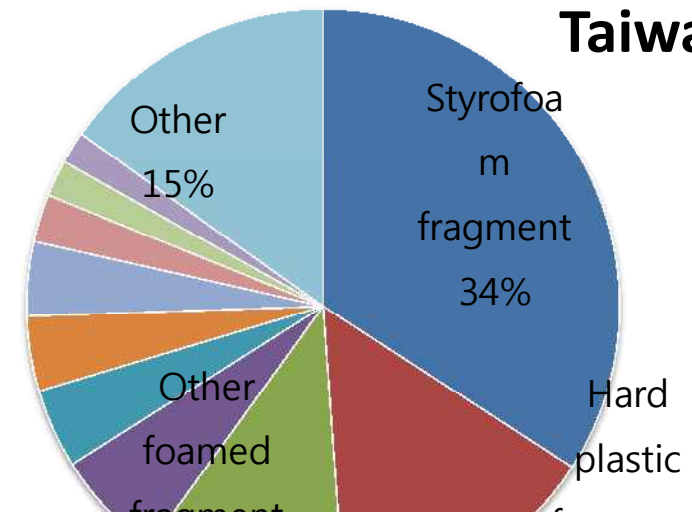
**Vietnam**



**Thailand**



**Taiwan**

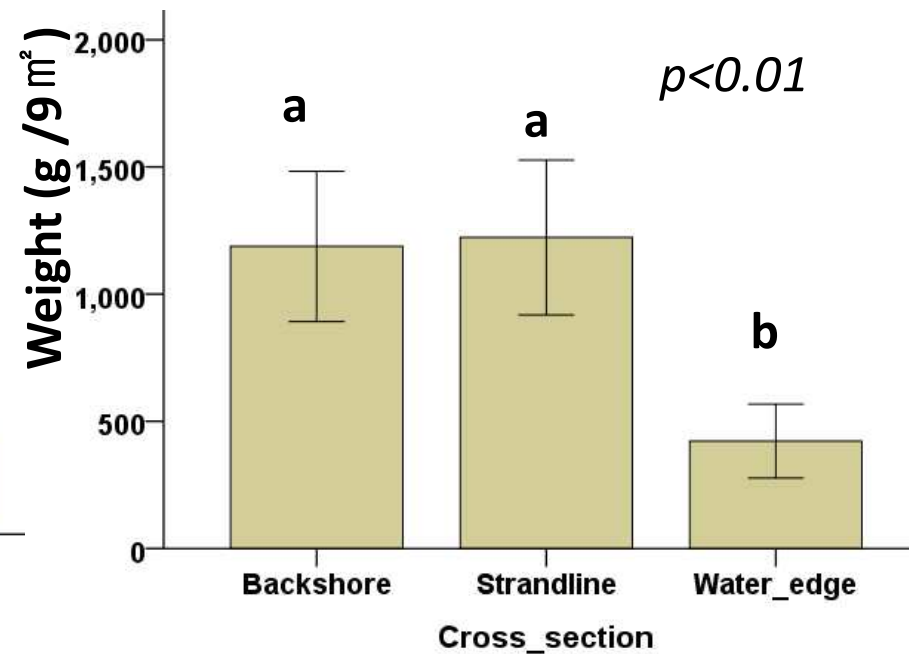
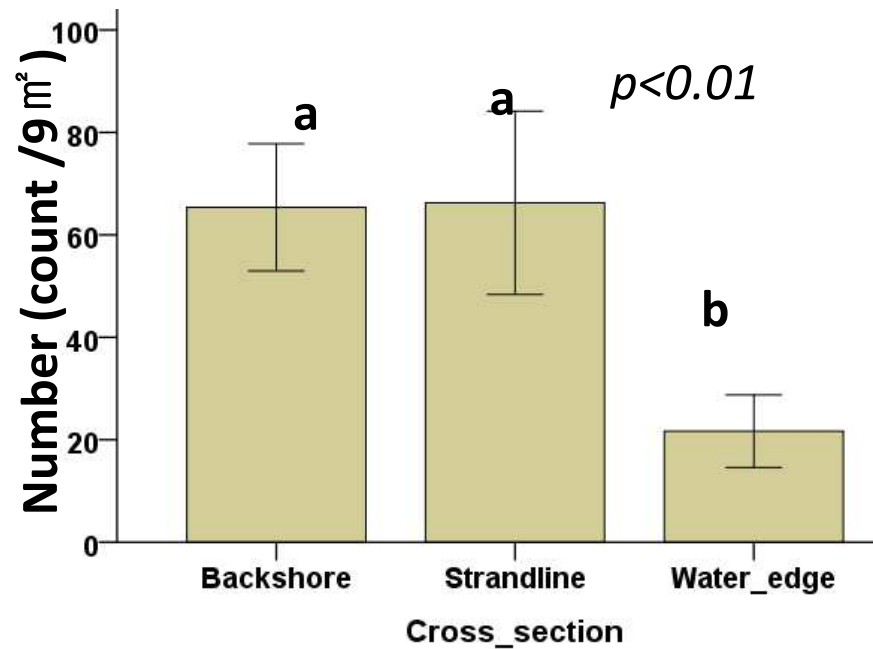


Top 10 in number and weight were listed and their sources should be interpreted in terms of social and economic diversity in each country.

# Comparison among cross sections

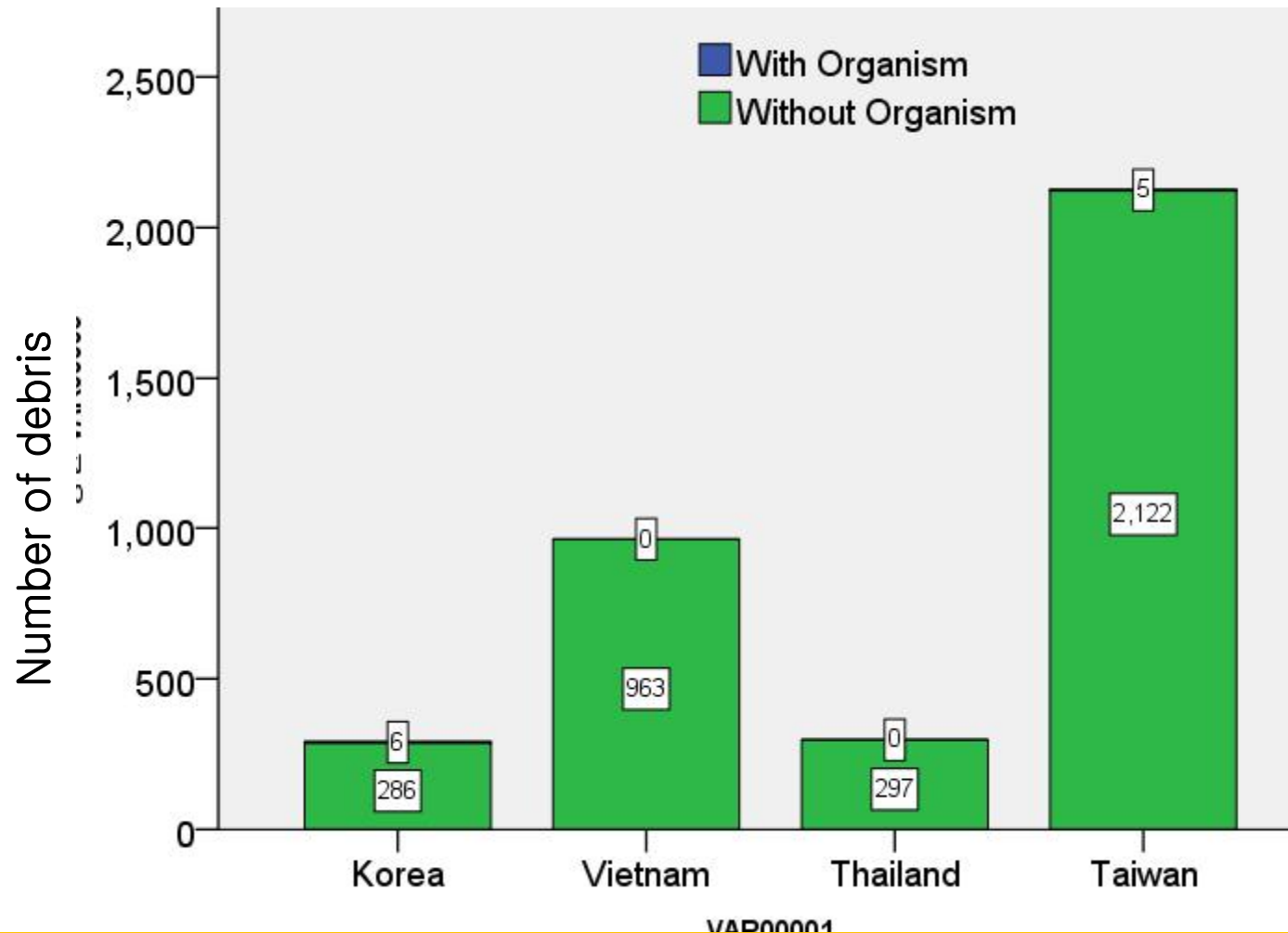
- By Kruskal-Wallis test

UNEP/IOC guideline: 1 data at one beach



It is hard to say abundance on the backshore is normally higher than others. To survey along strandline is likely to be reasonable.

# Debris with attached organism



Rare cases of organism attachment were found. It says low possibility of long distant transportation. Locality of beach debris sources may influence the result, implying to manage local sources of debris well is important.

## ◆ Lessons learned and future plan





# Lessons learned

1. Fragments were highlighted, which may contribute to understanding mechanism from macro to meso, and micro debris.
2. Using the same protocol allows data comparison and cooperation among countries in future.
3. The process to develop the AMETEC protocol was very important to raise capacity of NGOs.
4. This classification hardly shows clear source information, which will be overcome by communication with surveyors and further interpretation of the results.

## Future plan

1. We will make a report early in 2015 to compile data obtained in 2013~2014.
2. We hope more NGOs and experts participate this survey.
3. The works have been on the basis of voluntary involvement. We are looking for fund to make the works sustainable.

# Acknowledgement

Special thanks should go to all participants in the AMETEC workshops and surveys.

Thank you for listening!