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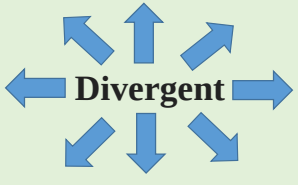
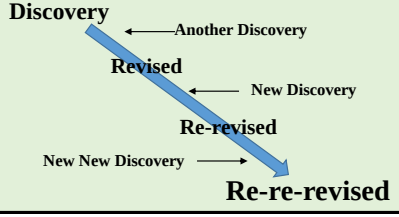
SCIENCE

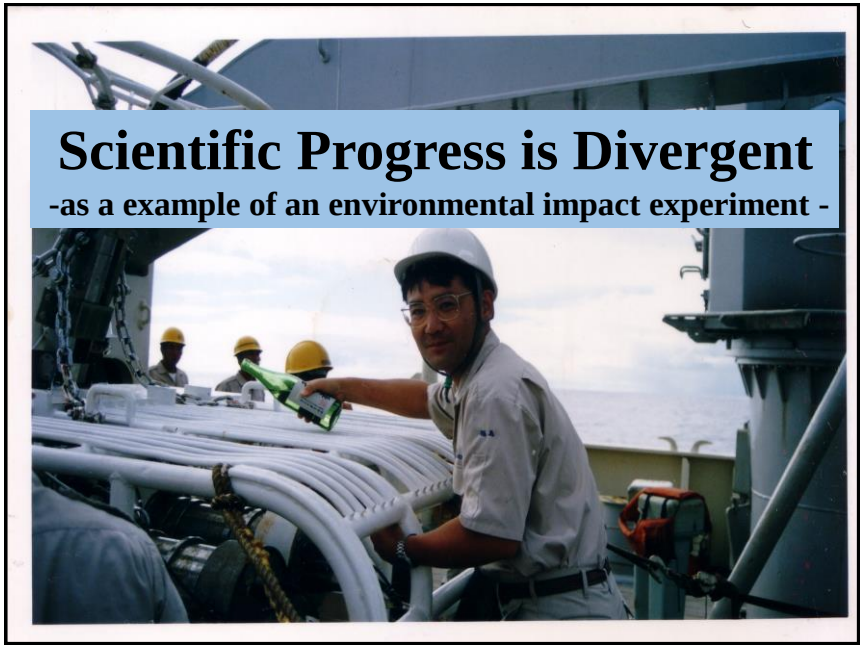
The Goal of Science is to Pursue of Truth

However the way is

♬ *The Long and Winding Road* ♬



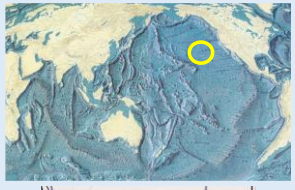




Scientific Progress is Divergent

-as a example of an environmental impact experiment -

Deep-Sea Impact Experiment



Benthic Disturber

The experiment has performed in the central Pacific Ocean form 1994 - 1996.

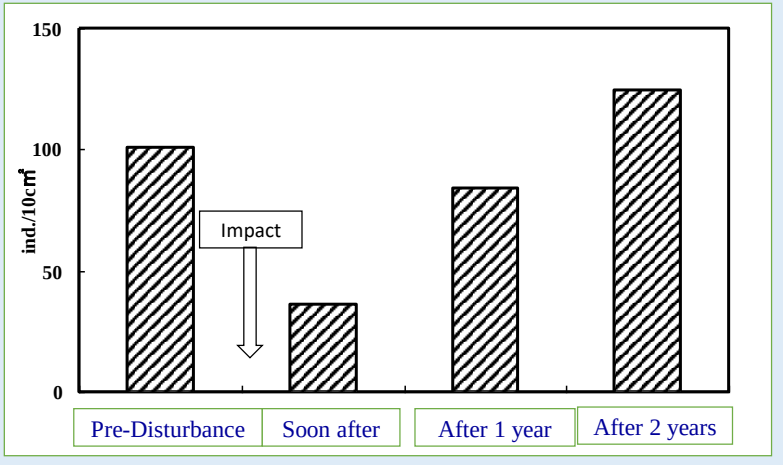
The aim of it is to estimate a magnitude of impact resulting from ocean mining.

To know the effect, smaller scale of impact that is supposed to similar impact with real mining are added.

After the artificial disturbance, an environmental condition are compared between before and after the impact.

After an artificial impact

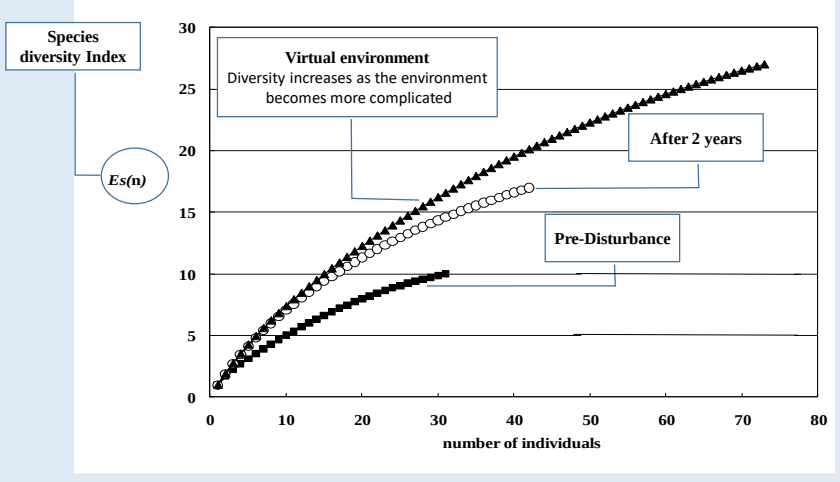
Abundance of Benthic Organisms Decrease



After Fukushima and Shirayama, 1997

After an artificial impact

Species Diversity of Nematoda Increase



After Fukushima and Shirayama, 2000

The progress of science is divergent

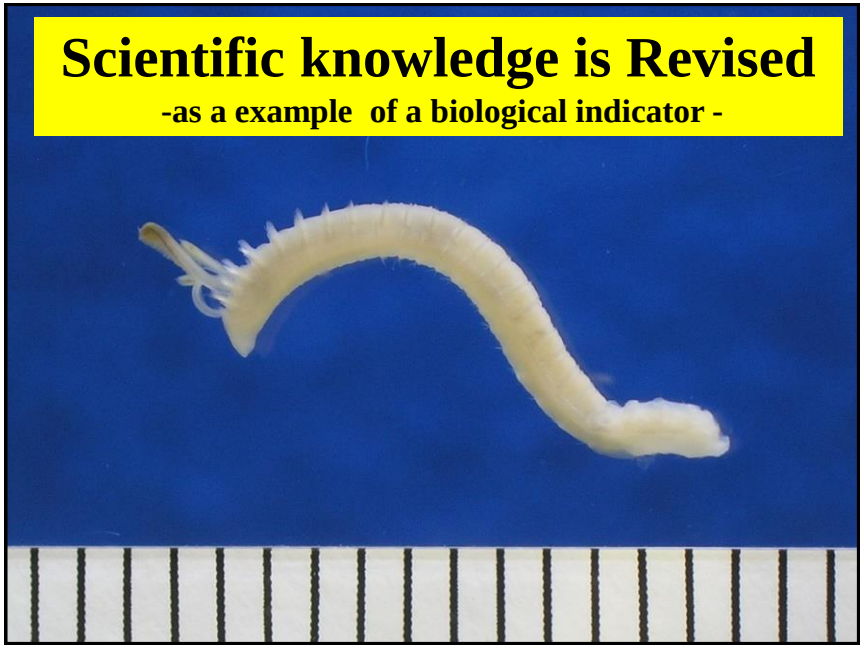
(in general)
Decrease Abundance
is evaluated as **Negative**

(in general)
Increase Species Diversity
is evaluated as **Positive**

Contradictory information are provided simultaneously

Scientific knowledge is Revised

-as a example of a biological indicator -



biological indicator

Pollution indicator species

The distribution of organisms varies in accordance with an environmental conditions. Therefore, organisms, which is sensitive to changes in environment can be regarded as sensors for knowing environmental characteristics.

Such organisms are referred to as **pollution indicator species**.

Theora fragilis

Cirriformia tentaculata

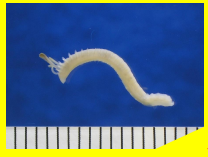
Grandidierella japonica

Those organisms can be survive in polluted environment.

(New Discovery)
Taxonomic System changed

Previous name

Paraprionospio pinnata



New name
Paraprionospio cordifolia

New name
Paraprionospio coora

New name
Paraprionospio patiens

New name
Paraprionospio oceanensis

Four species has born from one species

Only One Species is Pollution Indicator

Paraprionospio pinnata

Until taxonomic system changed, this species was a pollution indicator.

Paraprionospio cordifolia
Inner bay. A place where water is

Paraprionospio
Offsh current is the faster.

aprionospio patiens
Inner bay. Water is stagnant. Polluted environment.

Paraprionospio oceanensis
Open sea. Water current is the faster.

Past environmental estimation must be withdrawn

The Scientific Knowledge is destined to be revised

～The following cases can also occur～

（Based on previous taxonomic system）

The environment of a certain place was estimated to be “polluted”.

However

（Change to new taxonomic system / based on new taxonomic system）

the “polluted” cannot be estimated.

Previous Estimation should be withdrawn

The greatest contribution of Science to Ocean Development is ・・・・・

The progress of science is divergent. In addition, the Scientific Knowledge is destined to be revised.

On the other hand, ocean developments are economic activities, so the direction of activity is converging. Not divergent !!

So science sometimes confuses ocean developers, policy makers and layers.

However, by updating scientific knowledge, we can encounter new findings.

In other words, by science we can know that we are ignorant.

This is the great contribution of Science to Ocean Development.

Thank you for your kind attention

Tomohiko Fukushima