

# **Health Examination of Enclosed Coastal Seas in Japan : Concept, Scheme and the Results of Preliminary Examination**

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# Coastal Management and Environmental Monitoring

- For ICM and for any kind of coastal management including remediation and restoration, appropriate holistic monitoring and evaluation on the present status of coastal environment is necessary.
- As one of the holistic environmental monitoring system, concept and scheme of “Health Examination” has been developed by Ocean Policy Research Foundation (Ship and Ocean Foundation).
- I , as a committee member of the “Health Examination of Coastal Seas” , would like to introduce major concept, scheme and the results of preliminary “Health Examination” of 88 enclosed coastal seas in Japan. Recent advances and future perspective will be additionally introduced.

# Enclosed Coastal Seas in Japan

Characteristics: High possibility of artificial eutrophication due to poor water exchange

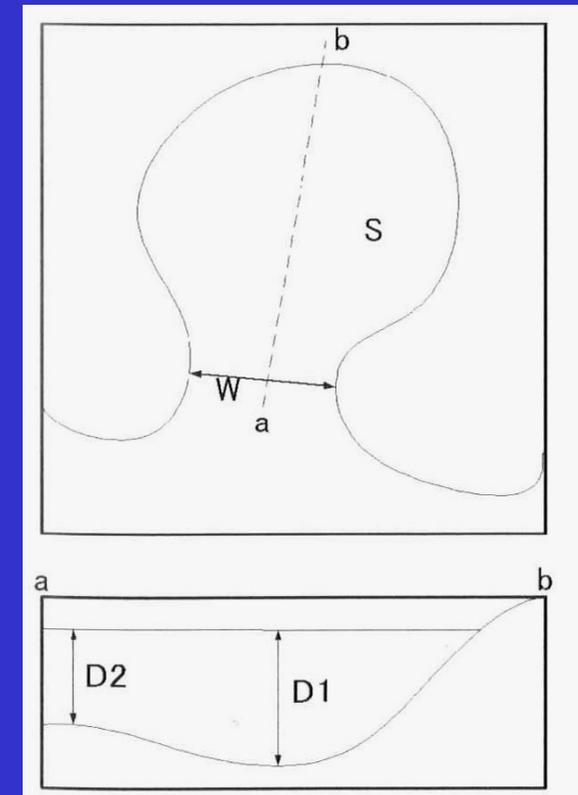


Special Environmental Management: Water quality control of effluents and area-wide total pollutant load control on COD, TN, TP

Definition of Enclosed Coastal Seas:  
Enclosedness Indicator (E.I.) larger than 1, where

$$\mathbf{E. I.} = \frac{\sqrt{S} \times D1}{W \times D2}$$

(Ministry of the Environmental )

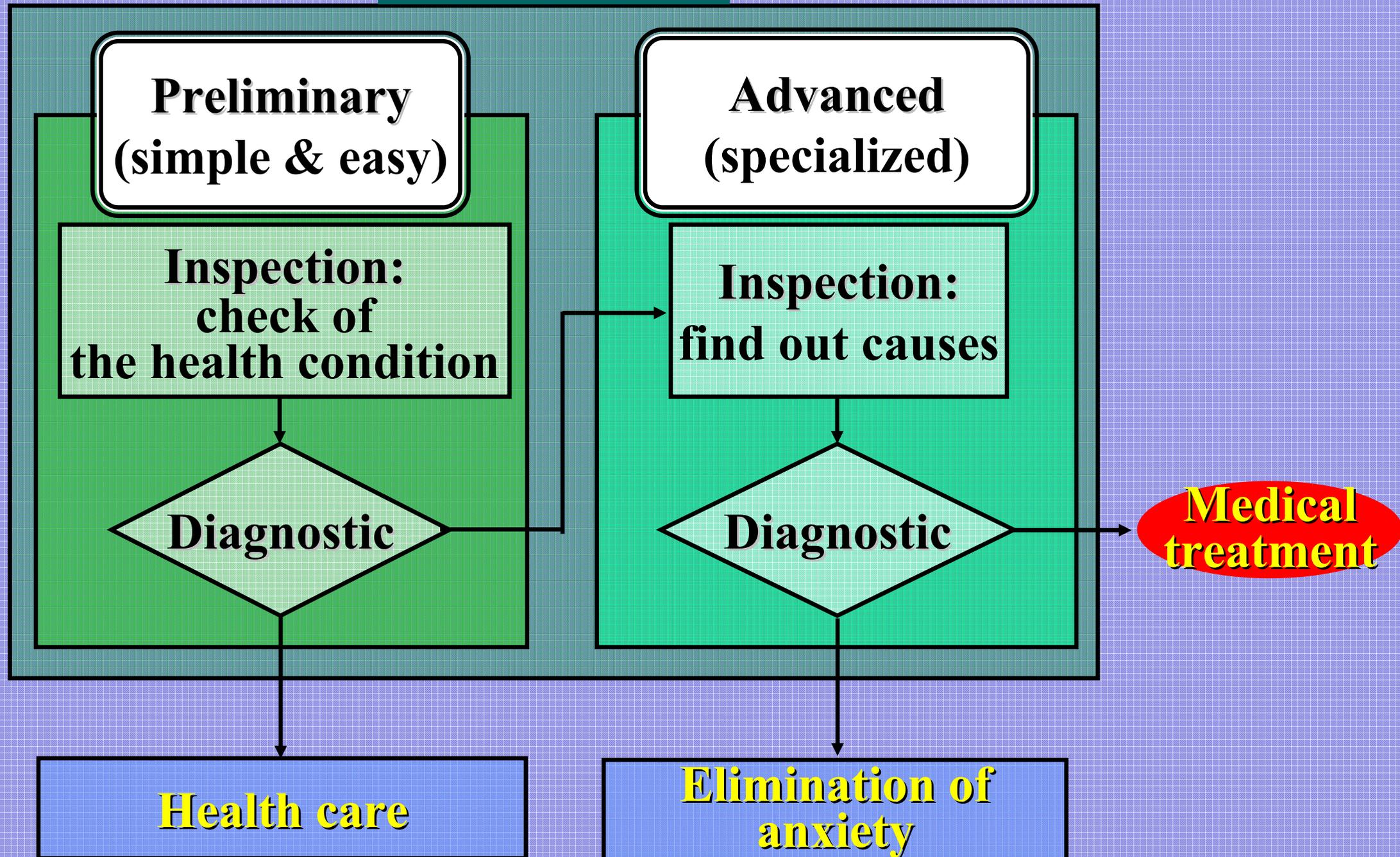


# Officially designated 88 enclosed coastal sea areas in Japan

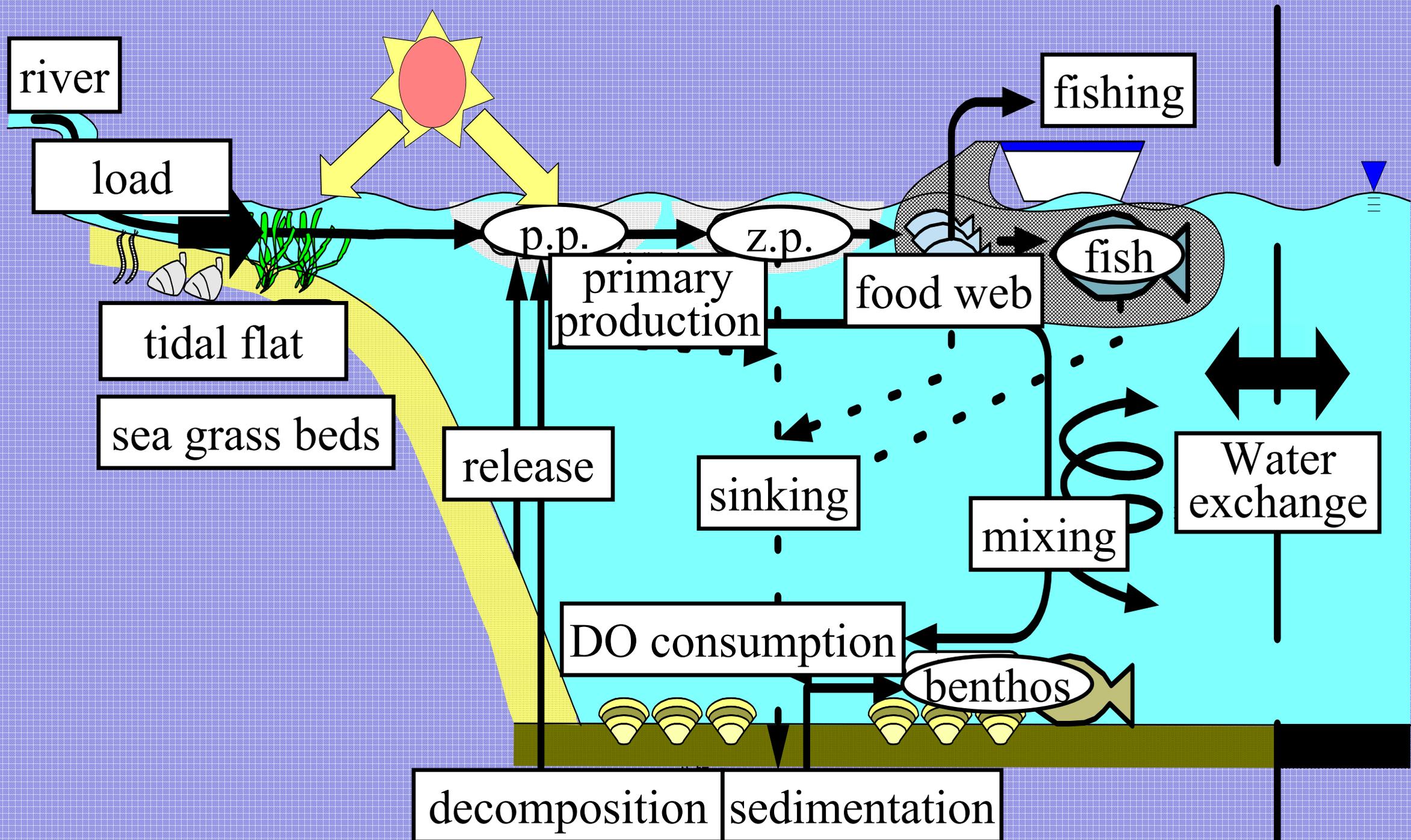


# Flow chart of the health examination

## Examination

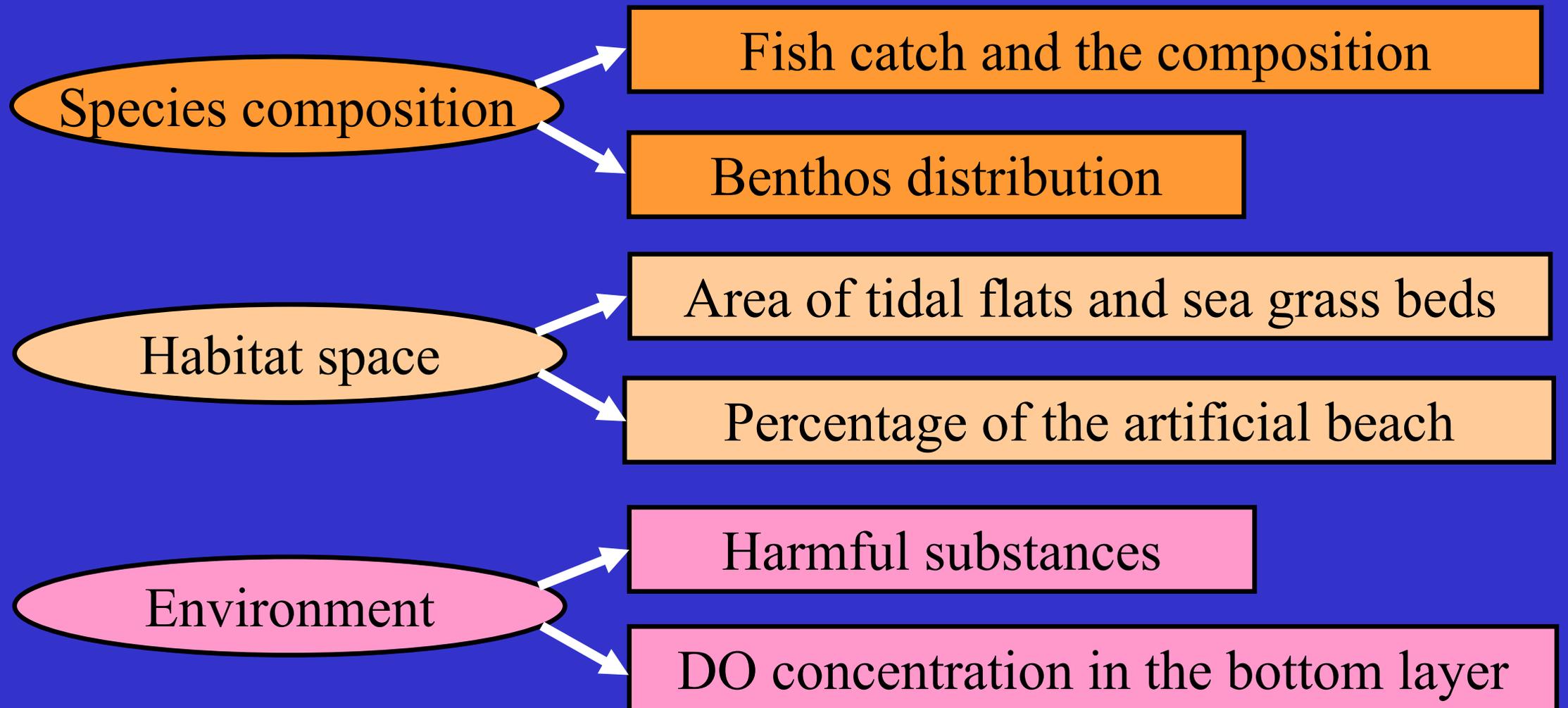


# Structure of the coastal ecosystem and material circulation



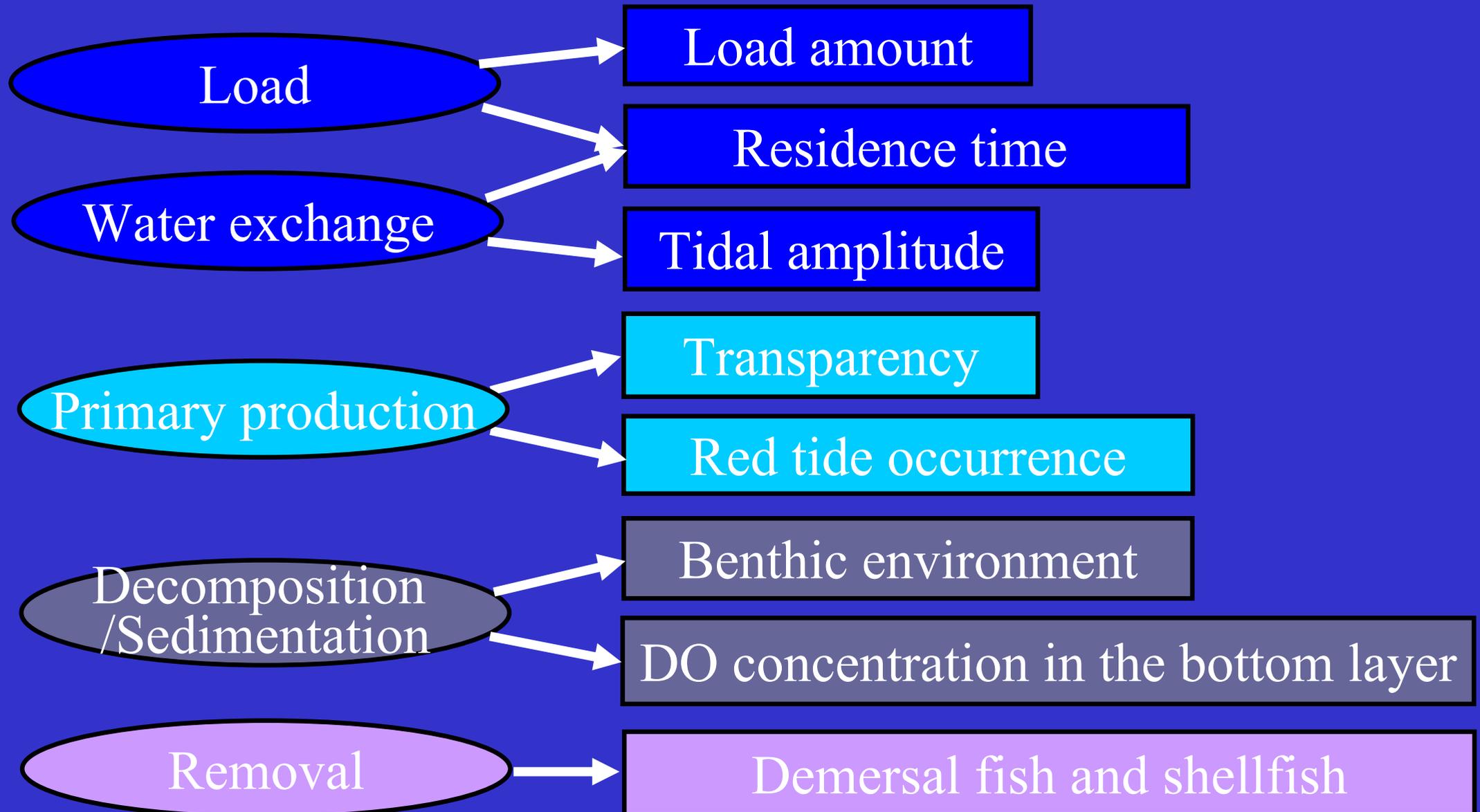
# Items for the “Health Examination”(1)

## The extent of ecosystem stability



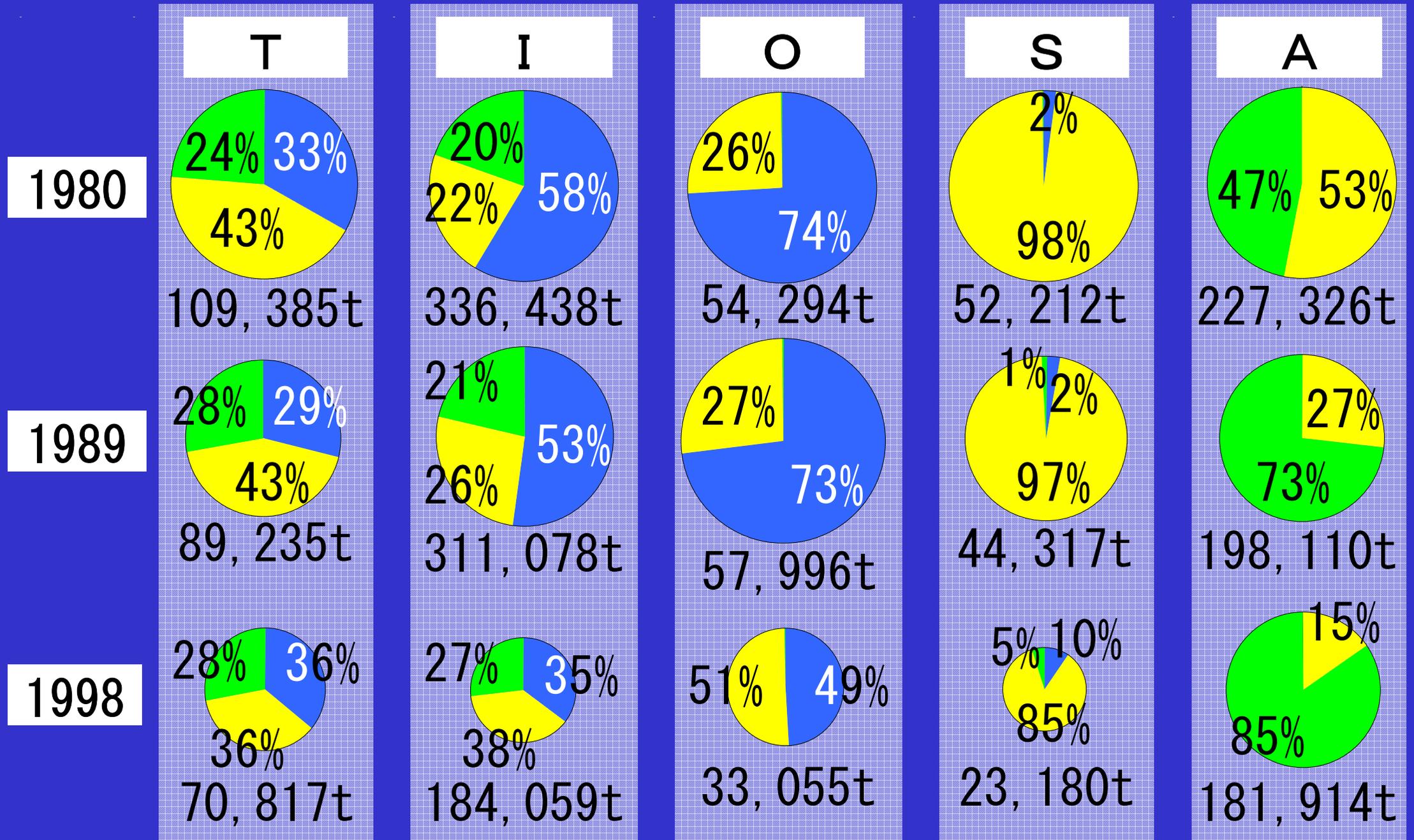
# Items of the “Health Examination”(2)

## The smoothness of material circulation



# "Species composition"

## Fish catch and the composition



■ : pelagic   
 ■ : benthic   
 ■ : seaweed

# Example of criteria and evaluation

Item for the “HEALTH EXAMINATION” (1)

## The extent of ecosystem stability

Fish catch and the composition

Species composition



### Indicator:

Change of the ratio of dominant group (F) =  
Mean of recent 3 years / Mean of past 20 years

### Criteria and Classification:

$0.8 < F < 1.2$  , and also steady or increasing for recent 3 years: Class A

$0.8 < F < 1.2$  , and also decreasing for recent 3 years: Class B

$F < 0.8$  , or  $1.2 < F$ : Class C

A: healthy, B: warning (need inspection), C: unhealthy (deteriorated)

# Hakata Bay

## Geographical condition

- Area : 134.2km<sup>2</sup>
- Width of entrance : 7.7km
- Maximum depth : 23m
- Due to highly populated metropolis of Fukuoka City, terrestrial load is large



## Historical and environmental aspect

- Hakata Bay has long been the gate for the imported culture from the continent and still provides many functions on international activities.
- Improvement of the water qualities has been conducted by special plan and also by high performance water treatment system.

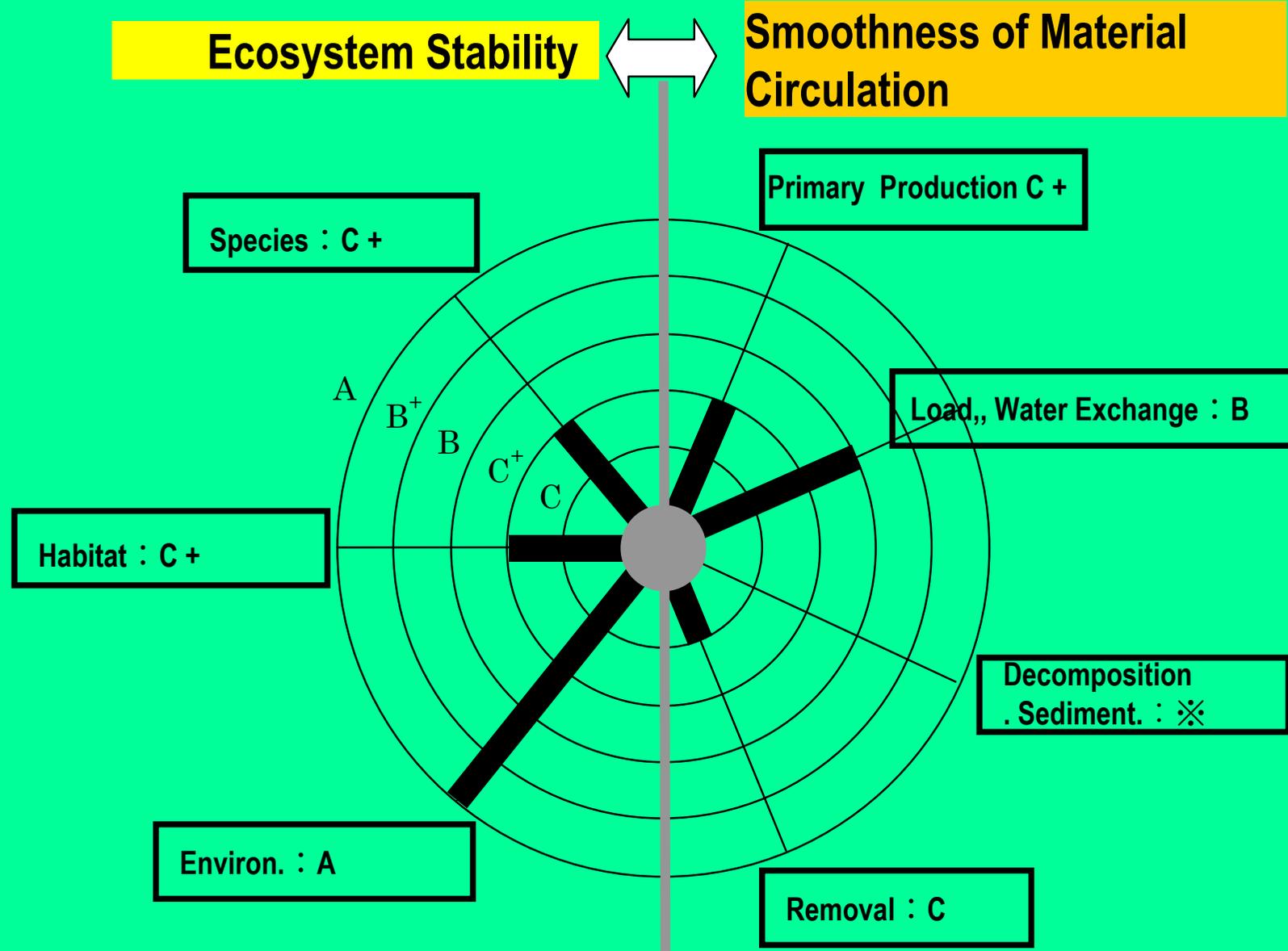
# Result of the preliminary examination on Hakata Bay as an example

| 視 点                          | 検査項目                          | 検査基準  |  |   | 検査結果  | 診断  |       |                |
|------------------------------|-------------------------------|---|--|---|---|---|-------|----------------|
|                              |                               | 良好(A)   | 要注意(B)   | 悪化(C)   |   |   |       |                |
| 【生態系の安定性】を示す項目               | 生物組成                          | 最優占分類群の漁獲量比：F（最近3年間の平均/過去の平均）                           | $0.8 < F < 1.2$ かつ 最近3年間増加もしくは横這い傾向            | $0.8 < F < 1.2$ かつ 最近3年間減少傾向                          | $0.8 \geq F$ または $1.2 \leq F$                           | F = ( 0.68 )  | A B C | C <sup>+</sup> |
|                              |                               | 海岸生物の出現状況比：L（代表種の確認種類数/代表種類数）                           | $0.7 \leq L$                                   | $0.4 < L < 0.7$                                       | $0.4 \geq L$  | L = ( 1 )   | A B C |                |
|                              | 生息空間                          | 干潟・藻場面積比：K,S（K=最新の干潟面積/過去の干潟面積、S=最新の藻場面積/過去の藻場面積）       | $0.8 < K$ かつ $0.8 < S$                         | $0.8 < K$ 、 $0.8 \geq S$ または $0.8 \geq K$ 、 $0.8 < S$ | $0.8 \geq K$ かつ $0.8 \geq S$                            | K = ( 0.88 )<br>S = ( 0.99 )  | A B C | C <sup>+</sup> |
|                              |                               | 最新の人工海岸の割合：M（%）   | $20 \geq M$                                    | $20 < M < 50$   | $50 \leq M$   | M = ( 52 )  | A B C |                |
|                              | 生息環境                          | 有害物質分析値の比：P（過去の最大値/環境基準値）                               | $P < 0.8$                                      | $0.8 \leq P < 1$                                      | $1 \leq P$  | P = ( 0.3 )   | A B C | A              |
| 貧酸素水の出現比：G（貧酸素水確認地点数/全調査地点数） |                               | $G < 0.5$ かつ 最近3年間減少もしくは横這い傾向                           | $G < 0.5$ かつ 最近3年間増加傾向                         | $0.5 \leq G$  | G = ( 0.25 )<br>最近は ( 横這い ) 傾向                          | A B C   |       |                |
| 【物質循環の円滑さ】を示す項目              | 基礎生産                          | 透明度の差：D(cm)（過去20年間の平均-最近3年間の平均）                         | $D < 20$ かつ 最近3年間横這い傾向                         | $D < 20$ かつ 最近3年間増加もしくは減少傾向                           | $20 \leq D$   | D = ( 5 )<br>最近は ( 横這い ) 傾向   | A B C | C <sup>+</sup> |
|                              |                               | 赤潮の発生日数比：R（赤潮の発生日数/全調査年数）                               | R=0  | $0 < R < 1$   | R=1   | R = ( 1 )   | A B C |                |
|                              | 負荷・海水交換                       | 負荷滞留濃度：C <sub>x</sub> （淡水滞留時間×単位面積当たりの負荷量(x=cod, n, p)） | $C_{cod} < 0.2$ かつ $C_n < 0.2$ かつ $C_p < 0.02$ | 正常(A)、悪化(C)の検査基準以外の場合                                 | $C_{cod} \geq 0.2$ かつ $C_n \geq 0.2$ かつ $C_p \geq 0.02$ | C <sub>cod</sub> = ( 0.47 )<br>C <sub>n</sub> = ( 0.19 )<br>C <sub>p</sub> = ( 0.08 ) | A B C | B              |
|                              |                               | 潮位振幅変化量：T(m)（過去30年間の期望平均満潮位と干潮位の差の線形回帰より求めた傾き(G)×30(年)） | $T < 0.05$ かつ 最近3年間減少傾向にない                     | $T < 0.05$ かつ 最近3年間減少傾向                               | $T \geq 0.05$   | T = ( 0.027 )   | A B C |                |
|                              | 堆積・分解                         | 底質環境（硫化物の最大値：SD(mg/g)）                                  | $SD < 0.2$                                     | $0.2 \leq SD < 1$                                     | $1 \leq SD$   | SD = ( データなし )  | A-B-C | ※              |
| 底層の最低溶存酸素濃度：N(mg/L)          |                               | $4.2 \leq N$  | $0.5 \leq N < 4.2$                             | $0.5 > N$   | N = ( 0.5未満 )   | A B C   |       |                |
| 除去                           | 底生魚介類の漁獲量比：FB（最近3年間の平均/過去の平均） | $0.8 < FB < 1.2$ かつ 最近3年間増加もしくは横這い傾向                    | $0.8 < FB < 1.2$ かつ 最近3年間減少傾向                  | $0.8 \geq FB$ または $1.2 \leq FB$                       | FB = ( 0.23 )   | A B C   | C     |                |

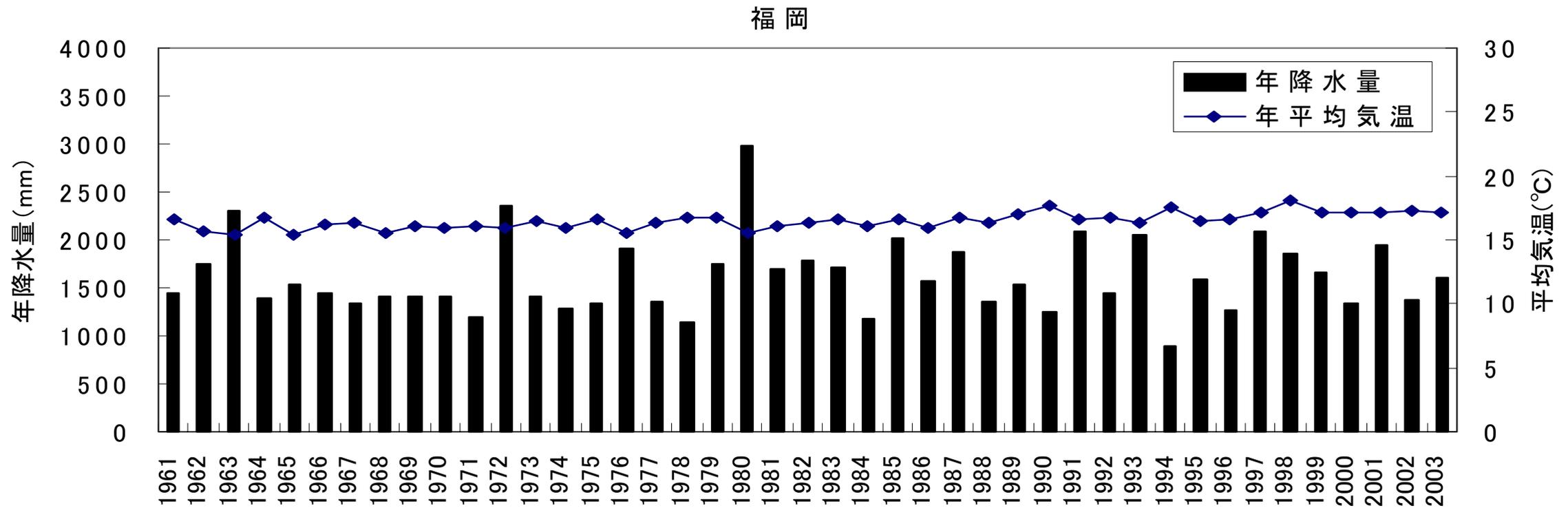
注）※印は一部またはすべてのデータがないため、診断できない部分を示す。

# Diagnostic chart

# Hakata Bay, Fukuoka pref.

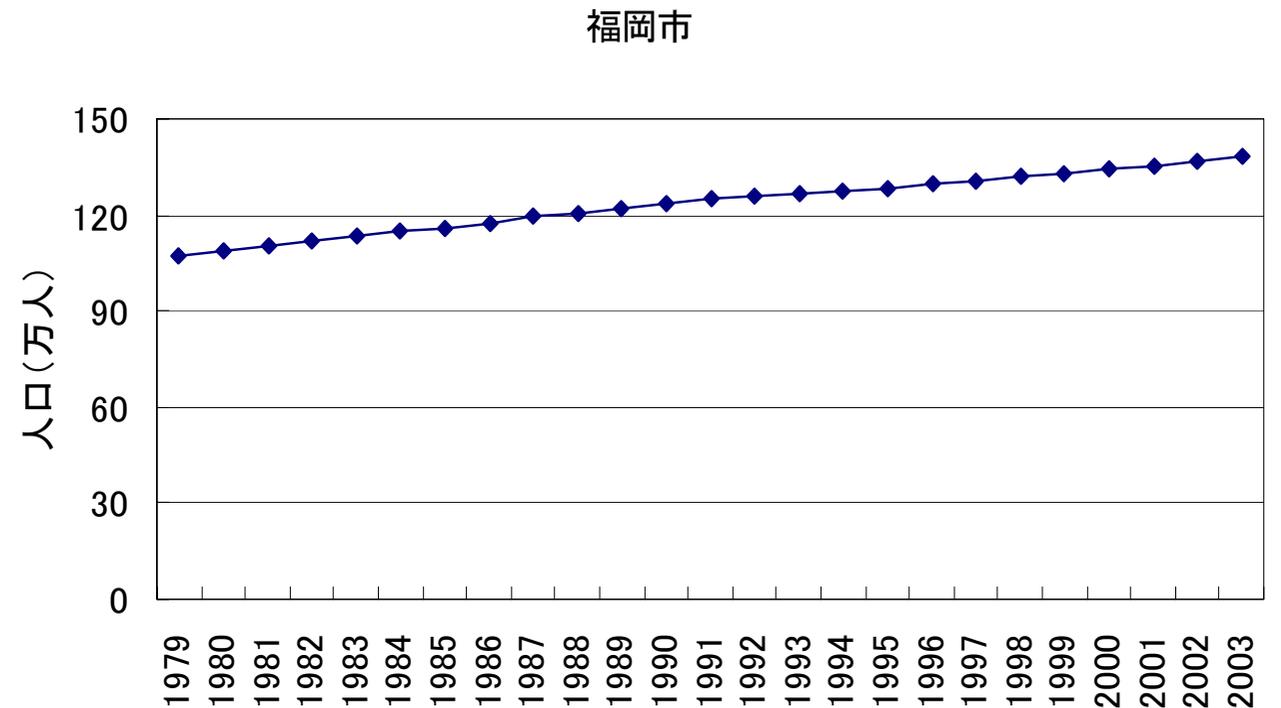


# Basic Information: Meteorological and social conditions



Annual precipitation (bar)  
and  
Mean temperature (line)

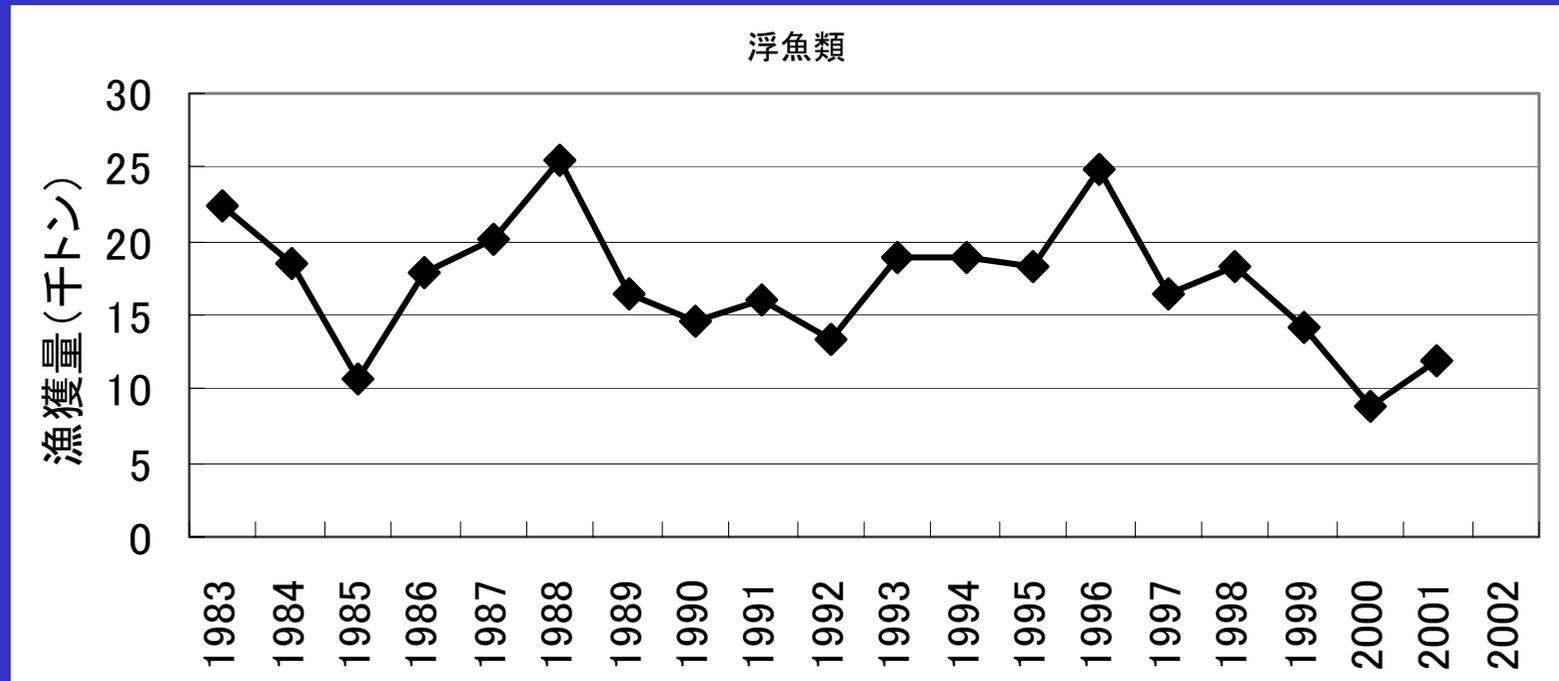
Population  
(million)



# The extent of ecosystem stability

Species composition : C<sup>+</sup>

[Catch of dominant group: pelagic fishes]



1000 tons

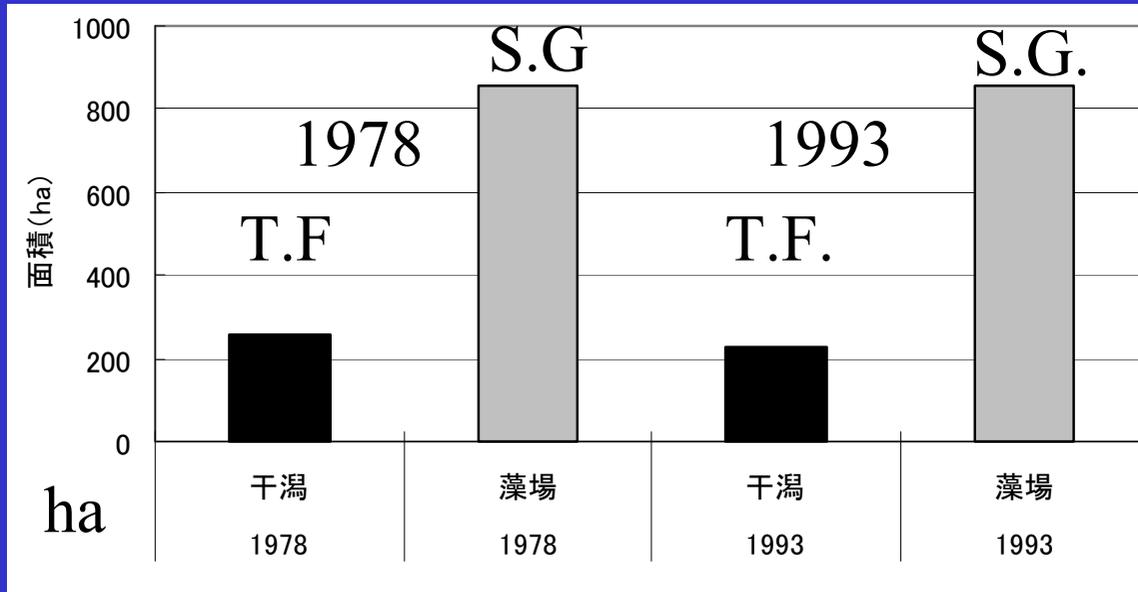
[Benthos and seashore animal]

( Description on the existence of species observed)

# The extent of ecosystem stability

## Habitat space : C<sup>+</sup>

### [Tidal flats and sea grass beds]

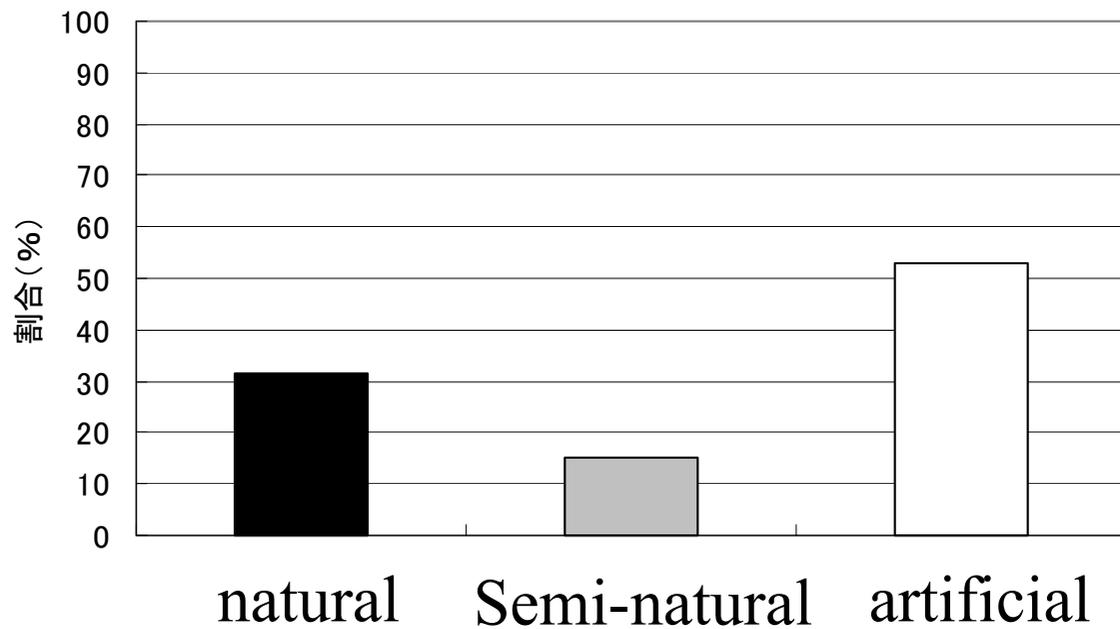


## Environment : A

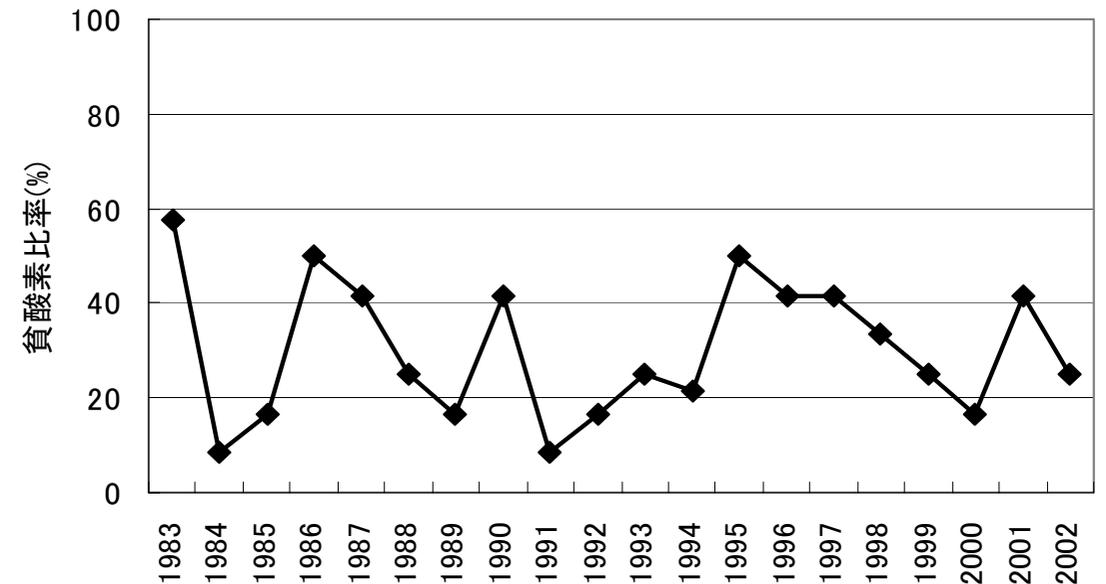
### [Harmful substances]

Within the criteria

### [Percentage of the artificial shoreline]



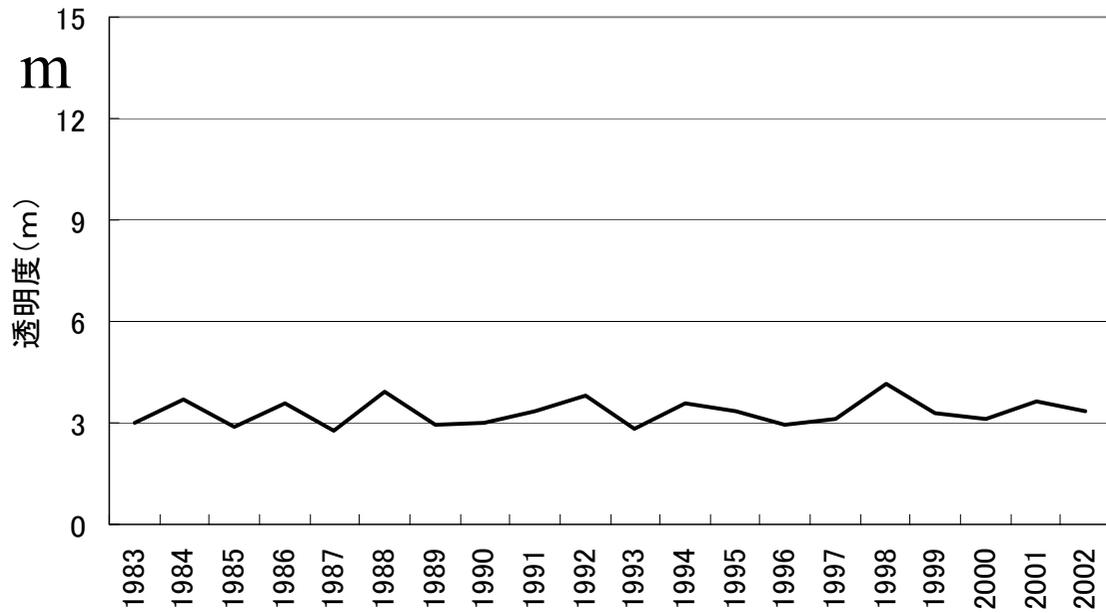
### [Occurrence % of low DO]



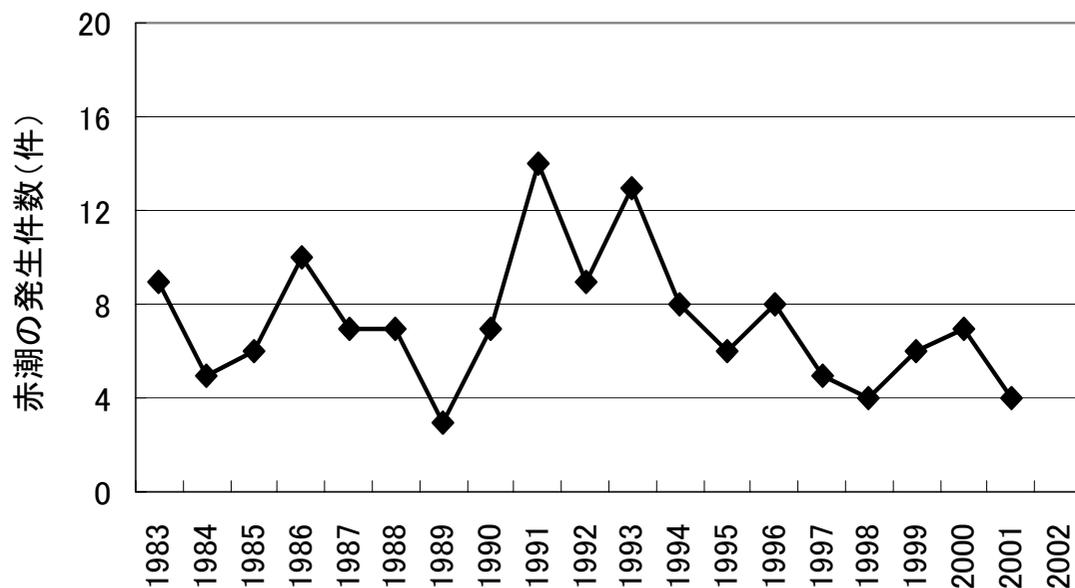
# Smoothness of material circulation

## Primary production: C<sup>+</sup>

### [Transparency]

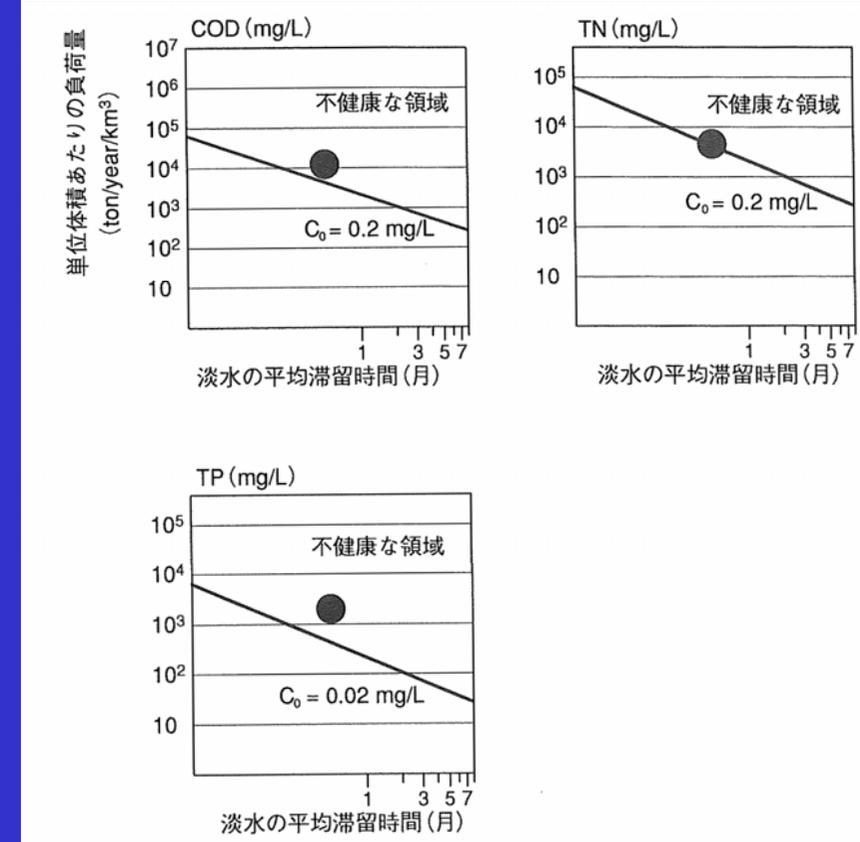


### [Red tide occurrence]

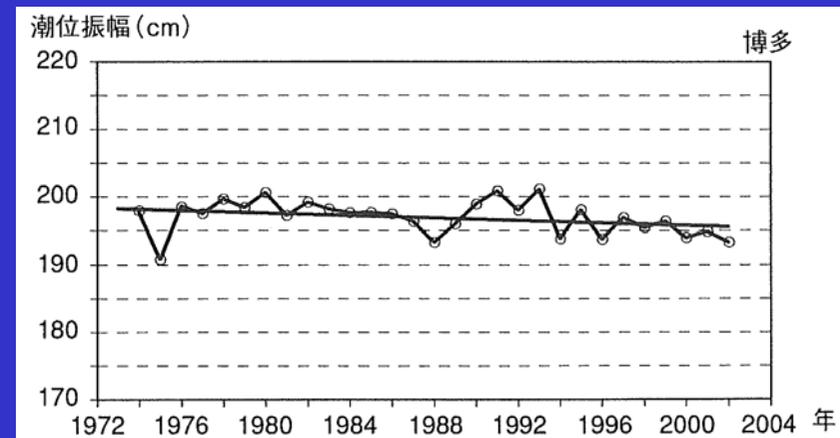


## Load & water exchange: B

### [Load residence concentration]



### [Tidal amplitude]



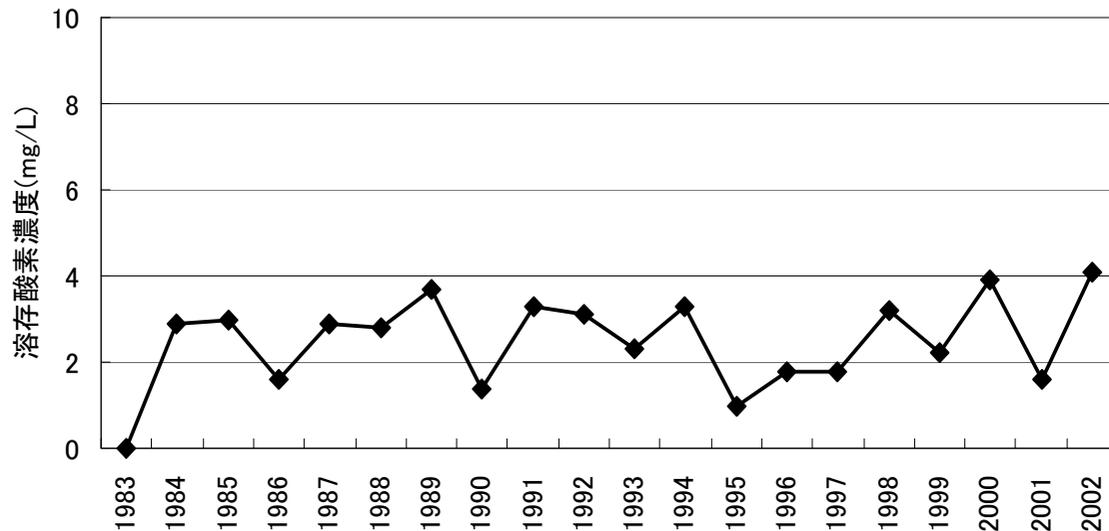
# Smoothness of Material Circulation

Sedimentation &  
Decomposition

[Benthic environment]

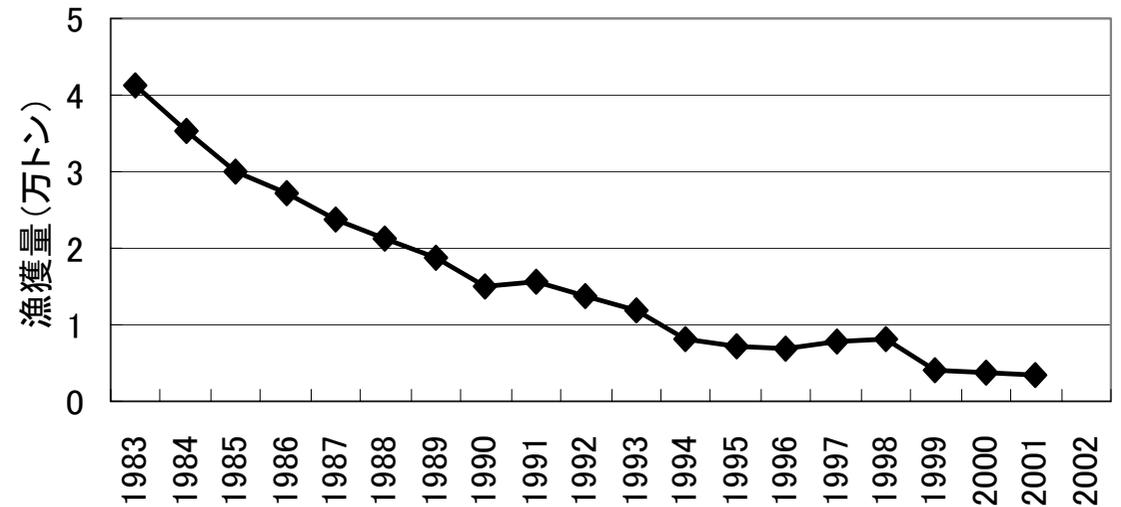
No data

[DO in the bottom layer]



Removal : C

[Demersal fish and shellfish catch]

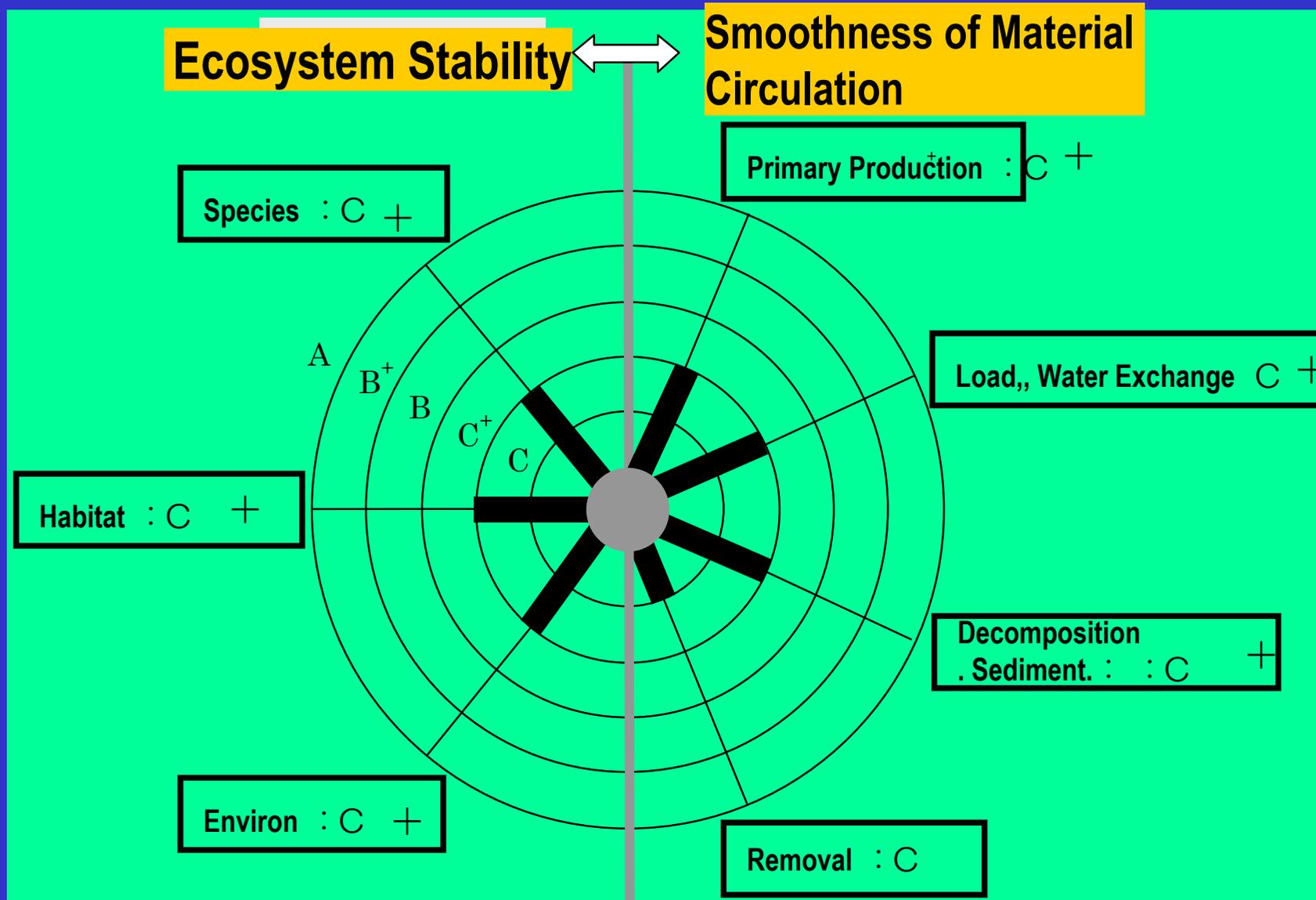


1000 tons

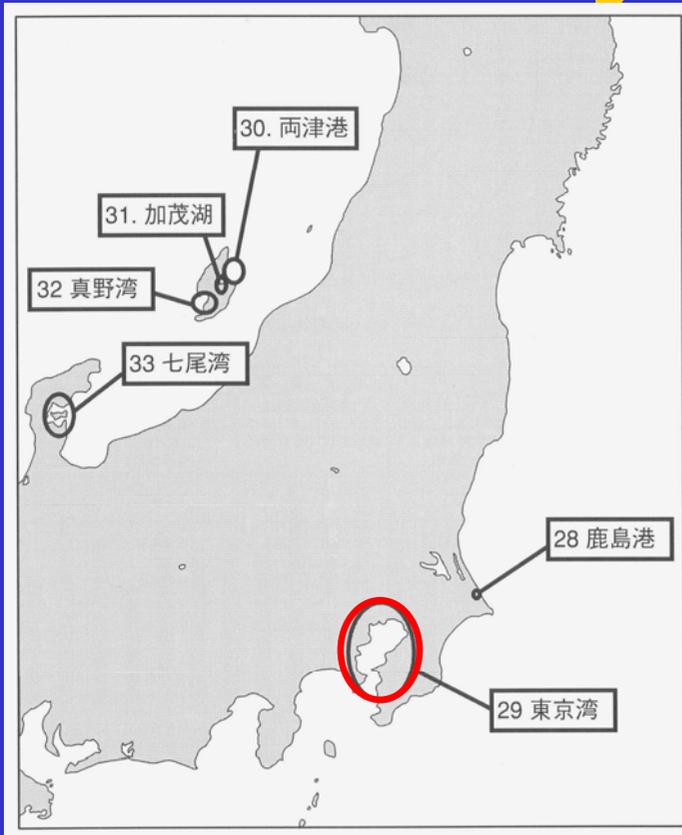
# Ariake and Shimabara Bay

Fukuoka - Kumamoto - Saga - Nagasaki pref.

## Diagnostic chart



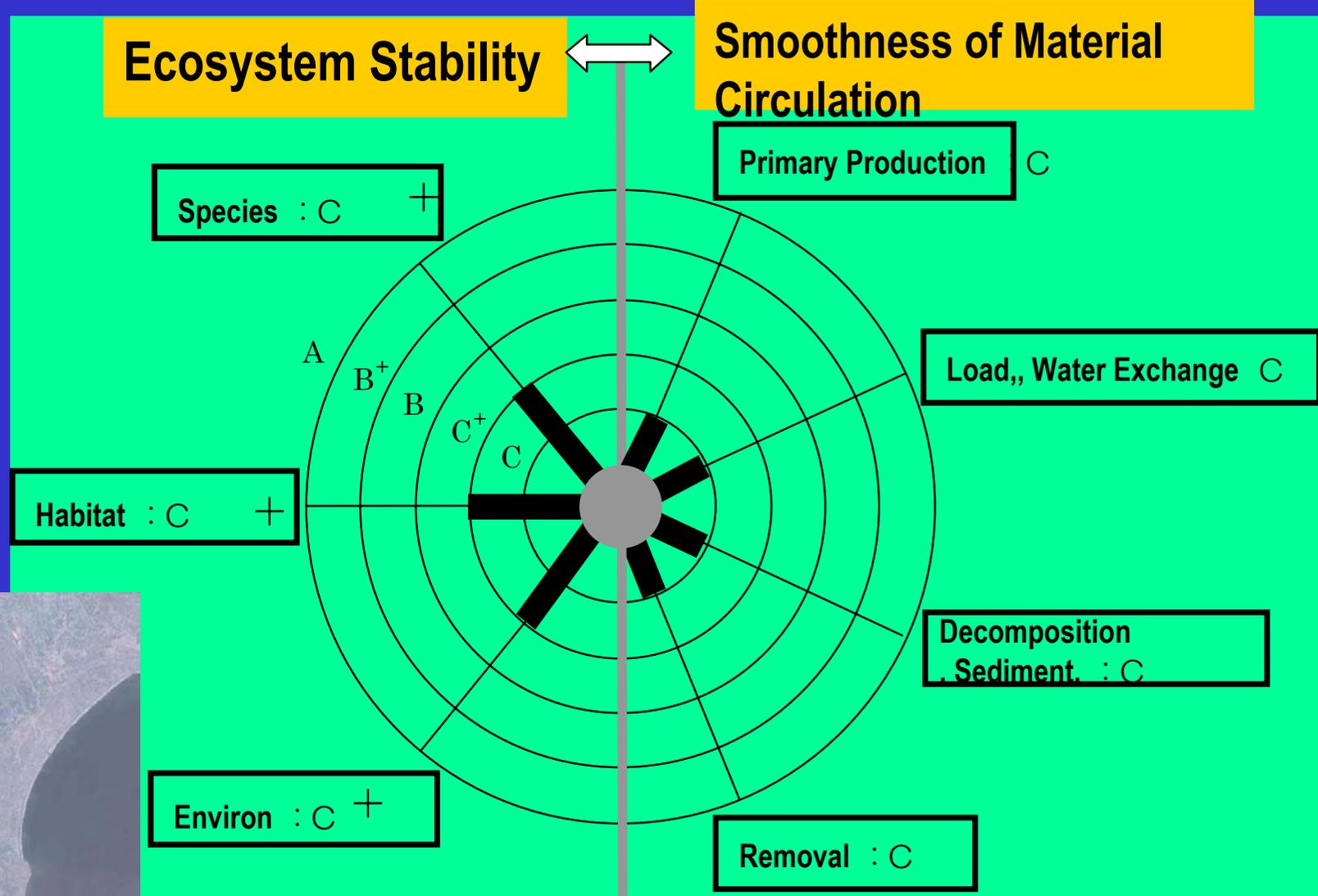
# Tokyo Bay Tokyo - Chiba - Kanagawa pref.



## Diagnostic chart

Ecosystem Stability

Smoothness of Material Circulation



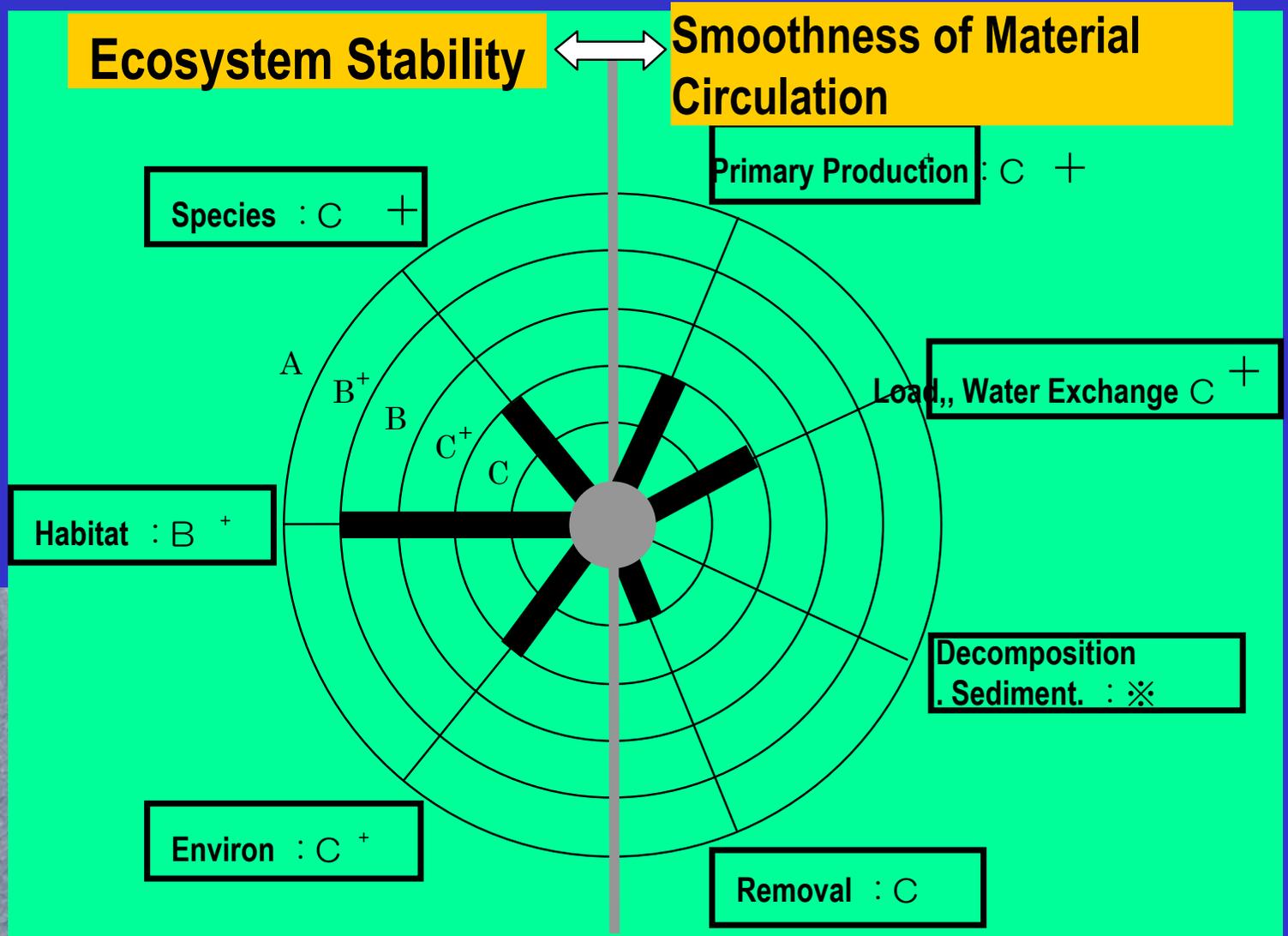
# Ago Bay Mie pref.



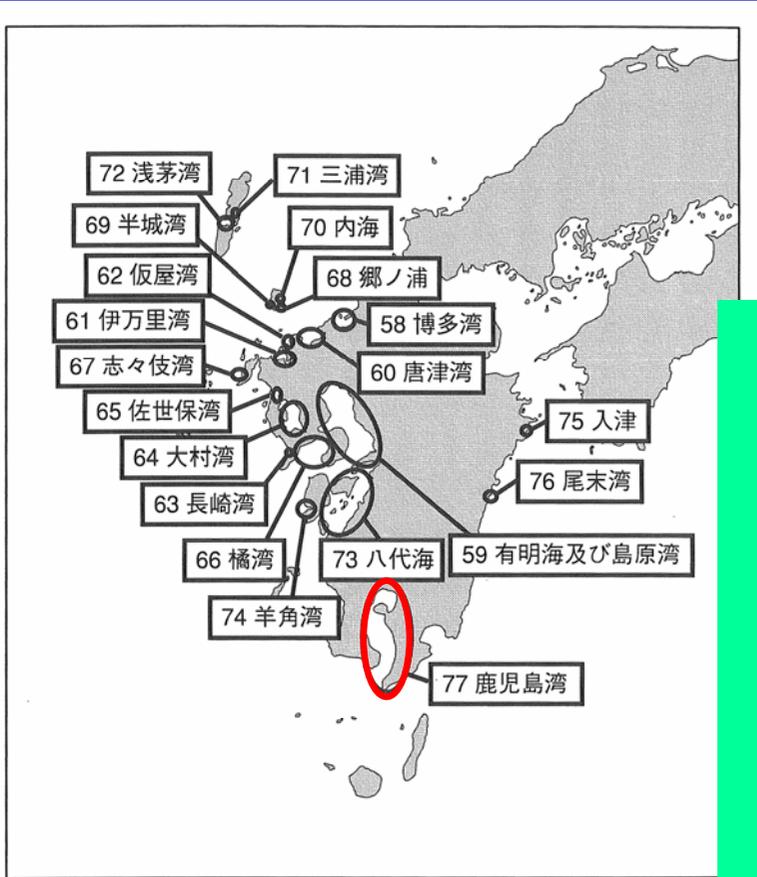
## Diagnostic chart

Ecosystem Stability

Smoothness of Material Circulation



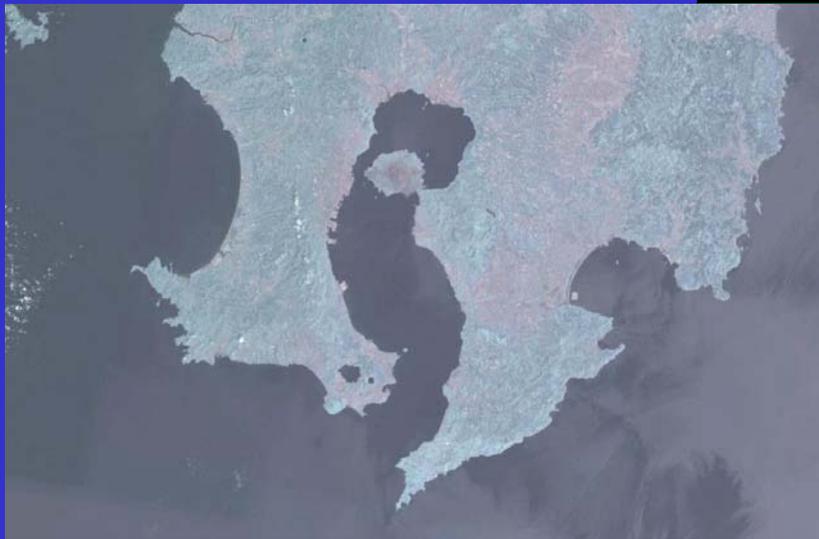
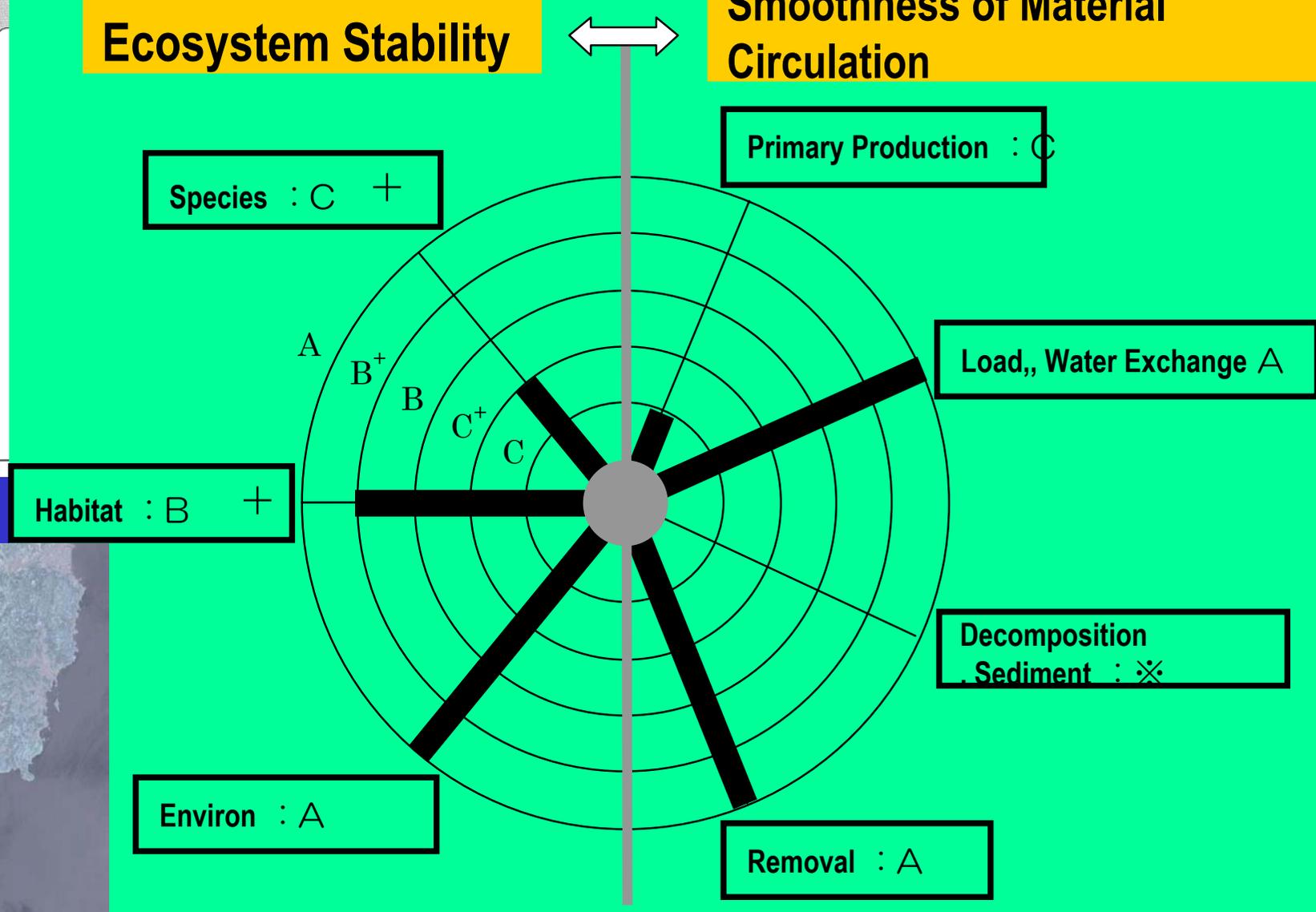
# Kagoshima Bay Kagoshima pref.



## Diagnostic chart

Ecosystem Stability

Smoothness of Material Circulation



## Seto Inland Sea

Since the Seto Inland Sea is officially designated as one enclosed coastal sea, the present preliminary health examination was made for total area of the Seto Inland Sea.

However, condition of the Seto Inland Sea is so diversified according to each sub-area.



## Recommendation

Health examination of the Seto Inland Sea should be made as to each sub-area such as Osaka Bay, Hiroshima Bay and so on in order to get correct information on diagnostic.

# Summary of preliminary health examination in 88 areas

## 1). The extent of ecosystem stability

Species composition (fish catch data): C 82 % most serious

Habitat space (coastline): B+C 60 %

Environment (bottom DO): no data was available in 22 % areas, however, approximately 40 % areas were judged to be B and C

## 2). The smoothness of material circulation

Removal (demersal fish and shellfish catch): C 63%

Primary productivity (transparency): C 90 %

Sedimentation, decomposition: only a few data were available, mostly B or C among them

## **Recommendation from the results of preliminary examination**

- **DO in bottom layer is essential for health examination but not many data are available→improvement of monitoring system**
- **Disclosure of data base to the public is strongly recommended**
- **If appropriate data base is available, preliminary health examination can be done by anyone or any group**
- **Indicators and criteria for preliminary health examination are both to be improved**
- **Some special areas such as Seto Inland Sea which is officially designated as one area should be divided into more characteristic sub-areas.**
- **To give effect of “health examination” on the authorized standard and criteria is very important**

## Recent advances and future perspective

- Preliminary health examination of additional 71 enclosed sea areas in Japan was made. Artificial coastline has strong relationship to the health condition.
- Preliminary health examination of complicated areas such as Seto Inland Sea was improved by the examination of individual sub-area such as Osaka Bay, Hiroshima Bay etc.
- Advanced (specialized) examination was made or is being made on Omura Bay, Mikawa Bay and Sendai Bay.
- Health examination of Sendai Bay is conducted by the government of Miyagi prefecture.
- Successful case study of total “health management” from preliminary examination, advanced examination to “medical treatment”, and also evaluation of the treatment, should be established in near future.
- Application of health examination to the PEMSEA countries might be possible with some modification of the scheme.

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