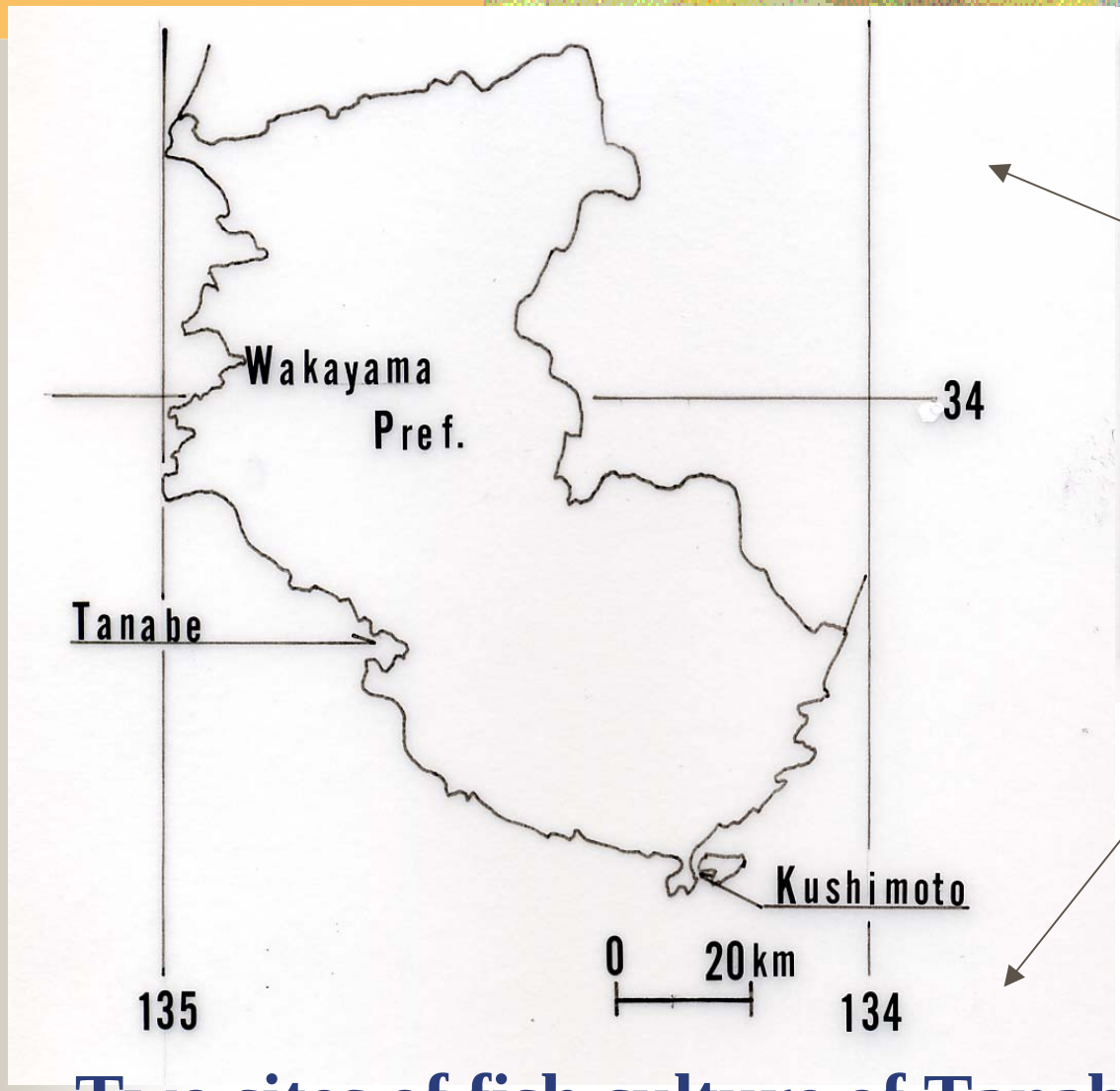
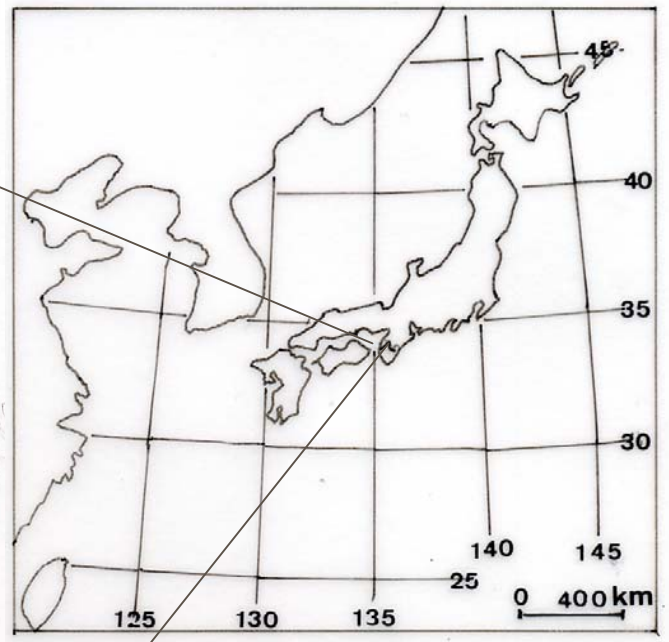
Ulva pertusa and *Undaria undarioides* culture for reducing nitrogen from fish culture area in Wakayama Prefecture, Japan

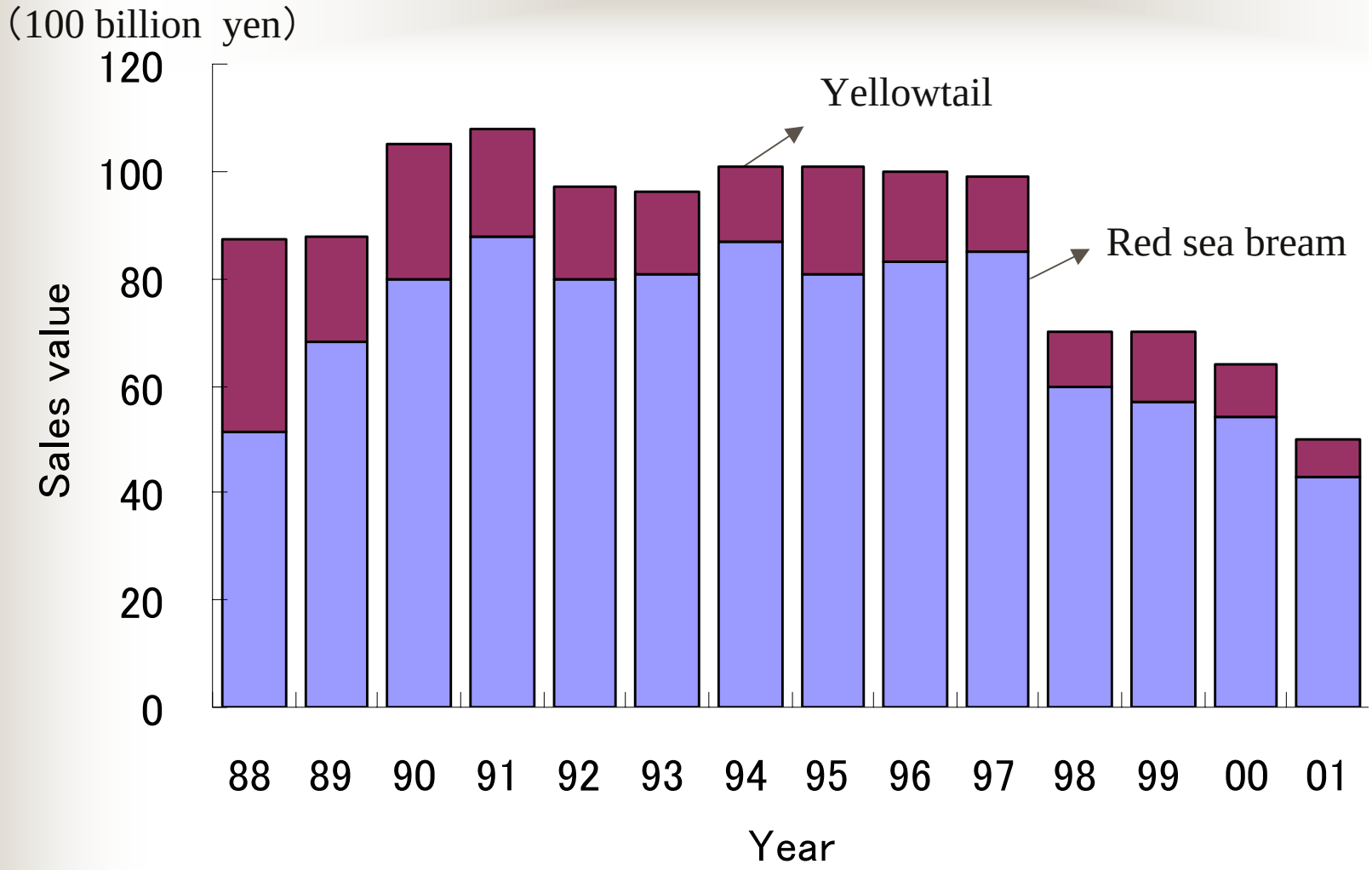
Hajime Kimura[1] and Masahiro Notoya[2]

[1]Fish Farming Laboratory, Fisheries Experimental Station of Wakayama, Research Center of Agriculture, Forestry and Fisheries, Mera, Tanabe, Wakayama Prefecture, 646-0058 Japan.
[2]Laboratory of Applied Phycology, Tokyo University of Fisheries, Konan-4, Monato-ku, Tokyo, 108-8477 Japan.

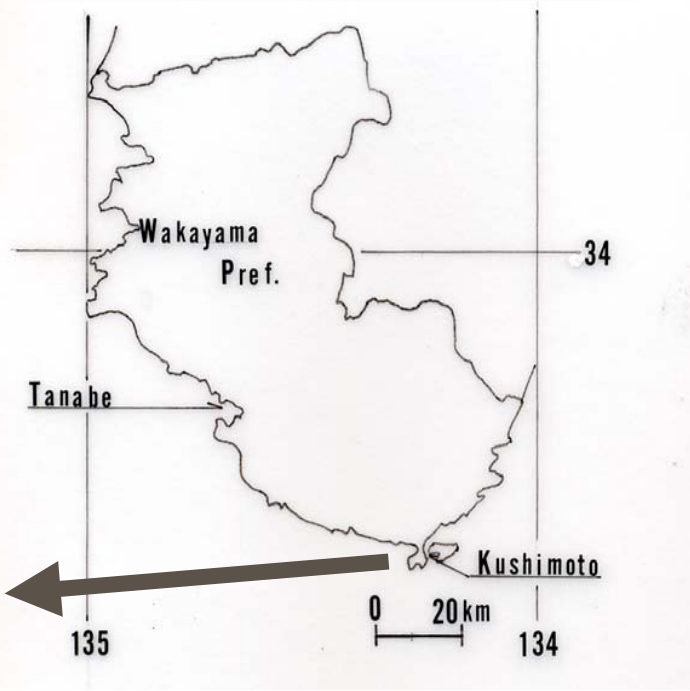




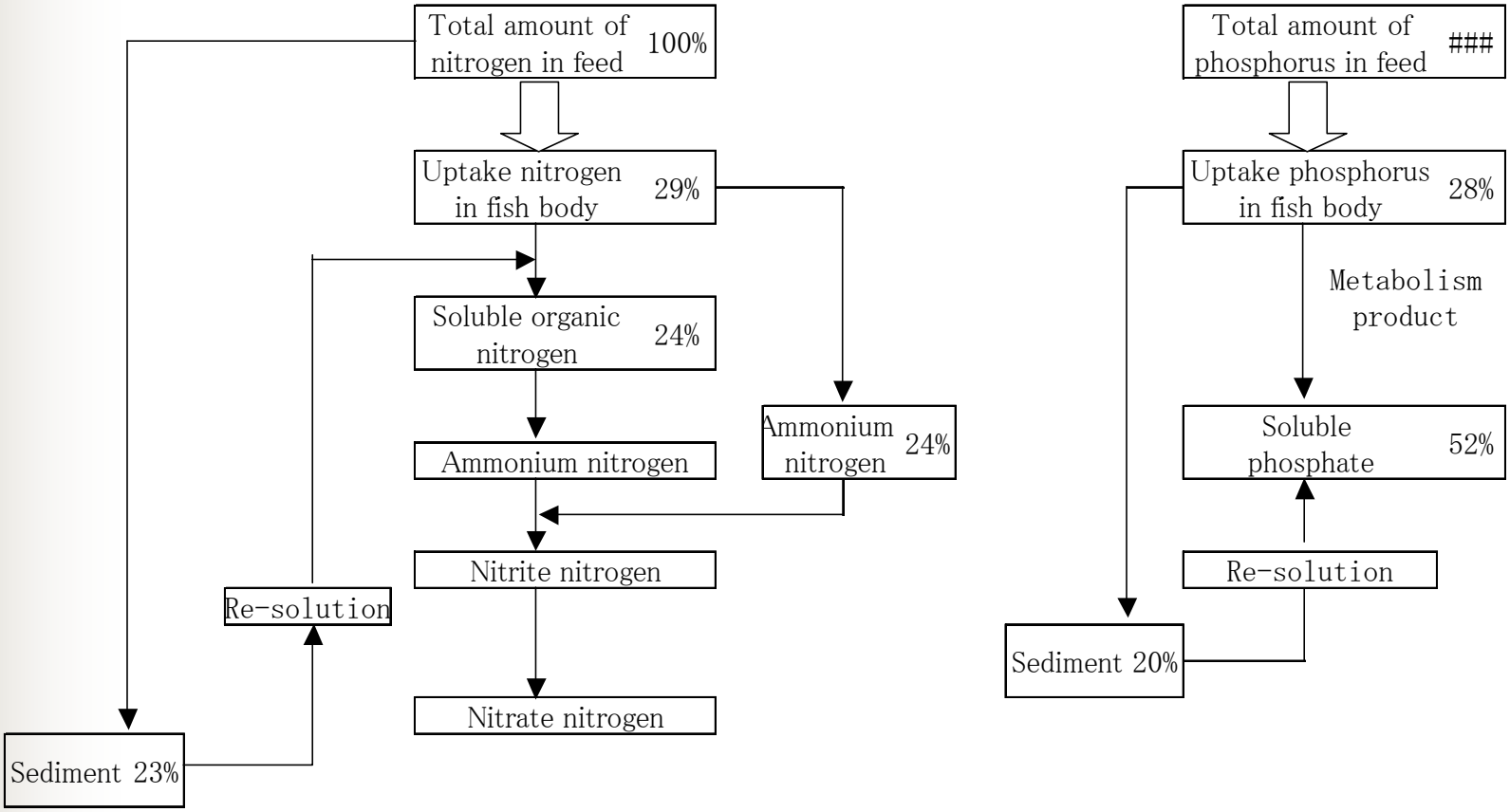
Two sites of fish culture of Tanabe and Kushimoto in Wakayama Prefecture, Japan.



Production of fish culture in Wakayama Prefecture.



The site of fish culture at the coast of Kushimoto city.



Balance of nitrogen and phosphorus on the fish culture

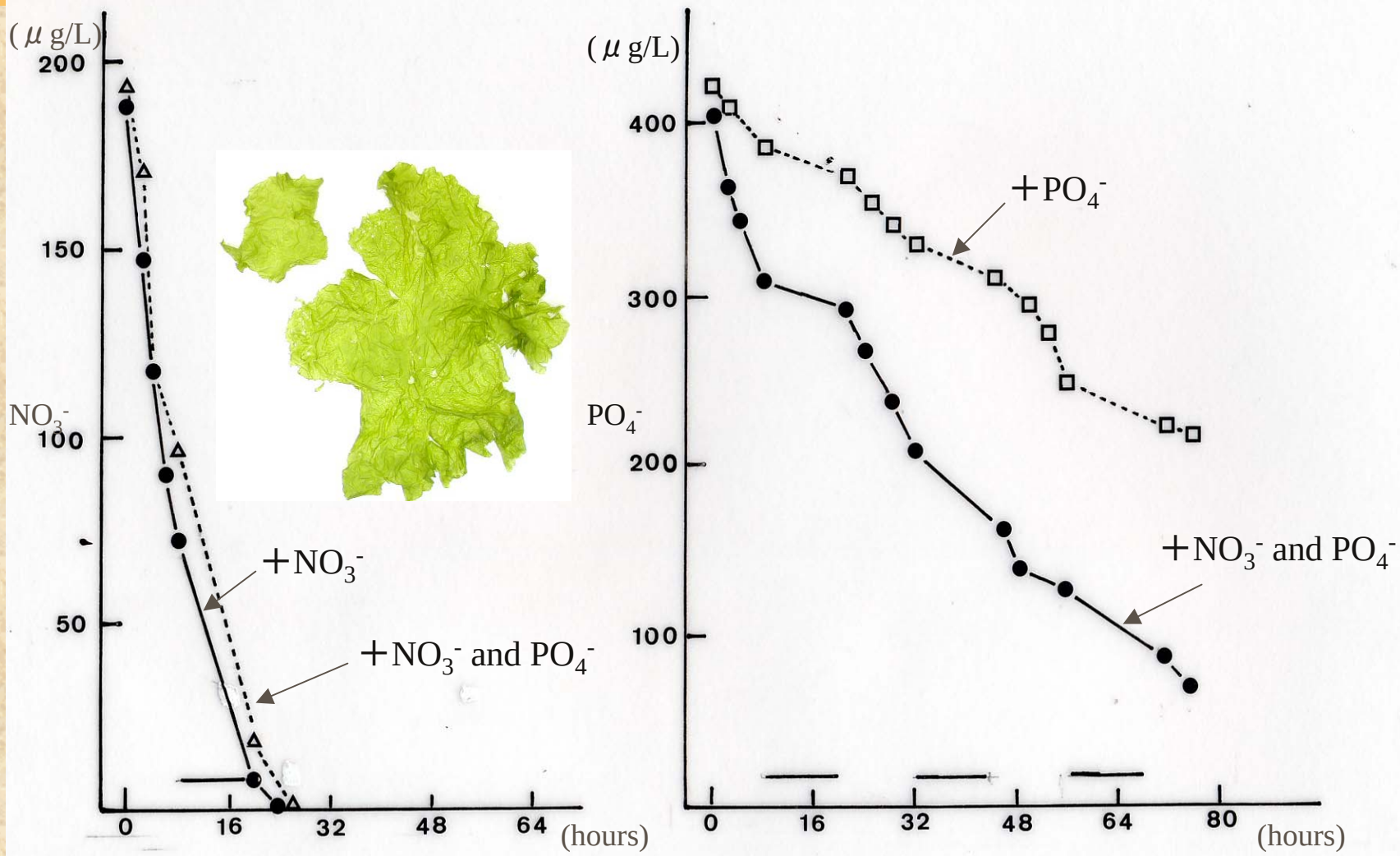
Culture experiment of *Ulva pertusa and Undaria undarioides* for uptake of nitrogen and phosphate.

Three different types medium of the component in filtered seawater

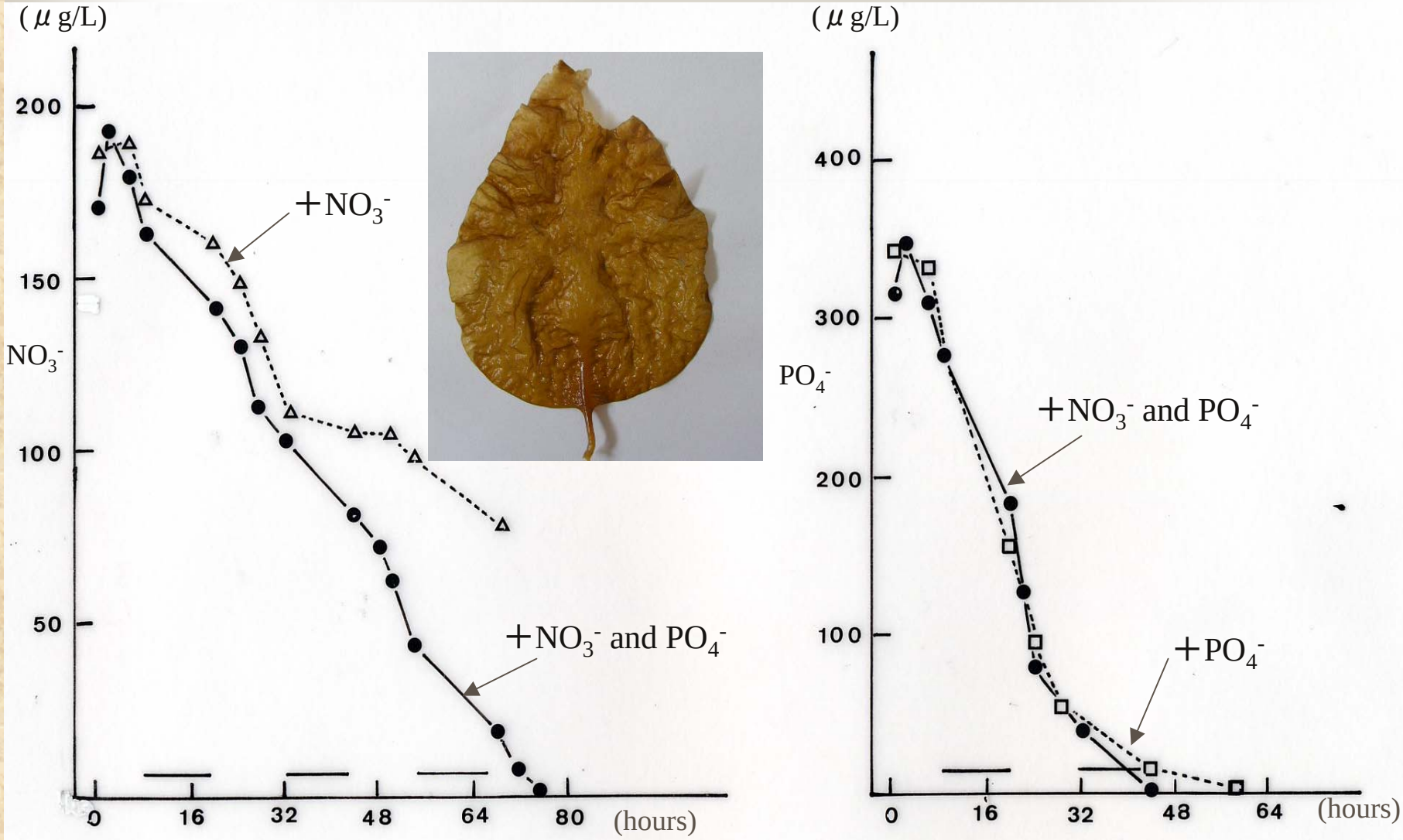
1. NO_3-N 420 μg／ℓ and PO_4-P 93 μg／ℓ
2. NO_3-N 420 μg／ℓ
3. PO_4-P 93 μg／ℓ

Culture conditions

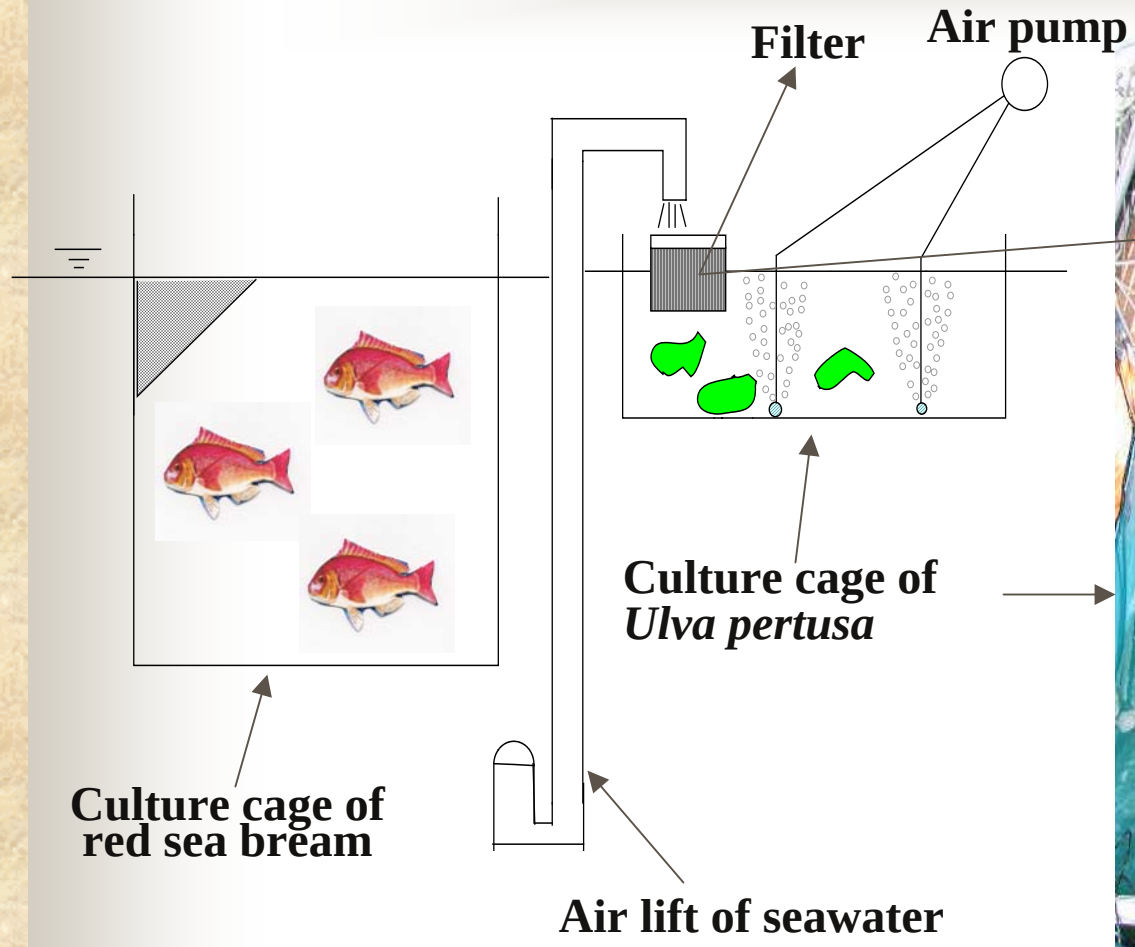
	Ulva pertusa	*Undaria undarioides*
Water temperature	15.2～17.7℃	15.8～17.6℃
Max. light intensity	873.72 μ mol/$m^{-2}s^{-1}$	1,025 μ mol/$m^{-2}s^{-1}$



Uptake of nitrogen and phosphate in three types of culture medium by *Ulva pertusa*.



Uptake of nitrogen and phosphate in three types of culture medium by *Undaria undarioides*.



A system of reducing nitrogen from the culture area of red sea bream by *Ulva pertusa*.

Composition of the blade of *Ulva pertusa*.

Moisture	g/100g	79.6
Crude fat	g/100g	0.5
Total amount of nitrogen	g/100g	0.7
Total amountof phosphorus	mg/100g	45

3,200－1,000＝2,200g (Growth of *U. pertusa* for 6 days)

2,200g×0.007=15.4g (Uptake of nitrogen for 6 days)

15,400mg÷6 days÷1,000g=2.56mg/wet g/day (Uptake of nitrogen a day)

2,200g×0.00045=990mg (Uptake of phosphorus for 6 days)

990mg÷6 days÷1,000g＝0.17mg/wet g/day (Uptake of phosphorus a day)

Results of red sea bream feeding with the EP-pellet in the 3×3×3 m net cage from Sept. 9 to Dec. 13.

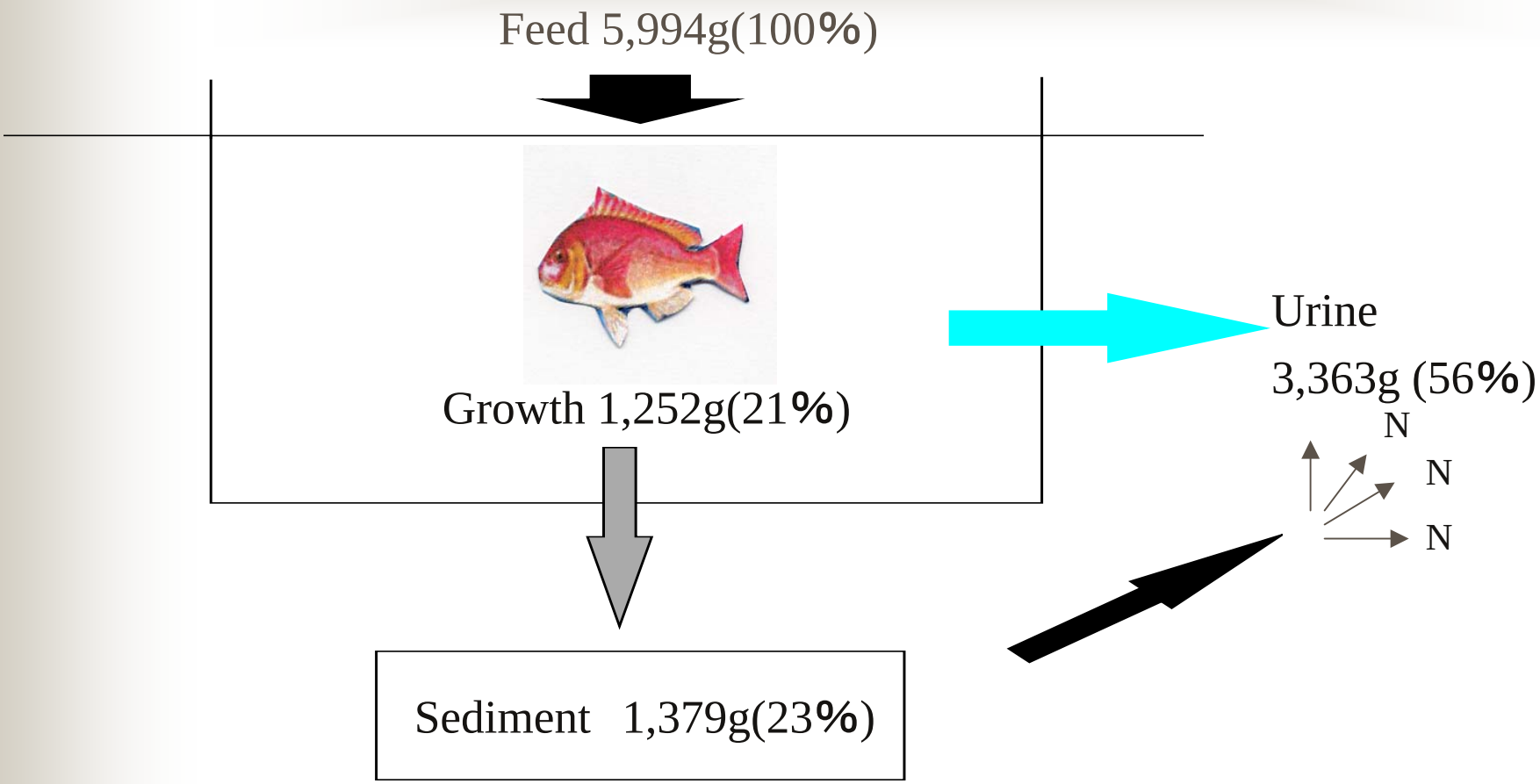
No. of fish	Average Body Fish Initial	Final	Daily feed intake (%)	weight gain (g)	Growth rate(%)	Amount of feeds(g)	Feed efficiency	Mortality (%)
450	73.50	177.00	1.51	42,745 b	241.00	76,300 a	56.02	15.60

Composition of the feed and the whole body of red sea bream.

		diet	Body
Moisture	(%)	1.7	67.3
Crude prot	(%)	49.1 c	18.3 d
Crude fat	(%)	20.5	9.0
Crude ash	(%)	9.3	4.7
Phosphorus	mg/g	16.7	8.63

Amount of nitrogen in feed: a×c/100×0.16=5,994g

Amount of uptake nitrogen in the body of red sea bream: b×d/100×0.16=1,252g



Balance of nitrogen at the culture area of red sea bream at 27-17℃.

Calculation of nitrogen balance on the discharge from the fish culture and uptake by *Ulva pertusa* at 27-17℃.

Discharged total amount of nitrogen from fish culture in a day: (1,379g+3,363g)÷96 day =49.4g

The production of *Ulva pertusa* require for take off all discharged nitrogen from the culture area in a day: 49.4g÷0.007÷0.37=19.1kg

The maximum production of *Ulva pertusa* in a day in this culture system: 4,000g×0.37=1,480g

Uptake of nitrogen by the maximum production of *Ulva pertusa* in this culture system: 1,480g×0.007=10.36g

Removable rate of nitrogen by *Ulva pertusa* in this system: 10.36g÷49.7g=0.21

Undaria undarioides **and its rope line culture in the sea.**

Composition of the blade of *Undaria undarioides*.

Moisture	g/100g	90.3
Crude fat	g/100g	0.1
Total amount of nitrogen	g/100g	0.3
Total amountof phosphorus	mg/100g	34

27.4g (Growth amount of *U. undarioides* for 86 days)

27.4g×0.003=82.2mg (Uptake of nitrogen for 86 days)

82.2mg÷86days＝0.96mg/wet g/day (Uptake of nitrogen a day)

27.4g×0.00034=9.3mg (Uptake of phosphorus for 86 days)

9.3mg÷86days=0.11mg/wet g/day (Uptake of phosphorus a day)

Result of red sea bream feeding with the EP-pellet in the 3×3×3m net cage form Dec. 14 to Mar.12.

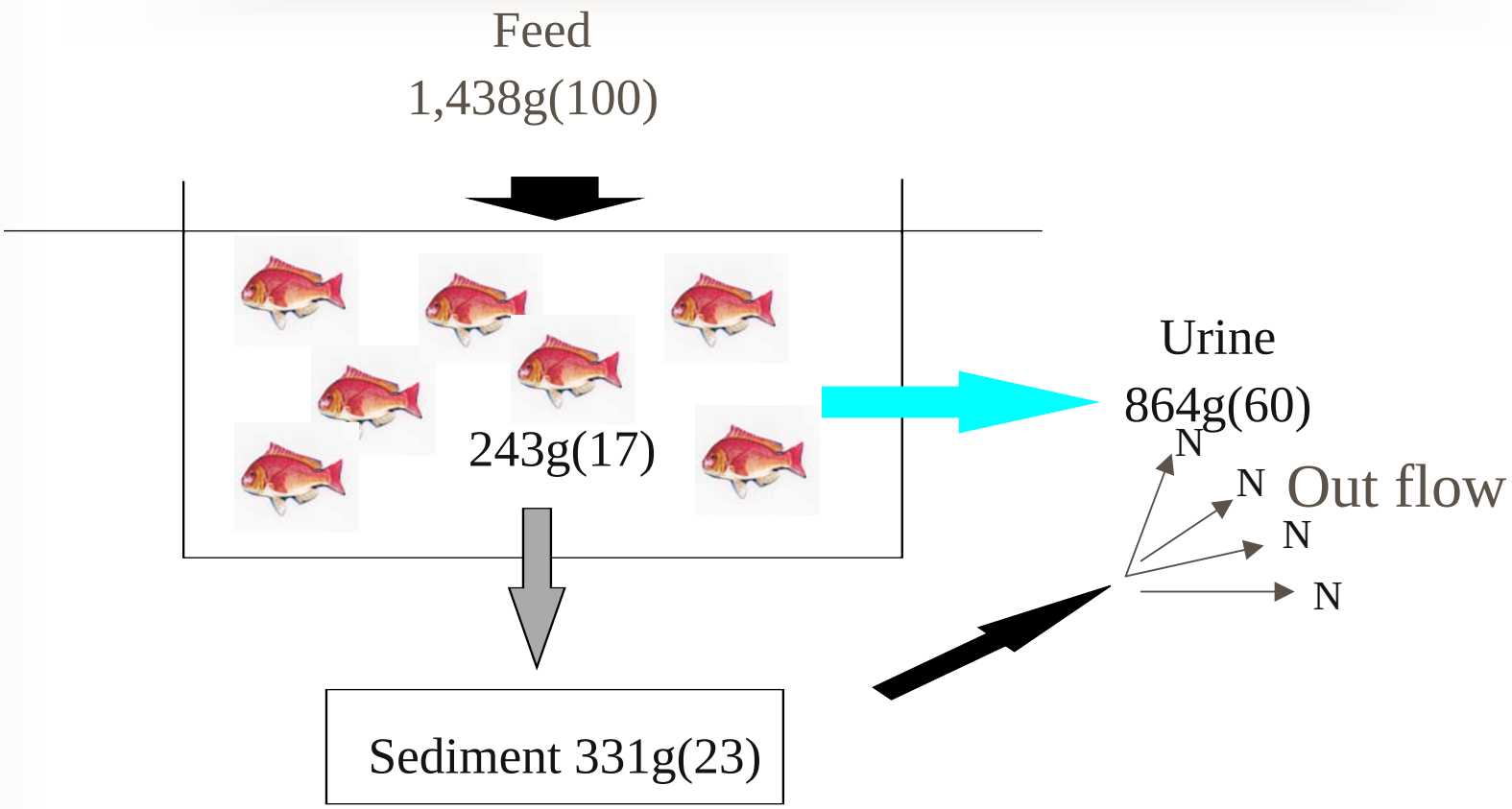
No. of fish	Average Body Fish Initial	Final	Daily feed intake (%)	weight gain (g)	Growth rate(%)	amount of feeds(g)	Feed efficiency	Mortality (%)
239	172.70	205.30	0.44	8,300 b	1.19	18,300 a	45.34	4.23

Composition of the feed and the whole body of red sea bream.

		feed	Body
Moisture	(%)	1.7	67.3
Crude protein	(%)	49.1 c	18.3 d
Crude fat	(%)	20.5	9.0
Crude ash	(%)	9.3	4.7
Phosphorus	mg/g	16.7	8.63

Amount of nitrogen in the feed :a×c/100×0.16=1,438g

Amount of uptake nitrogen in the body of red sea bream : b×d/100×0.16=243g



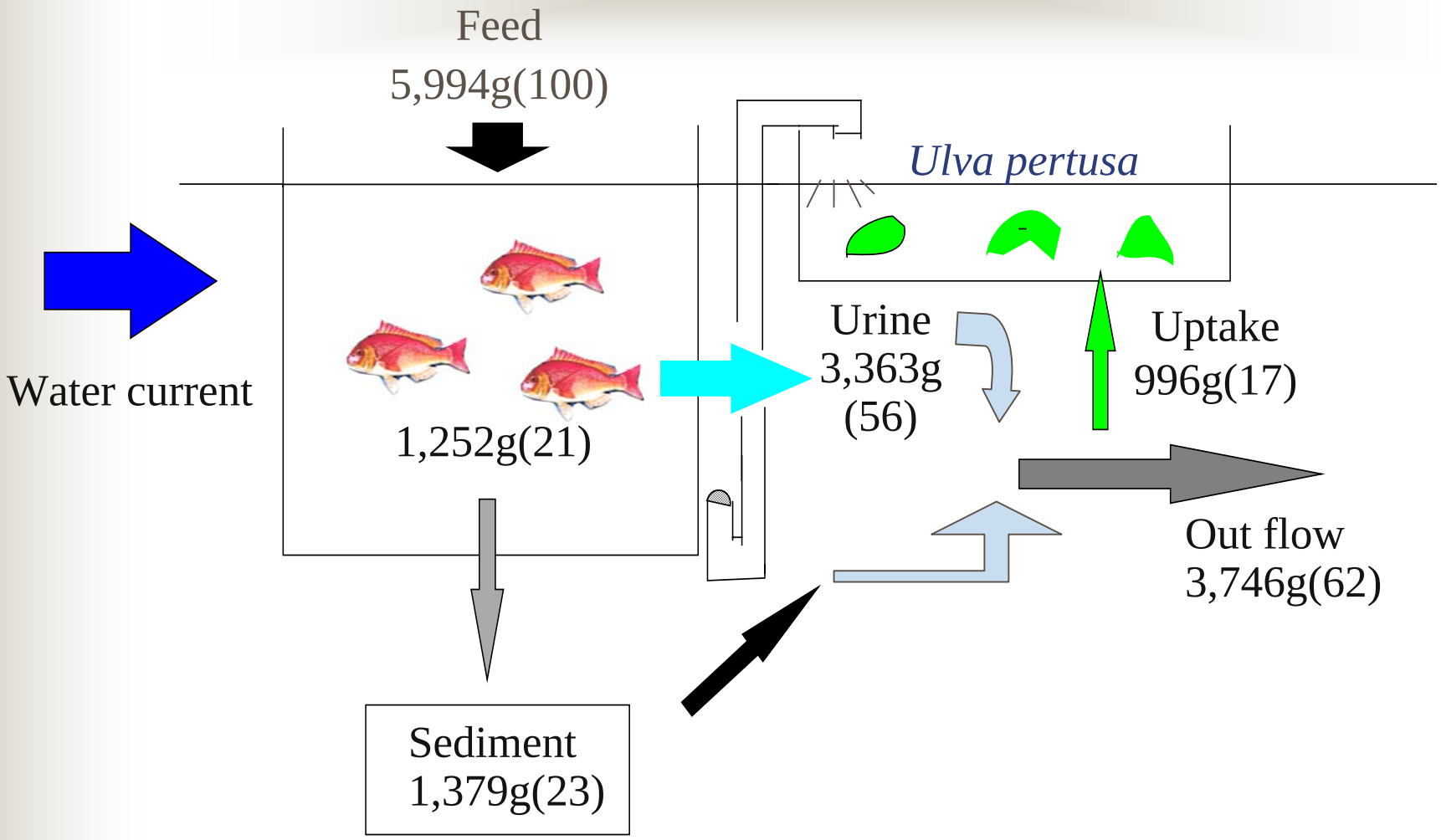
Balance of nitrogen at the culture area of red sea bream at 18-14℃.

Calculation of nitrogen balance of the discharge from the fish culture and uptake by *Undaria undarioides* at 18-14℃.

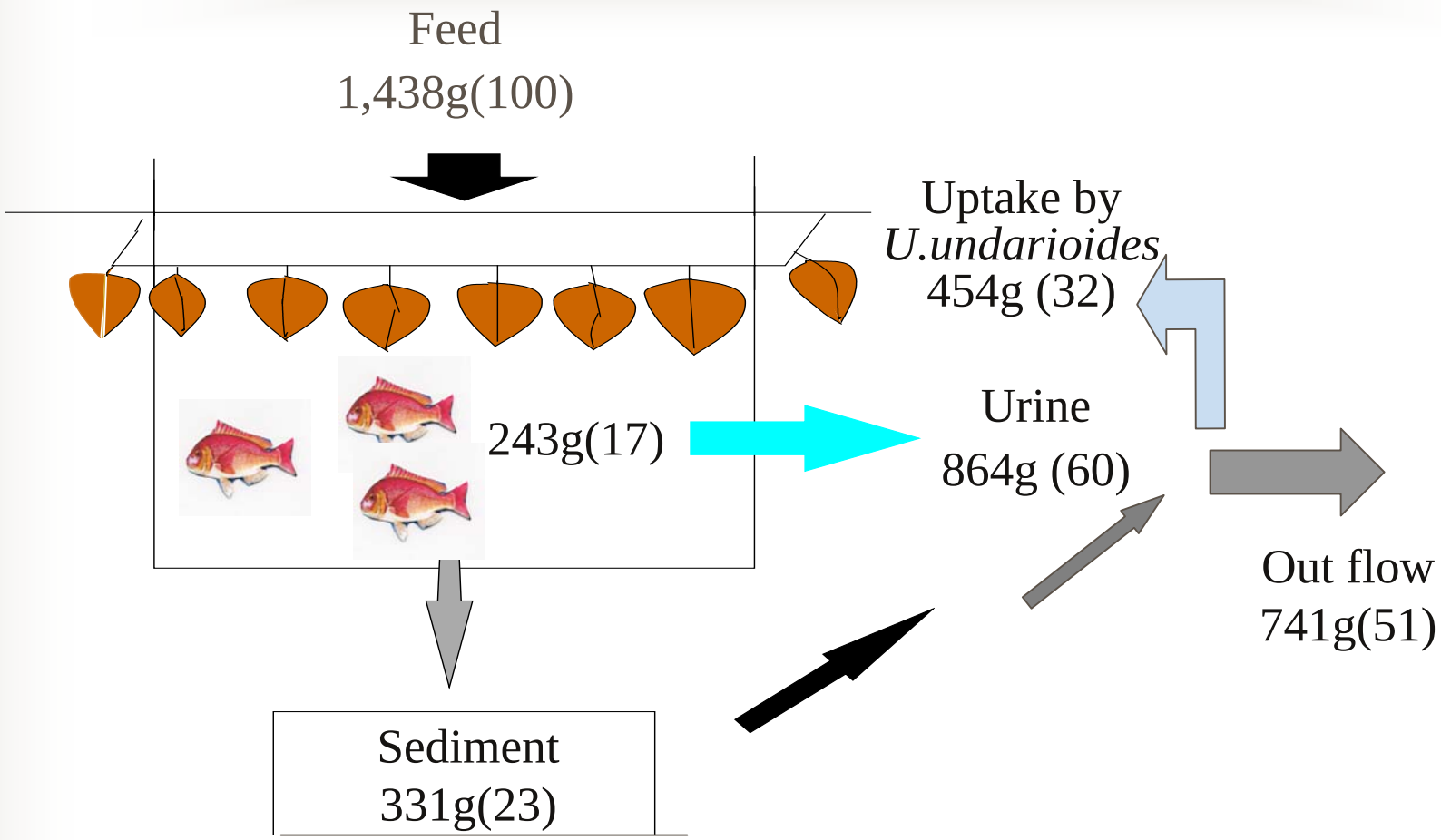
The production of *Undaria undarioides* require for take off all discharged nitrogen from culture area : (331g+864g)÷0.003=398.3kg

The production of *Undaria undarioides* from the surrounding cage of the red bream culture system in this experiment: 150kg

Removable rate of nitrogen by *Undaria undarioides* in this culture: 150kg÷398.3kg=0.38



Effect of reducing nitrogen from the red sea bream culture area by *Ulva pertusa* at 27-17℃.



Effect of reducing nitrogen from the red sea bream culture area by *Undaria undarioides* at 18-14℃.

Top shell (*Turbo (Batillus）cornutus*) culture with feed of *Ulva pertusa*.

Thank you for your attention

H. Kumura and M.Notoya