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RECENT MARICULTURE TECHNIQUES IN JAPAN

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RÉSUMÉ

La production de produits de la mer au Japon continue à augmenter régulièrement, atteignant 10 millions de tonnes en 1972. Les produits de l'aquaculture marine représentaient environ 9,8 % du total en quantité et environ 19 % en valeur en 1976.

La production aquacole consiste principalement en sérioles, crevettes japonaises, huîtres et huîtres perlières, porphyra, etc... Récemment, les techniques de production de masse de crevettes, daurade japonaise, coquille St-Jacques et ormeau ont enregistré des progrès importants, conduisant les organismes nationaux ou préfectoraux à mettre en place les installations permettant une production de masse de ces espèces pour rétablir ou augmenter les ressources marines des zones peu profondes. Après de nombreuses études de faisabilité, ces établissements produisent actuellement plus de 200 millions de larves (poissons, mollusques, crustacés) destinées à repeupler la mer côtière.

Le repeuplement des zones naturelles "ouvertes" implique une connaissance écologique approfondie de la distribution, des migrations et de l'habitat de ces espèces.

Cette communication permettra d'expliquer les récentes études en matière d'aquaculture marine, incluant le repeuplement, et de discuter certains aspects ainsi que les perspectives d'avenir.

The changes in annual catch by fisheries type during the last ten years in Japan are shown in figure 1. Japan's fisheries continued to develop steadily with production reaching 9,900 million tons in 1971. The catch level of 10 million tons was achieved in 1972, and maintained from 1973-1975. Comparing 1976 production with 1966's, production increased by about 1.5 times or 3,55 million tons during those ten years (Table 1).

Production by shallow sea culture is about 9.8 % of the total in quantity and about 19.0 % in value. Production by culture in shallow coastal waters mainly consists of yellowtail, Kuruma shrimps, oyster, scallop, pearl oyster, Nori *(Porphyra)*, Undaria, etc..., and annual production for the same period is shown in Tables 2 and 3. Quite a few species of aquatic animals are commercially cultivated. Among them, production by culture of yellowtail, oyster, pearl oyster, scallop, undaria and nori has been stagnant, in spite of the continued development of culture techniques for these species, because of the narrowing down of the culture grounds due to pollution and reclamation of the foreshore. Production of Kuruma shrimp, abalone and red sea bream has been increasing and the scale of culture of these species is expected to continue to expand.

Recently, mass production techniques for Kuruma shrimp, red sea bream, scallop and abalone have made great progress. National and prefectural governments have established facilities for seed production of these species to restore and increase the marine resources in their areas (Fig. 2).

After many feasibility studies, they now produce at least more than 200 million larvae per year including both fish and shellfish to stock the open sea (mainly shallow waters) with them. In order to restock the fenceless natural environment effectively much ecological knowledge is needed about the distribution of the species to be restocked. In this respect, I would like to explain the sumarized results of studies concerning Kuruma shrimp *Penaeus japonicus* wich is a sedentary shrimp species, not a wandering species such as *P. setiferus* and *P. orientalis.*

Through the development of indoor culture techniques for the mass production of postlarvae and many trials for the restocking of this species, it has been possible to gain some understanding of their life cycle as shown in Fig. 3 and Table 5. During the juvenile stage they remain in tidal estuary areas where there are many pools offering a plentiful supply of foods and some protection from predator fished.

Principles for restocking :

1. Life history stage principle
Restocking should be carried out at the same phase of life history as corresponds to natural life cycle of shrimp, especially in relation to habitat and food.

2. Protection principle
Postlarvae should be released in an area where they have some protection from predators.

3. Dispersion principle
They should be distributed as sparesely and homogeneously as possible.

It is very important to check out the above mentioned ecological factors for the specific species as a base for reasonable restocking activity but this requires much time, many researchers and a sufficient budget.

Hatchery production abbreviates the pelagic life stages (Fig. 3) and the survival rate can be increased to ca. 50 % compared with the very low natural survival rate.

Next, I would like to give an actual example of restocking. Fig. 4 and 5 are a summary of the results monitered by Yamaguchi prefecture Fish. Res. St. The releasing trials were carried out between 1972 and 1974. In each trial about 2 million pieces were used for restocking and in total 27 million postlarvae. (12 mm in total length, 0.01 g in body weight) were released during three years. In Omi Bay, Yamaguchi Pref., released postlarvae reach a size of 10 cm and are caught in the sound by set-nets after two and half months and individuals measuring more than 14 cm are caught offshore by small trawls up to November.

It has been established that released larvae move to offshore areas as they grow larger based on the results of tagging experiments as shown in Fig. 4. After restocking trials, mortality among the released larvae occurs in the following steps.
1. 24 hours after being released,
2. 2-4 weeks after releasing up to a size of ca. 3 cm : mortality is estimated at max. 3.5 %/5 days,
3. 2 months, up to a size of ca. 10 cm : mortality is estimated at 3.5 %/day. During this period, the growth rate has been measured as 1-2 mm/day in summer.

Finally, 6-7 % of the restocked larvae survive to reach a size of 10-14 cm and are caught by set nets or small trawls, but recapture rate varies greatly according to the conditions in each releasing area.

The economic effect on the fishing yield in the case of restocking with Kuruma shrimp larvae was investigated by Dr Hasegawa in relation to one farming fishery trial at the pilot farm of Saijo, Shikoku Is. in 1971. The natural mortality of the shrimp was estimated at 3-4 percent per day and this rate remained stable from seedling size (10-13 mm) to commercial size. Growth was very rapid and larvae stocked in June reached commercial size in September and were recaptured by gill nets and small trawls in the fishery grounds near and off the releasing sites in the tidal area. The results are summarized in Table 5.

As already mentioned, for fish farming of a specific species, the basic thing is to establish the mass production of seed. There are two methods for this. One is the natural seed collecting method. In the case of species such as scallop, oyster and yellowtail, the juveniles are collected in the open sea. It is possible to obtain large numbers of spats or juveniles of each species every year. In order to assure the stability of the quantities collected by this method, it has become clear recently that one of the main factors of successful natural collection, especially in semi enclosed waters with a fixed current pattern, is the building up of the natural parent population to a certain level by culture, restocking, etc. Once the parent population has been increased up to this level yearly spat collection can be expected to achieve a good degree of stability. One of the relatively clear examples of this is the case of scallop spat collection in Mutsu Bay as shown in Fig. 6. It can be seen that once the density of larvae with size of larger than 200 μm in shell length has reached more than 100 inds. / m^3, the number of spat collected yearly achieves stability at about more than 4 000 spats per collector. The density of larvae corresponds very closely to the numbers of the parent population.

The other method for mass production of seed is culture in tanks. In case of red sea bream, flatfish and abalone, the seed cannot be collected in the open sea, therefore, juveniles are reared artificially in tanks. Recently, the techniques in this field have made great progress, especially those for red sea bream and about a million juveniles 3-4 cm in length can be produced in one hatchery facility.

Now, I would like to explain the techniques used in relation to the food supply system. Fukusho et al. carried out experiments for mass production employing 100 ton tanks and the results are shown in Fig. 7 and Table 6. They have established a practical technique for the mass production of red sea bream and can produce 62 x 10^4 juveniles per tank. Through such practical rearing and filed work, some knowledge has been aquired concerning the life history of the species as shown in Table 7. The differentiation of trophic migration and food habit are shown in Fig. 8 and 9. This information will be very effective in working out a reasonable restocking plan in the next stop of sea farming.

Beginning in 1972, the phenomenon of mass mortalities of hanging scallop has been experienced in all the major scallop culture areas as shown in Fig. 10. This phenomenon began in the southernmost culture areas which also happened to be practically enclosed bays of relatively small area. However, in 1975 the same phenomenon appeared in Mutsu Bay and spread north to Funka Bay in 1977 in spite of this bay being one of the largest and most open embayment areas. Following the mass mortality of cultured scallops ecological studies have been made in all major culture areas. It has been found that there is a limit to total potential production in each area. In the case of Mutsu Bay, the limit for production by bottom culture may be about 20,000 tons and by hanging culture somewhat less than 30,000 tons as shown by the data contained in Fig. 11. Studies carried out to investigate the causes of this phenomenon have clearly shown that there is a maximum density for scallop culture above which such mortality tends to occur.This is shown in Fig. 12 where it can be seen that after reaching a certain culture density no increase in production is possible.

Concerning the future research problems in the field of large scale mariculture, they are as follows :

1. Development of effective restocking methods particularly the improvement of the natural habitats by using man-made reefs, etc...

2. The theoretical and practical methods for calculating the potential capacity of the culture and restocking areas.

3. Exploitation of mass culture techniques for new species. Compared with traditionnal style mariculture such as oyster culture, the recent advances in technology are the mass culture of Kuruma shrimp, abalone and red sea bream. Now, having developed large scale mariculture for coastal and off-shore waters, there remains some unexploited areas for mariculture, like the culture of oceanic species such as tuna.

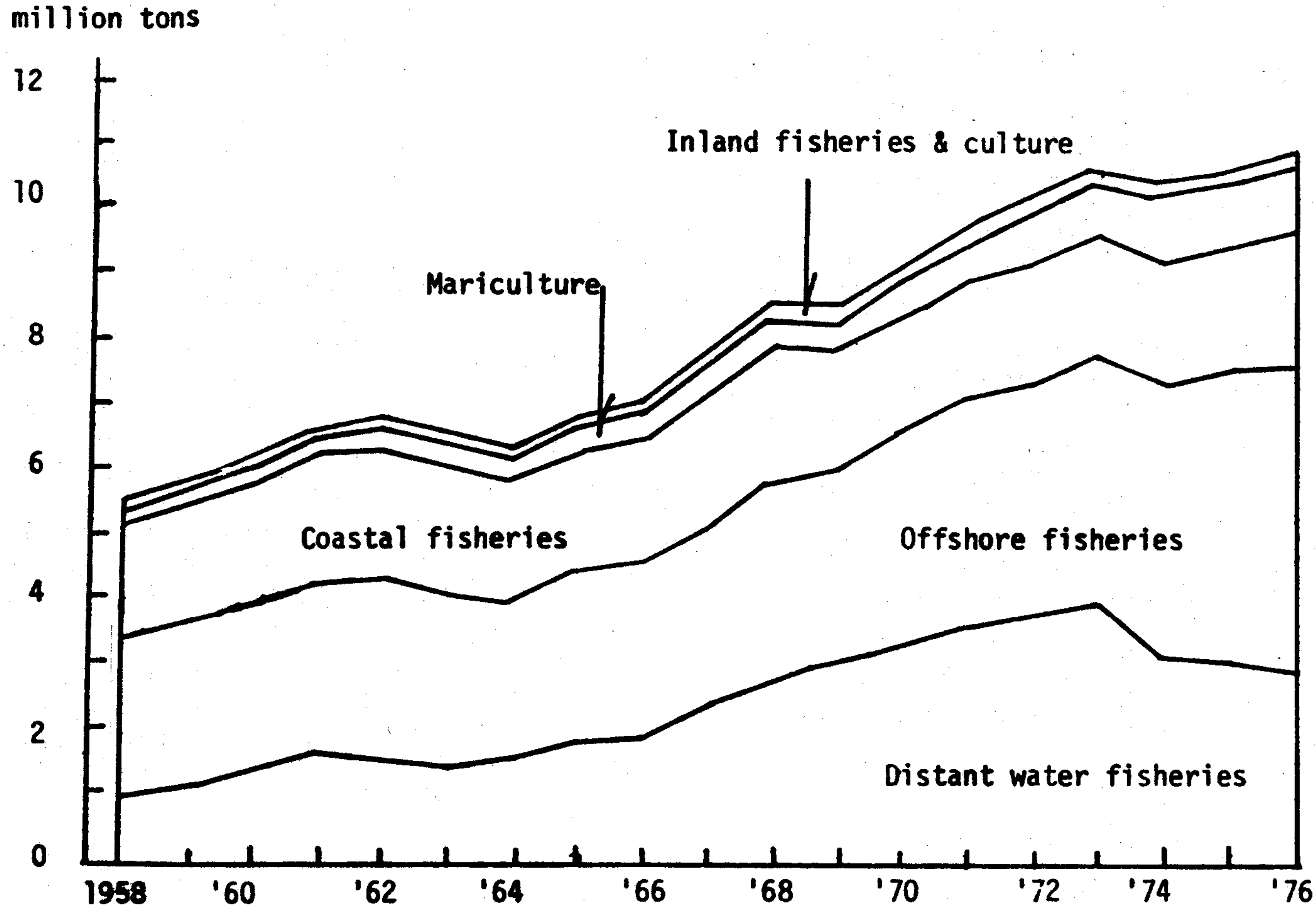


Fig. 1. Changes in annual fisheries catch by type of fisheries (Japan Fisheries Ass. 1977).

Tabl. 1. Quantity and value by type of Fisheries
Quantity : metric tons ; value : million yen (1976).

Type, Fisheries	Quantity	Value
Distant waters	2,948,990	520,930
Offshore waters	4,656,193	662,830
Coastal waters	2,000,100	586,480
Mariculture	849,909	293,340
Inland fisheries & culture	200,711	122,560
Total	10,655,903	21,861,140

Tabl. 2. Major species for mariculture

Fin-fish (10 species)		Shellfish (9 species)	
Yellowtail	*Seriola quinqueradiata*	Spiny lobster	*Panulirus japonicus*
Red sea bream	*Pagrus major*	Blue crab	*Neptunus tribuberculatus*
Black sea bream	*Acanthopagrus*	Kuruma shrimp	*Penaeus japonicus*
Jack mackerel	*Trachurus japonica*	Ascidian	*Holocynthia roretzi*
Caranx	*Caranx delicatissima*	Scallop	*Patinopecten yessoensis*
Puffer	*Fugu rubripes*	Oyster	*Crassostrea gigas*
Filefish	*Monocanthus cirrhifer*	Pearl	*Pinctada martensii*
Sea bass	*Lateolaborax japonicus*	Abalone	*Haliotis discus hannai, H. discus discus H. gigantea, H. sieboldii, H. diversicolar aquatilis*
Parrot fish	*Oplegnathus fasciatus*		
Flatfish	*Paralichthys olivaceus*		
Algae (3 species)			
Nori	*Porphyra tenera*		
Undaria	*Undaria pinnatifida*		
Laminaria	*Laminaria japonica*		

Tabl. 3. MARICULTURE PRODUCTS BY SPECIES

(AFTER STATISTICS OF FISHERIES, 1977, MINISTRY OF AGRICULTURE/ FOREST AND FISHERIES)

FINFISH

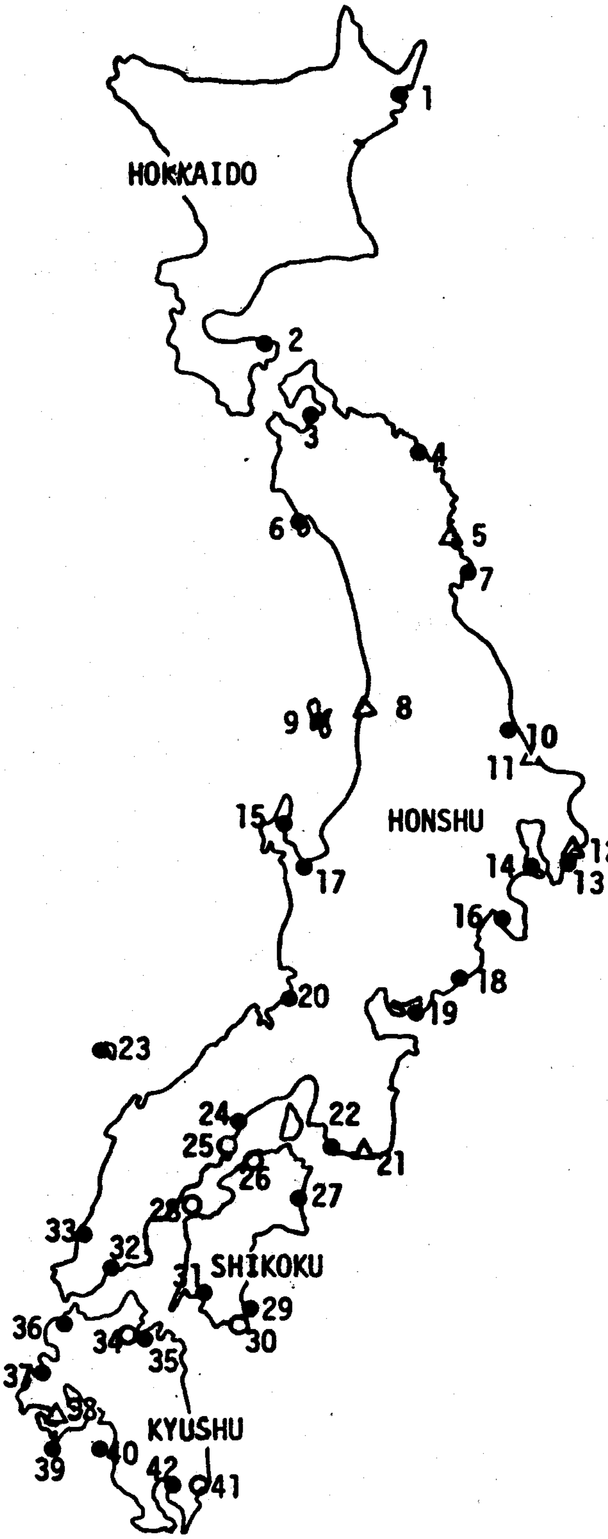
Year	Total	Seriola	Red sea bream	*Evynnis japonica*	Jack mackerel	Filefish	Caranx	Fugu	Black sea bream	Others
1960	284,828	1,431	-	-	-	-	-	-	-	-
1961	322,498	2,036	-	-	-	-	-	-	-	-
1962	362,897	4,470	-	-	-	-	-	119	-	25
1963	389,987	5,038	-	-	-	-	-	118	-	60
1964	362,992	10,321	-	-	-	-	-	113	-	112
1965	379,697	14,779	-	-	-	-	-	91	-	105
1966	405,197	16,875	-	-	-	-	-	75	-	270
1967	470,133	21,169	-	-	-	-	-	46	-	313
1968	521,942	31,777	-	-	-	-	-	63	-	354
1969	473,292	32,613	-	-	-	-	-	52	-	481
1970	549,081	43,300	460	5	2	63	36	26	2	16
1971	608,682	61,743	971	23	24	44	43	21	1	41
1972	647,905	76,913	1,298	95	112	149	15	15	13	113
1973	790,973	80,269	2,606	58	348	253	30	17	9	179
1974	879,758	92,684	3,414	85	628	51	48	8	4	158
1975	772,741	92,352	4,303	126	923	17	22	11	6	236
1976	849,908	101,619	6,453	125	721	10	69	11	61	187

SHELLFISH

Year	Spiny lobster	Kuruma shrimp	Neptunus	Octopus	Ascidian	Others	Scallop	(Bivalve) Oyster	Pearl	Others
1960	15	97	-	-	-	-	-	182,779	48	-
-	20	85	1	-	-	-	-	172,895	80	-
-	16	125	-	145	-	-	-	203,594	69	-
-	8	179	4	371	-	-	-	240,144	80	-
-	10	154	3	787	-	-	-	240,564	85	-
65	9	96	2	623	-	-	-	210,603	99	-
-	13	212	9	190	47	-	-	221,139	118	-
-	14	305	11	117	203	-	-	232,200	125	-
-	11	311	15	77	167	-	-	267,388	112	-
-	2	295	1	50	102	-	-	245,458	97	«
70	0	301	0	109	94	-	5,675	190,799	85	4
-	0	306	1	98	339	-	11,165	193,846	49	5
-	0	454	1	68	1,118	-	23,162	217,373	42	42
-	-	653	0	56	4,678	-	39,372	229,899	34	298
-	-	911	5	54	5,036	-	62,673	210,583	30	132
75	-	936	0	41	6,313	-	70,256	201,173	30	114
-	-	1,042	-	42	8,390	16	64,909	226,286	34	73

ALGAE

Year	Porphyra	Undaria	Laminaria
1960	100,457	-	-
-	147,379	-	-
-	154,631	-	-
-	144,531	-	-
-	111,851	-	-
65	140,753	12,537	-
-	128,440	37,809	-
-	157,550	58,080	-
-	144,969	76,698	-
-	134,320	59,821	-
70	231,464	76,698	282
-	244,946	94,350	666
-	217,906	105,678	3,338
-	311,410	113,159	4,648
-	339,314	153,762	10,177
75	278,127	102,058	15,696
-	291,050	126,723	22,087



○ : Seto Inland Sea Fish Farming Center Facility
● : Prefectural Facility
† : Others

1. Kushiro (Hokkaido : E,P)
2. Shikabe (Hokkaido : H,E)
3. Moura (Aomori Pref. ; Pe, H)
4. Miyako (Iwate ; H)
5. Mone (Miyagi ; H, Pe, 0)
6. Toga (Akita ; H)
7. Ojika (Miyagi ; H, Pa)
8. Murakami (Niigata ; H, Pa)
9. Mano (Niigata ; H, Pa)
10. Isozaki (Ibaragi ; H)
11. Tokaimura (Ibaragio ; Pr, Pa)
12. Ubara (Chiba ; H)
13. Chikura (Chiba ; H, Pg, C)
14. Misaki (Kanagawa ; H, Pr. Pg)
15. Notojima (Ishikawa ; Pa, Pg, N, Pr)
16. Numazu (Shizuoka ; Pg, Pr, Pu, H)
17. Himi (Toyama ; Pg, H)
18. Hamaoka (Shizuoka ; Pg, Pr, Pa)
19. Atsumi (Aichi ; Pr, H, A)
20. Katami (Fukui ; N, Pg, Pr, H)
21. Shirahama (Wakayama ; Pa, C, Pu, Pg etc)
22. Tanabe (Wakayama ; Pa, Pg, H etc)
23. Urago (Shimane ; Pg, Pr, H)
24. Ushimado (Okayama ; Pr, N, Pg etc)
25. Tamano (Okayama ; Pg, Pr, N)
26. Takamatsu (Kagawa ; Pr, S, Pg)
27. Asakawa (Tokushima ; Pg, H, Pr)
28. Kakatajima (Ehime ; Pg)
29. Komame (Kochi ; Pg, S)
30. Komame (Kochi ; S, Pg)
31. Shitabe (Ehime ; Pr, Pg, H)
32. Aio (Yamaguchi ; Pr, Pu, A)
33. Nagato (Yamaguchi ; Pg, A)
34. Kamiura (Oita ; Pg, Pr, H)
35. Kamiura (Oita ; Pg, Pr)
36. Genkai (Fukuoka ; Pg, Pr, H)
37. Chizei (Fukuoka ; Pg, Pr, H)
38. Sasebo (Saga ; H, Pg, Pr)
39. Nomozaki (Nagasaki ; Pg, H)
40. Ushibuka (Kumamoto ; Pg, Pr, H)
41. Shibushi (Kagoshima ; Pr, Pg, H)
42. Tarumizu (Kagoshima ; H, Pr, Pg)

E : Erimacrus isenbecki and Paralithodes camtschatica
H : Haliotis spp.
Pe : Patinopecten yessoensis
Pa : Paralichtys olivaceus
C : Caranx delicatissim
Pg : Pagrus major
Pu : Fugu rubripes
N : Neptunus trituberculatus
Pr : Penaeus japonicus
A : Plecolossus altivelis
S : Seriola quinqueradiata

Fig. 2. Map of hatcheries in Japan for mariculture (1978).

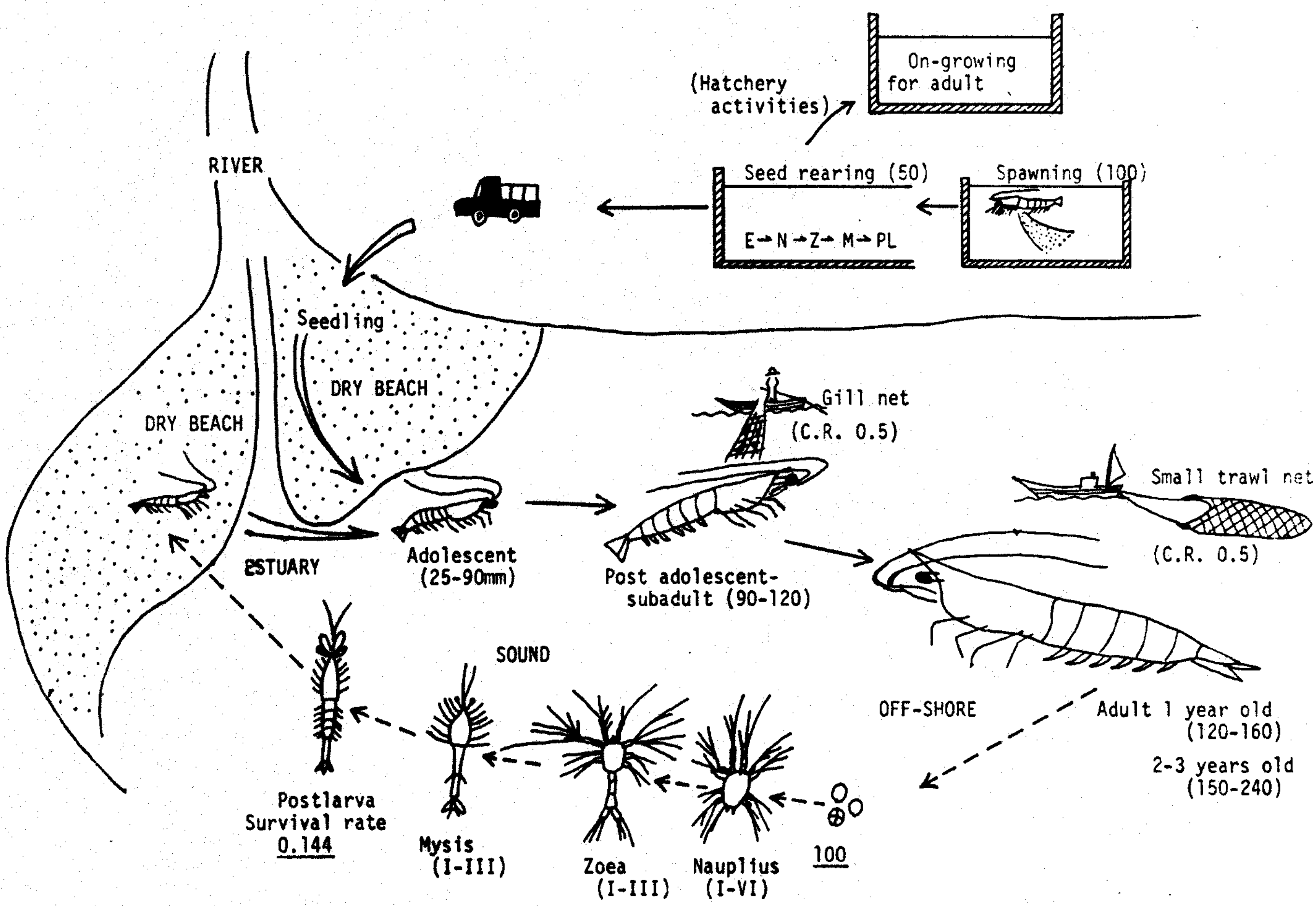


Fig. 3. Diagramatical drawing of life cycle in *P. japonicus*.

Tabl. 4. Life history phase of *Penaeus japonicus* (Kurata, 1972)

Phase	Beginning from	Duration in days a)	Approx. BL (mm) Male Female	Life form	Habitats
Embryo	Fertilization	0.6	0.24b)	Planktonic	Off-shore
Larva	Hatching	14-15	0.35-5.0	do	do
Juvenile	Metamorphosis	30	5-25	Planktonic-benthic	Off-shore estuary
Adolescent	Development of secondary sex characteristics	60	25-90 c) 25-110 d)	Benthic	Estuary sound
Subadult	Onset of gonad maturation	?	90-100 e) 110-125 e)	do	Sound off-shore
Adult	Completion of gonadal maturation	?	100-220 f) 125-262	do	Off-shore

a. Approximate number days in summer,
b. diameter of egg,
c. minimum size with jointed petasma,
d. minimum size with stopper,
e. minimum size with ripe gonad,
f. maximum size ever found.

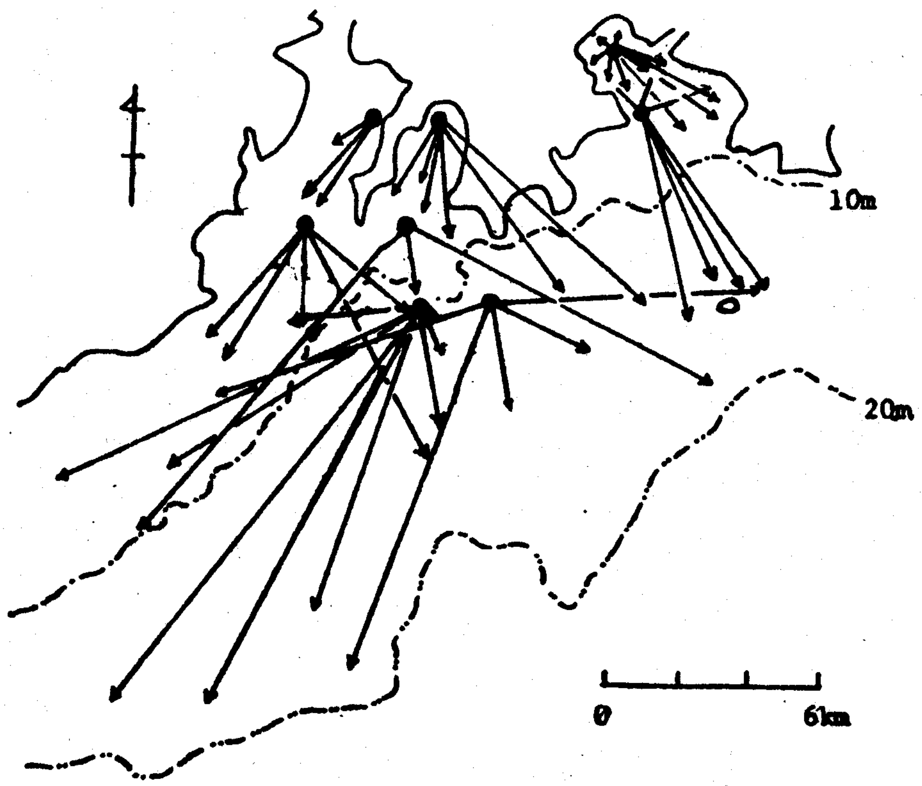


Fig. 4. Movement of Kuruma shrimp based on tagging experiments in Yamagu - Pref. (Hiyama 1976).

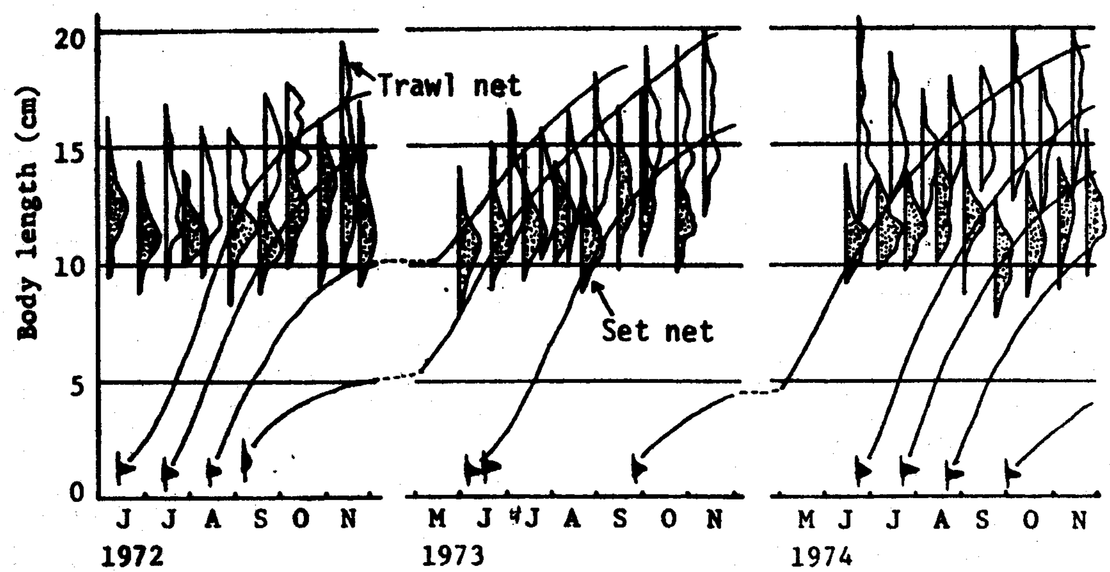


Fig. 5. Growth of restocked population in the Omi Bay, Yamaguchi Pref. (Hiyama, 1976).

Tabl. 5. Economic compaison between kuruma-prawn culture and "farming fishery". (Hasegawa, 1973).

	Type of production	Yield rate (%)	Body weight of harvested prawn	Market price of prawn (yen/kg)	Income rate (%)
Premises of comparaison	Culture Farming fishery	70 10	20g 35g	3.000 2.000	33 70

	Price of seedling (yen/head)	Type of production	Yield (yen)	Material cost (yen)			Income (yen)
				Seedlings	Others	Total	
Income per head of seedling	0.26	Culture Farming Fishery	42 7	0.26 0.26	27.9 2.1	28.1 2.36	13.9 4.6
Income per kilogram of harvested prawn	0.26	Culture Farming Fishery	3.000 2.000	18.5 74.3	1.981 600	2.000 674	1.000 1,326
Income per kilogram of harvested prawn	4.9	Culture Farming Fishery	3.000 2.000	348 1.400	1.981 600	2.329 2.000	671 0

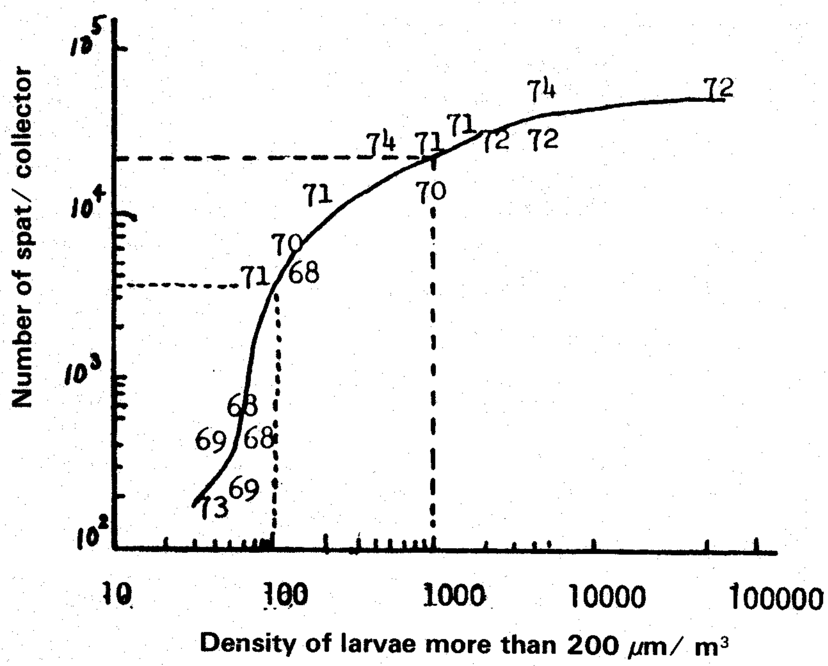


Fig. 6. Relation between spats collecting and density of larvae (Kanno et al, 1975) (Inds/m³).

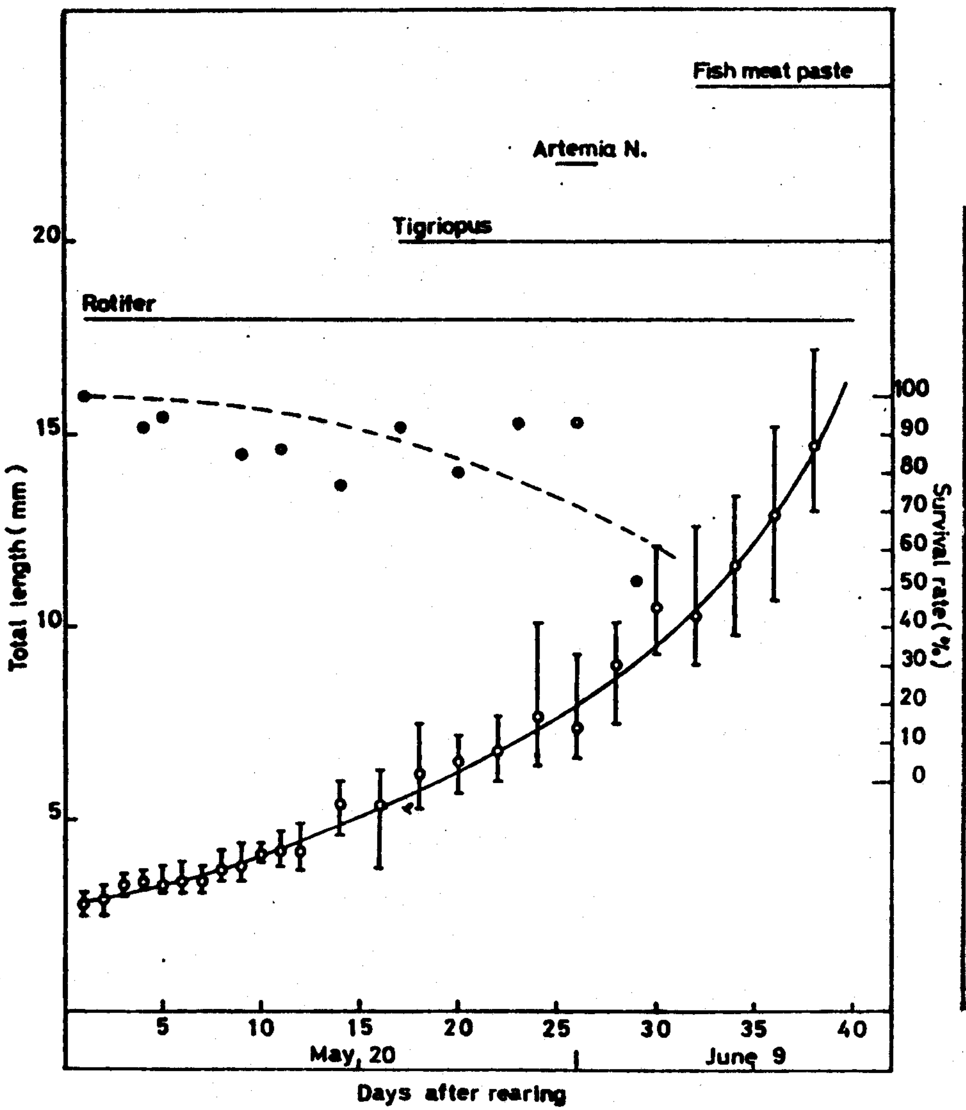


Fig. 7. Growth of larvae of red sea bream in mass culture tank (100 t). Wf ; 17.3-22.6 C, PH ; 7.6-9.0, Initial number of larvae ; 2.68 million, survival rate ; 40.0 %. (Fukusho et al, 1976).

Age (Day)	Total length	a	b	c	d	e (d/a)	f (b/a)	g
			5.0	0(t)	5.00			
0	2.98		0	0	0			
1	2.91	173	3.0	0	3.00	173.4	173.4	1.00
2	3.10	173	2.0	10	1.82	105.2	115.6	1.10
3	3.10	173	1.5	10	1.36	78.6	86.7	1.10
4	3.27	173	0	10	0	0	0	—
5	3.47	173	0	25	0	0	0	—
6	3.50	172	2.0	25	1.60	93.0	116.3	1.25
7	3.90	163	2.0	25	1.60	98.2	122.7	1.25
8	3.95	152	3.5	25	2.80	184.2	230.3	1.25
9	4.11	140	3.0	30	2.31	165.0	214.3	1.30
10	4.04	132	4.0	30	3.08	233.3	303.0	1.30
11	4.56	130	4.0	42	2.82	216.9	307.7	1.42
12	4.89	130	5.0	42	3.52	270.8	384.6	1.42
13	5.40	130	12.0	42	8.45	650.0	923.1	1.42
14	5.64	130	4.0	38	2.90	223.1	307.7	1.38
15	6.02	129	5.0	50	3.33	258.1	387.6	1.50
16	6.62	123	9.0	48	6.08	494.3	731.7	1.48
17	6.25	112	10.0	50	6.67	595.5	892.9	1.50
18	7.14	102	10.0	50	6.67	653.9	980.4	1.50
19	7.04	94	14.0	50	9.33	992.6	1.489.4	1.50
20	7.98	91	15.0	50	10.00	1.098.9	1.648.4	1.50
21	8.45	90	17.0	100	8.50	944.4	1.888.9	2.00
22	8.65	90	12.0	100	6.00	666.7	1.333.3	2.00
23	9.17	90	14.0	100	7.00	777.8	1.555.6	2.00
24	9.56	90	3.5	120	1.59	176.7	388.9	2.20
25	9.43	90	12.0	150	4.80	533.3	1.333.3	2.50
26	10.83	83	5.0	100	2.50	301.2	602.4	2.00
27	9.82	76	5.0	150	2.00	263.2	658.0	2.50
28	10.71	69	11.0	200	3.67	531.9	1.595.7	3.00
29	11.90	62	9.5	300	2.38	383.9	1.535.6	4.00

Tabl. 6. Daily variation of ration of larvae *Pagrus major* in out door tank (100 t). Temperature 17.0-22.0°C ; specific gravity ($\delta = 15$) 23.12-25.76 ; PH 8.12-8. ; a, number of larvae ; b, nos. of rotifer supplied ; c, vol. of water exchenged ; d, nos, of available rotifer for larvae ; e, rotifer inds. / larva ; f, actual rotifer density (inds/larva) ; g, feeding ratio (f/e). (Fukusho, 1977).

Tabl. 7. The life history phases of *Pagrus major*, Japanese red sea bream

	Phase	Size	Age	Organ	Behavior	Food	Habitats
Tank rearing	Egg	1 mm	—	—	Pelagic	None	Off-shore surface
			(day)				
	Prelarva	2.3-3.2	2-4	Yolk	Pelagic	None	
	Postlarva I	3.2-6.0	4-15	Yolk absorbed (4 days old)	Pelagic	None	
	Postlarva II	6-10	15-25	Origin of fins	Moving to benthic life. Schooling	Rotifer	Coastal waters
	Juvenile I	10-20	25-40	Digestive and swimming organs well developed	Cannibalism, schooling	Minced meat of fish and shellfish	Shallow waters
	Juvenile II	20-40	40-60	Digestive and swimming organs well developped	Cannibalism disappears	plus rotifer and copepods	Sound or bay
Field study	Adolescent	40-90	40-90	Development of adult form morphologically	Trophic migration and offshore dispersion	Gammaridea, Polycheata, Mysis,	Coastal or off-shore
	Subadult	9-23 cm	0.25-2 (year)	Onset of gonadal charactors		Crustacea, Ophiuroidea	
	Adult	23-36	<3	Completion of gonad maturation			Off-shore
	I	>36					

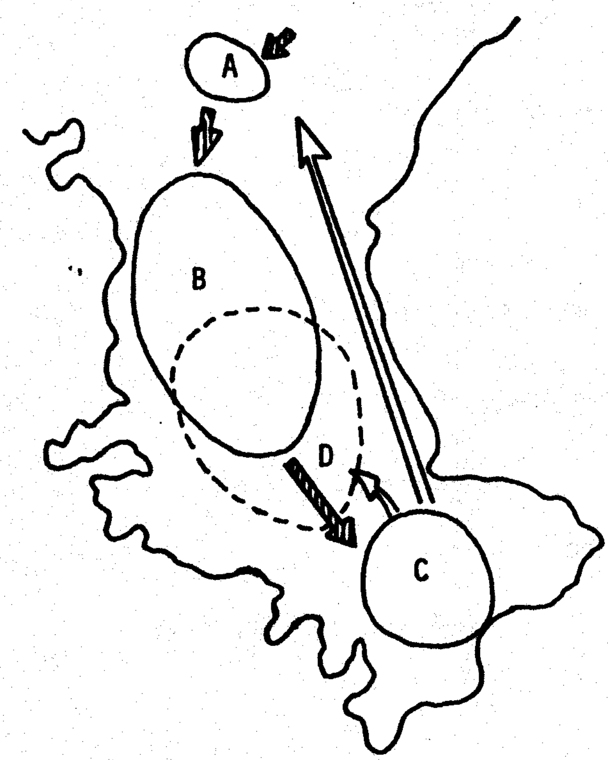


Fig. 8. Diagram of trophic migration of juvenile, *Pagrus major* in Shishiki Bay (Kûshû).
A : Larva (TL 3.3-10.0mm). Apr. - May — B : Juvenile (FL 10-20mm). May - June
C : Juvenile - Adolescent (FL 25-80mm). — D : Adolescent (FL 80-100mm).

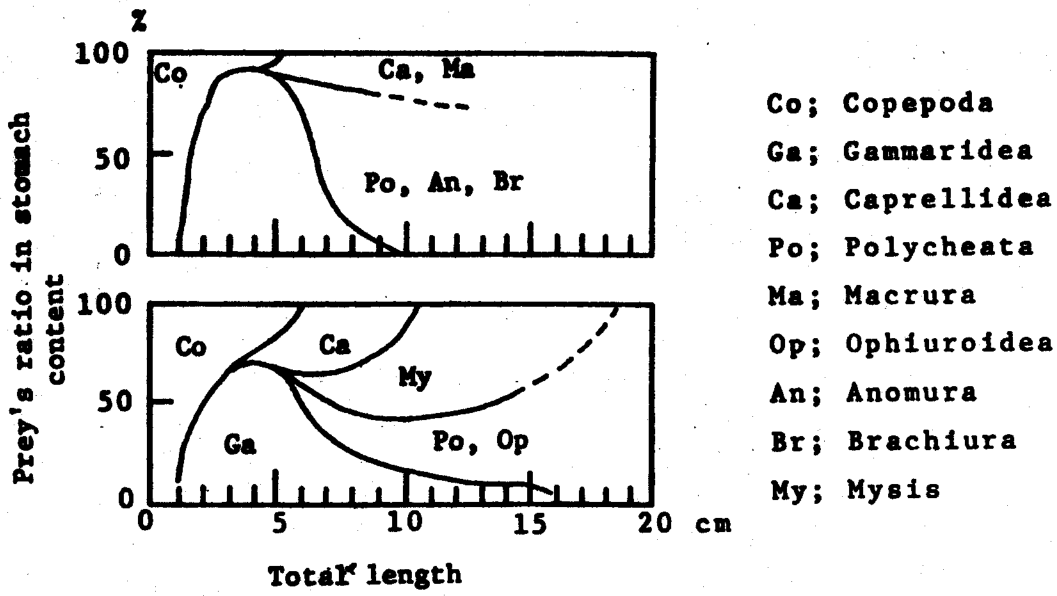


Fig. 9. Differentiation of food habits of *Pagrus major* through postlarva - adolescent stages. Upper ; Hosonosu, Seto Inland Sea (After Imabayashi *et al.* 1976), Lower ; Shishiki Bay, Kûshû Is. (After Tanaka *et al.*).

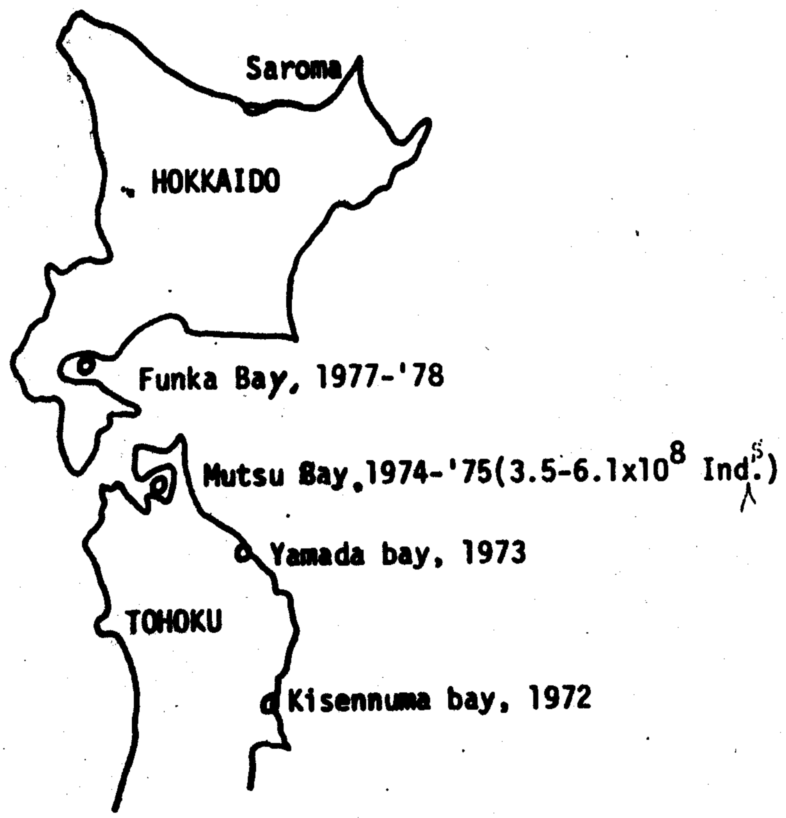


Fig. 10. Occurance of mass mortality of scallop in northern part of Japan.

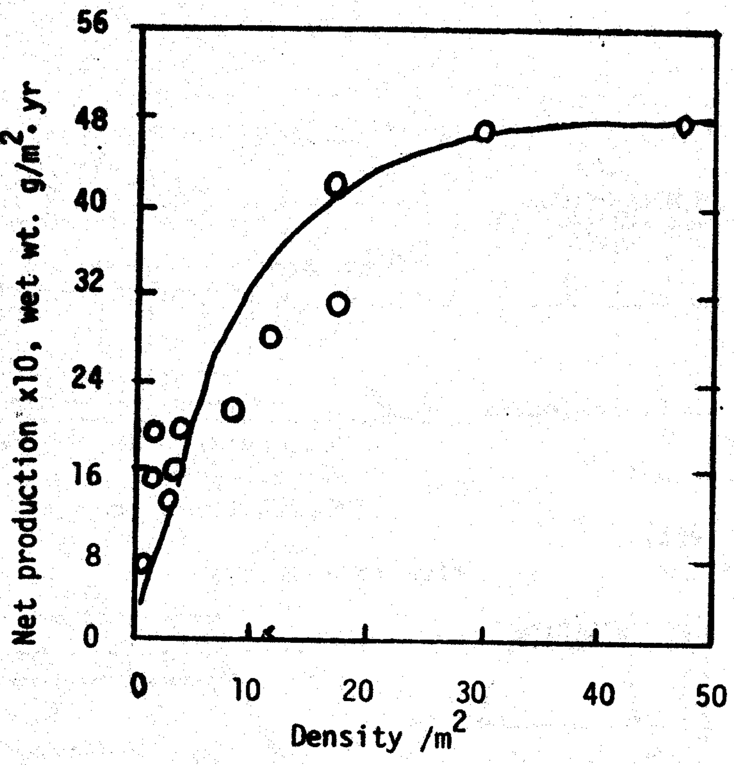


Fig. 11. Relation between the density and the net production of the scallop in Mutsu Bay (Yamamoto, 1975).

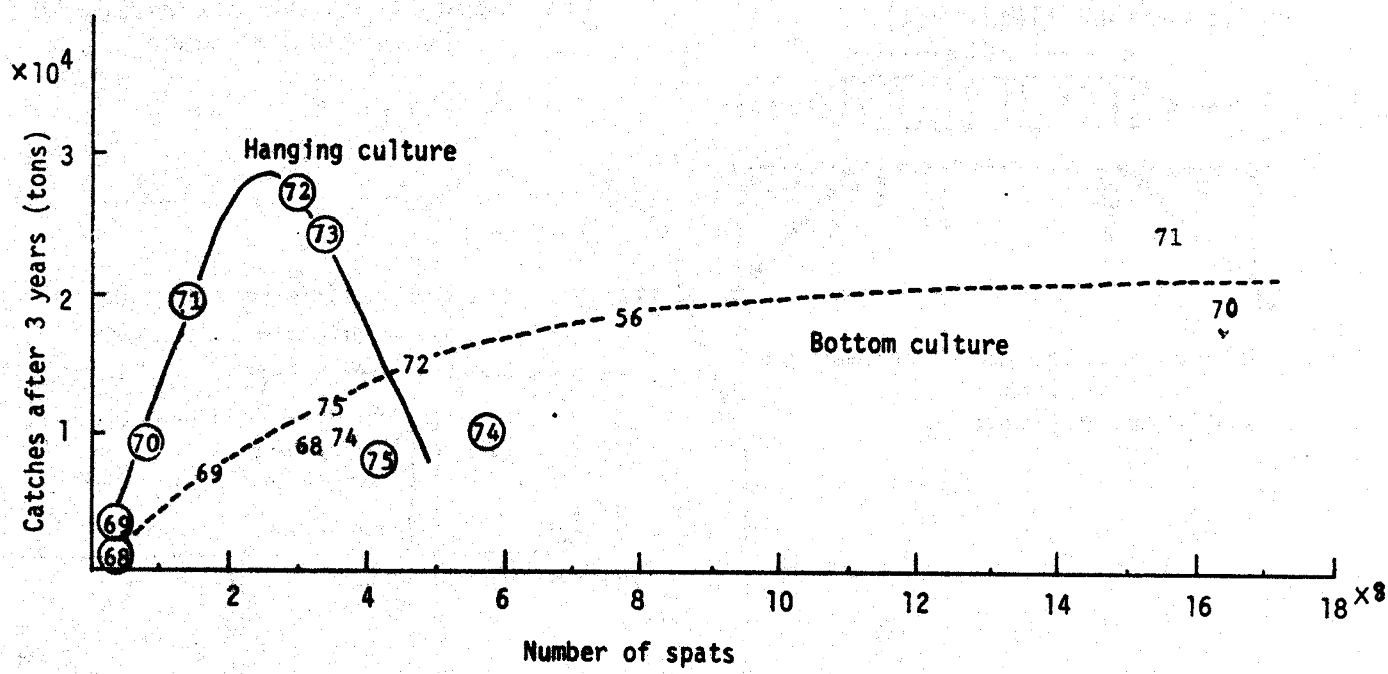
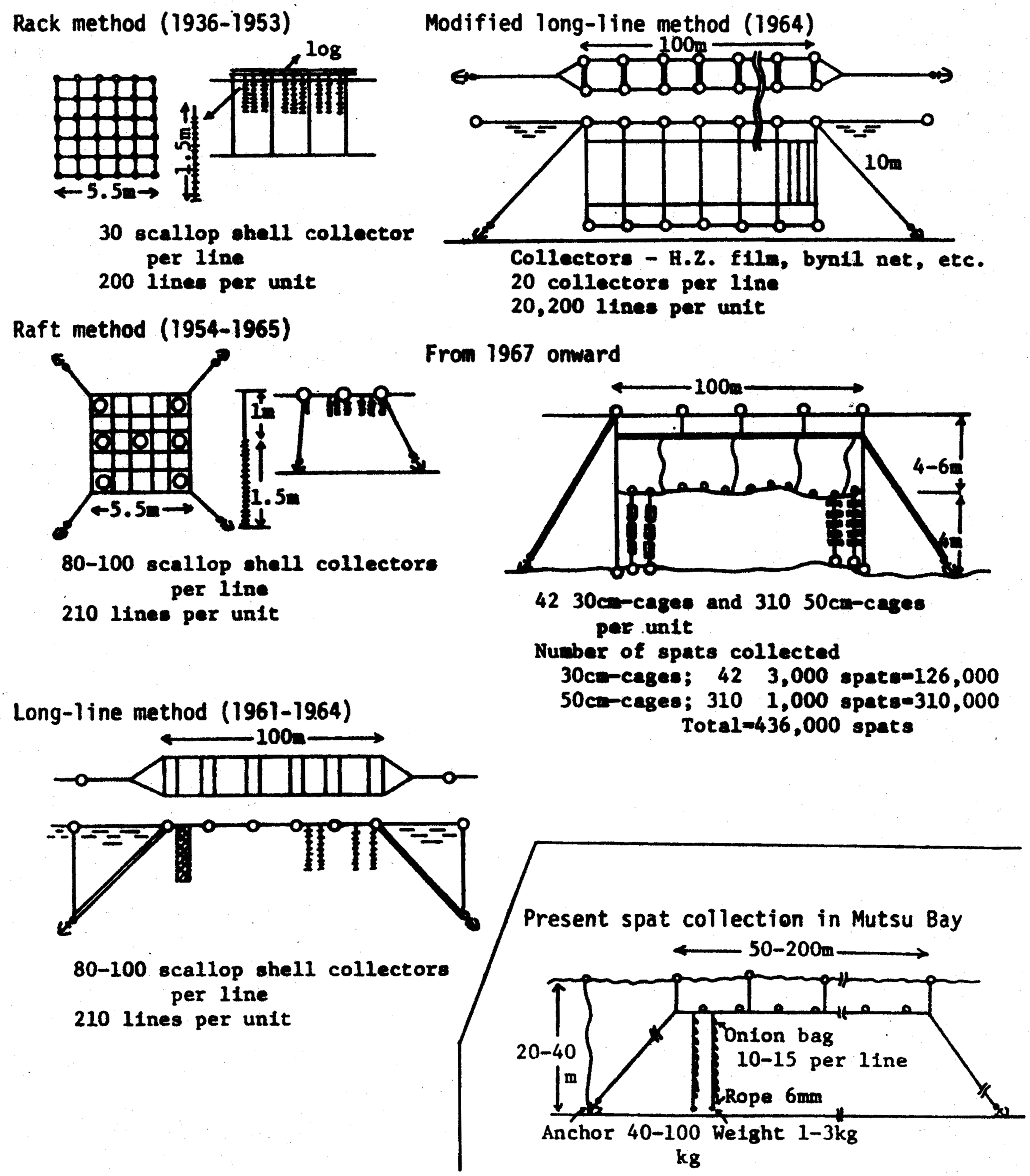
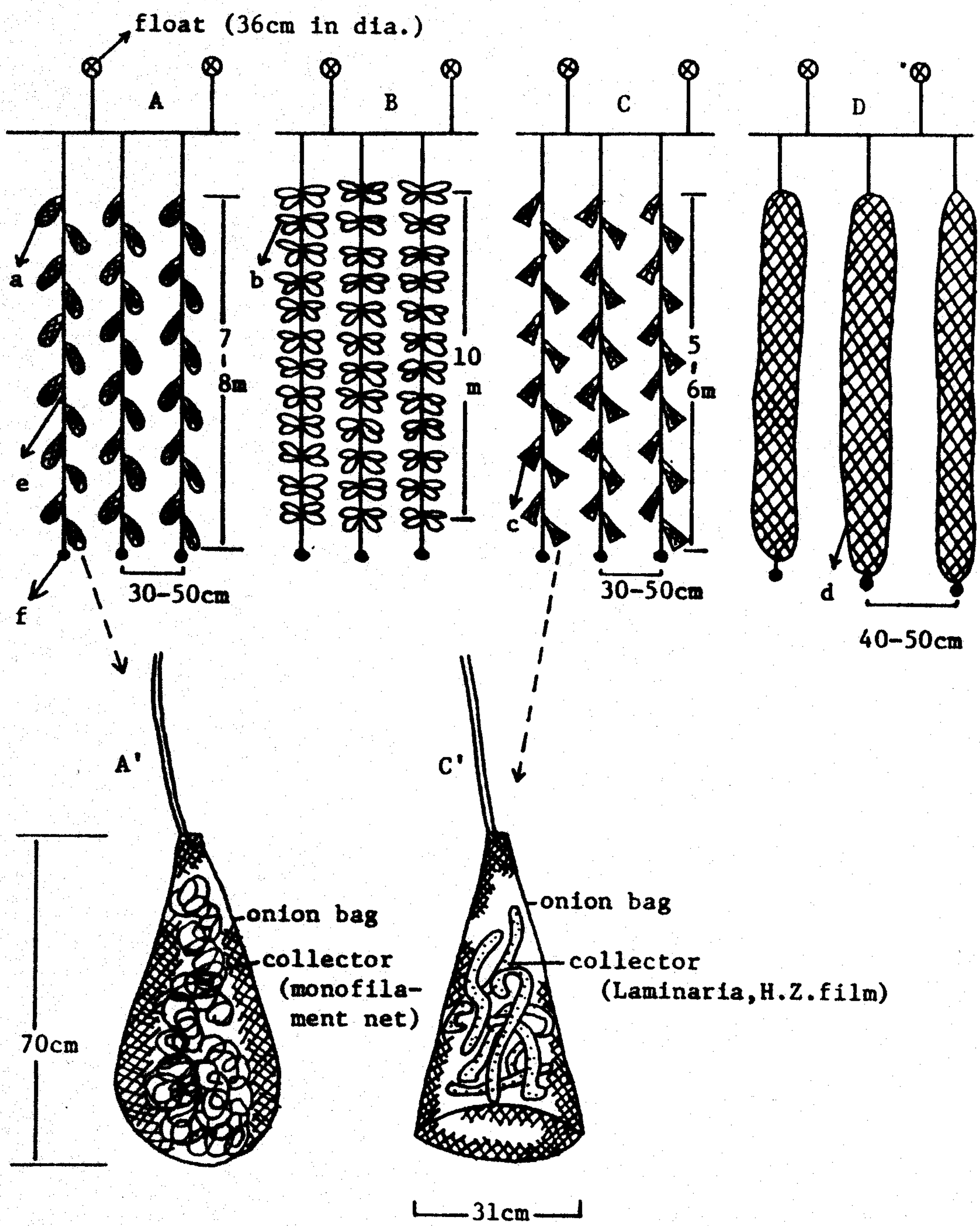


Fig. 12. Relationship between number of spats and catches after 3 years.



App. I. Progress of spat collection in Saroma Lagoon.



App. II. Recent facilities of spat collection.

a : Onion bag - Nylon net, etc. inside. 15-16 bags per line.
b : H.Z. film - Collect in onion bags (a) or cages (3mm mesh) before spats drop away.
c : Onion bag framed with bynil-enclosed iron wire on the bottom - Spats are collected from collectors (b), (d) or Laminaria.
d : Second-hand net collector - Gill net 'or flat fish, etc.
e : Hanging rope - H.Z. rope (6mm in dia.).
f : Weight - 0.8-1kg (sand or concrete).