STUDI PENDAHULUAN PEMELIHARAAN IKAN JENAHA, *Lutjanus johni*, DALAM KURUNG-KURUNG APUNG

Ketut Sugama*, Hideyuki Tanaka dan Hiroki Eda****

ABSTRAK : Studi pendahuluan pemeliharaan ikan Jenaha, Lutjanus johni dalam kurung-kurung apung telah dilakukan di Stasion Penelitian Bojonegara-Serang. Percobaan ini ditujukan untuk mempelajari laju pertumbuhan harian dan konversi makanan. Lamanya masa pemeliharaan adalah 225 hari.

Sembilan puluh delapan ekor ikan Jenaha dengan panjang total rata-rata 21,8 Cm (berat rata-rata 145,0 gr.) digunakan dalam percobaan ini. Ikan dipelihara dalam kurung-kurung apung 3x3x3 m. dan diberi pakan ikan tembang, sardin dan lemuru (Sardinella spp.) dua kali sehari hingga kenyang.

Hasil percobaan menunjukkan bahwa, berat-rata-rata ikan mencapai 1128,0 gr. dengan laju pertumbuhan harian (LPh.) 0,69 %. Hubungan antara berat tubuh dengan LPh. adalah : $Y = 3,95\ X^{-0,84}$. dan hubungan antara berat tubuh dengan ratio pemberian makan harian adalah: $Y = 21,67\ X^{-2,49}$. Konversi makanannya 6,7 dan kematian 7 %.

ABSTRACT : Preliminary study on rearing of Golden Snapper, Lutjanus johni in the floating net-cage. by Ketut Sugama *, Hideyuki Tanaka ** dan Hiroki Eda**

Preliminary study on rearing of Golden Snapper, Lutjanus johni in the floating net-cage was carried out in Bojonegara-Serang Research Station. This experiment was aimed to study daily growth rate and food conversion rate.

Ninety eight of fishes of 21.8 Cm. average total length (145.0 g. average body weight) were used in this experiment. The fishes were cultured on the net-cage 3x3x3 m. and were fed twice a day with Sardinella spp. until obtaining satiation.

The result showed that the fish grew until 1128.0 g. ABW within 225 days. The daily growth rate (DGR) was found to be 0.69 % BW. The relationships between body weight (BW) and DGR was $Y = 3.95\ X^{-0.84}$ and that between BW and Daily feeding rate was $Y = 21.67\ X^{-2.49}$. Food conversion ratio was 6.7 and mortality 7 %.

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PENDAHULUAN

Ikan Jenaha yang termasuk dalam famili Lutjanidae dijumpai hampir di seluruh perairan pantai Indonesia (Anonymous, 1981). Ikan ini tergolong ikan dasar (demersal) yang hidup di perairan dangkal, daerah hutan bakau sampai dengan perairan yang kedalamannya 60 m (Widodo, 1980). Di alam ikan ini memangsa **ikan** dan invertebrata dasar. Di Indonesia ikan Jenaha (Lutjanus johni) termasuk salah satu jenis ikan yang mempunyai nilai ekonomis penting, berukuran relatif besar (Badrudin, 1980).

Dalam usaha pengembangan budidaya laut di Teluk Banten, tenaga akhli dari Jepang yang bekerja dalam proyek kerjasama penelitian dan pengembangan budidaya laut Indonesia-Jepang menyarankan agar mencari jenis ikan laut yang cocok untuk dibudidayakan. Dalam menentukan pilihan jenis ikan yang akan dibudidayakan keterangan yang cukup tentang biologinya sangatlah diperlukan. Seperti yang disarankan oleh Reay (1979), dalam memilih jenis ikan yang akan dibudidayakan keterangan tentang laju pertumbuhan, konversi makanan, kelimpahan benih di alam dan ketahanan terhadap hama penyakit sangatlah diperlukan. Di Indonesia keterangan ikan Jenaha terbatas hanya daerah penyebarannya saja.

Berdasarkan alasan tersebut di atas, penelitian ini dilakukan untuk mendapatkan informasi tentang sifat-sifat biologis seperti laju pertumbuhan, ratio pemberian pakan harian, konversi makanan dan kematian ikan Jenaha (Lutjanus johni) yang dipelihara dalam kurung-kurung apung. Dari hasil penelitian ini diharapkan dapat dijadikan bahan pertimbangan dalam menentukan jenis ikan yang akan di budidayakan.

BAHAN DAN METODA

Penelitian ini dilakukan di Sub Balai Penelitian Budidaya Pantai Bojonegara-Serang dari Tanggal 30 Juli 1983 sampai dengan 12 Maret 1984. Ikan Jenaha, Lutjanus johni yang digunakan dalam percobaan ini merupakan hasil tangkapan dengan alat tangkap pancing di sekitar perairan antara Pulau Panjang dan Pulau Semut di Teluk Banten. Ikan hasil pancingan dipelihara dalam kurung-kurung apung selama beberapa waktu sampai sehat dan terbiasa memakan potongan daging ikan seperti tembang dan sardin (Sardinella spp.). Ikan yang terbiasa dengan kondisi tersebut diatas kemudian digunakan untuk percobaan.

Karena terbatasnya hasil tangkapan maka, percobaan ini hanya menggunakan 98 ekor ikan dengan panjang total rata-rata 21,8 cm. dan berat rata-rata 145,0 gr. Ikan dipelihara dalam kurung-kurung apung (3x3x3)m. Bingkai kurungan terbuat dari bambu dan pelampungnya dari drum 200 liter yang telah di cat terlebih dahulu dengan cat anti karat. Jaring kurungan terbuat dari polyethilene dengan ukuran mata jaring 2,0 cm. Ikan diberi makan 2 kali sehari yaitu sekitar jam 10^{00} dan 16^{00}. Makanan yang diberikan berupa ikan tembang, sardin dan lemuru (Sardinella spp.) yang telah dipotong-potong besarnya disesuaikan dengan lebar mulut ikan. Ikan diberi pakan hingga kenyang.

Pengukuran panjang dan berat ikan contoh dilakukan setiap bulan terhadap 20 ekor ikan, kecuali pada awal dan akhir percobaan semua ikan uji diukur. Sebagai data penunjang dilakukan pula pengukuran lingkungan perairan seperti suhu, kadar oksigen terlarut, pH, kadar garam dan kecerahan air.

Ratio pertumbuhan harian, ratio pemberian makan harian dan konversi makanan serta persentase kematian ikan disajikan dengan menggunakan rumus sebagai berikut (Yamaguchi,1978).

Ratio pertumbuhan harian (%)
(Daily growth ratio)
(DGR)

$$= \frac{ABW_t - ABW_o}{\frac{ABW_o + ABW_t}{2}} \times 100$$

Tabel 1. Laju pertumbuhan harian, ratio pemberian makan harian, konversi makanan dan kematian ikan Jenaha, _Lutjanus johni_ dalam kurung-kurung apung.

Daily growth ratio, daily feeding ratio, food conversion ratio and mortality of Golden Snapper, _Lutjanus johni_ cultured in floating net-cage.

Periode pengamatan (observation period) Tanggal/bulan (Date/month)	Jumlah ikan (No of fish) (ind.)		Berat rata-rata. (ABW) (gr)		Jumlah makanan (Feed) (Kg)	Ratio Pemberian makan harian (DFR) (%)	Laju pertumbuhan harian (DGR) (%)	Konversi makanan (FCR)	Kematian Mortality (%)
	Awal (Start)	Akhir (end)	Awal (Start)	Akhir (End)					
30/07 - 30/08 '83	98	92	145,0	206,2	42,0	8,4	1,16	8,8	6
30/08 - 26/09	92	91	206,2	306,0	53,4	8,1	1,39	6,0	1
26/09 - 27/10	91	49	306,0	472,0	57,0	6,8	1,38	5,5	46 *
27/10 - 28/11	49	49	472,0	601,3	54,0	6,4	0,75	8,6	0
28/11 - 27/12	49	49	601,3	752,8	58,8	6,1	0,77	7,9	0
27/12 - 01/02 '84	49	49	752,8	915,0	63,0	4,4	0,56	7,9	0
01/02 - 12/03	49	49	915,0	1128,0	81,4	4,1	0,52	7,8	0
30/07/'83 - 12/03/'84	98	49	145,0	1128,0	409,6	3,8	0,69	6,7	7

*) Lepas ditabrak kapal tongkang. (Escape clash by boat)

$$\text{Ratio pemberian makan harian (\%)} \\ \text{(Daily feeding ratio)} \\ \text{(DFR)} = \frac{\text{Jumlah pakan yang dimakan (feed)}}{\frac{N_o + N_t}{2} \times \frac{ABW_o + ABW_t}{2} \times t} \times 100$$

$$\text{Konversi makanan} \\ \text{(Food conversion ratio)} \\ \text{(FCR)} = \frac{\text{Berat basah pakan yang dimakan (gr) (Wet weight of food eaten)}}{\text{Berat basah pertambahan berat ikan (gr) (Wet weight gained by fish)}}$$

$$\text{Kematian (\%)} \\ \text{(Mortality)} = \frac{N_o - N_t}{N_o} \times 100$$

Dimana : t = hari (day's)

ABW_o = berat rata-rata awal (initial average body weight)

ABW_t = berat rata-rata hari ke-t (average body weight at t-day's

N_o = jumlah awal ikan (initial number of fish)

N_t = jumlah ikan pada hari ke-t (number of fish at t-day's

HASIL DAN PEMBAHASAN

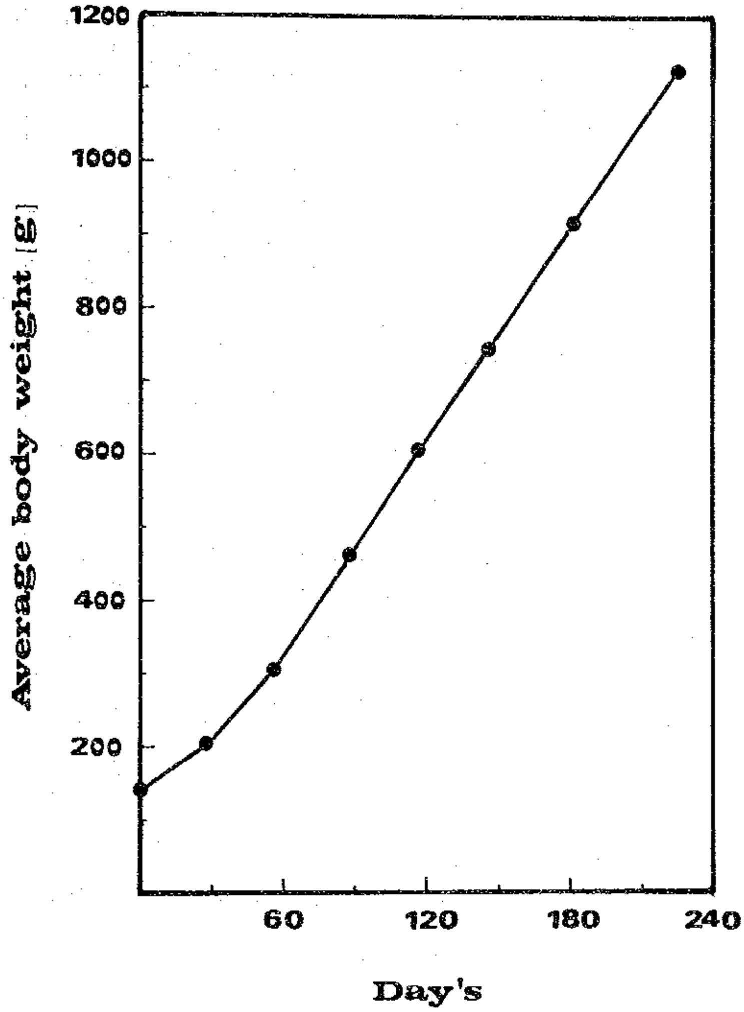
Selama 225 hari pemeliharaan, berat rata-rata ikan mencapai 1128,0 gr. dengan laju pertumbuhan harian 0,69 % (Tabel 1). Untuk lebih jelasnya pertumbuhan ikan dapat dilihat pada Gambar 1. Laju pertmbuhan harian cenderung menurun dengan bertambah beratnya ukuran ikan. Hubungan antara berat tubuh dengan laju pertumbuhan berlaku persamaan sebagai berikut : $Y = 3{,}95\ X^{-0{,}84}$ (r=-0,84) (Gambar 2). Pertumbuhan ikan ini relatif lebih cepat dibandingkan dengan pertumbuhan ikan Kakap merah (*Lutjanus altifrontalis* Chan,1970) yang dari berat awal 199,9 gr. dalam jangka waktu 225 hari pemeliharaan hanya mencapai berat 893,5 gr. dengan laju pertumbuhan harian 0,56 % (Sugama, 1984).

Di Singapore dalam budidaya ikan Jenaha dibutuhkan waktu 6 - 8 bulan pemeliharaan untuk mencapai ukuran konsumsi yaitu ukuran yang baik untuk dipasarkan dengan berat antara 600,0 - 900,0 gr. dari berat awal pemeliharaan antara 125,0 - 150,0 gr. (Chan, 1981). Sedangkan dalam penelitian ini menunjukkan, bahwa untuk mencapai ukuran yang sama dibutuhkan waktu pemeliharaan 4 - 6 bulan (Tabel 1).

Pada Gambar 2 terlihat pula hubungan antara berat tubuh dengan ratio pemberian pakan harian, yang mana ratio pemberian pakan harian cenderung menurun dengan bertambahnya ukuran ikan. Dalam hubungan ini berlaku persamaan : $Y = 21,67\ X^{-2,49}$ ($r=-0,96$). Hasil ini sesuai dengan pendapat Kafuku dan Ikenoue (1983) yang menyatakan bahwa ratio pemberian pakan Yellowtail menurun dengan bertambah beratnya ukuran ikan. Dalam budidaya laut ratio pemberian pakan harian yang tepat, perlu diketahui untuk menghindari kelebihan pemberian pakan karena kurang menguntungkan. Disamping itu pakan yang tidak termakan akan membusuk sehingga mempengaruhi lingkungan perairan seperti menurunnya oksigen terlarut dan terbentuknya zat amonia yang dapat membahayakan bagi kehidupan ikan (Koringga, 1976).

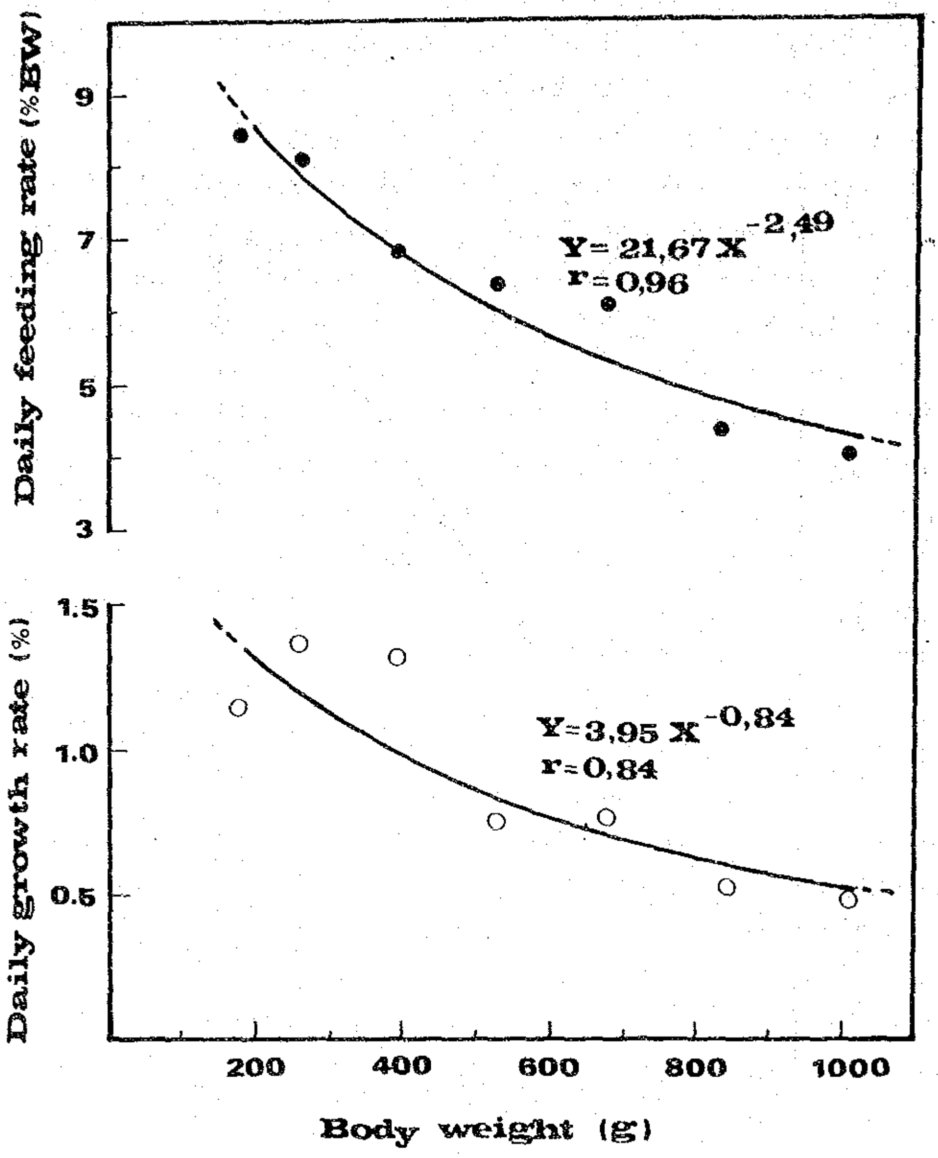
Konversi makanannya selama percobaan berkisar antara 5,5 - 8,8 pada setiap bulan pengukuran atau 6,7 selama percobaan (Tabel 1). Hasil ini lebih tinggi dibandingkan dengan konversi makanan ikan Jenaha yang dipelihara di Singapore yaitu sekitar 4,5 (Anonymous, 1981). Adanya perbedaan perbedaan laju pertumbuhan dan konversi makanan antara pemeliharaan ikan Jenaha di Singapore dengan percobaan ini diduga disebabkan oleh adanya perbedaan dalam ratio pemberian pakan harian dan padat penebaran. Di Singapore, Ikan Jenaha dengan berat antara 300,0 - 500,0 gr. diberi pakan antara 3 - 5 % per hari, sedangkan dalam pengamatan ini masih berkisar antara 6,2 - 7,5 % berat tubuh per hari (Gambar 2). Seperti ditemukan oleh Chua dan Teng (1978) bahwa, perbedaan ratio pemberian pakan harian akan mempengaruhi laju pertumbuhan dan konversi makanan.

Padat penebaran dalam percobaan ini berkisar antara 49 - 98 ekor dalam kurung-kurung yang berukuran 3x3x3 m. atau 1,8 - 3,6 ekor/m^3.



Gambar 1. Kurva pertumbuhan ikan Jenaha, *Lutjanus johni* dalam kurung-kurung apung.

Figure 1. Growth curve of Golden Snapper, *Lutjanus johni* cultured in floating net-cage.



Gambar 2. Hubungan antara berat ikan dengan ratio pemberian pakan harian dan hubungan antara berat ikan dengan laju pertumbuhan harian ikan Jenaha, Lutjanus johni dalam kurung-kurung apung

Figure 2. Relationships between body weight and daily feeding ratio and between body weight and daily growth ratio of Golden Snapper, *Lutjanus johni* cultured in floating net-cage.

Jumlah ini masih terlalu rendah dari yang disarankan di Singapore yaitu sekitar 12 - 15 ekor/m^3 pada ukuran ikan yang sama (Anonymous, 1981).

Kematian ikan hanya terjadi pada tiga bulan pertama pemeliharaan yaitu sebanyak 7 ekor (7 %) setelah itu tidak lagi dijumpai ikan yang mati (Tabel 1). Penyebab kematian tidak diketahui secara pasti karena dari hasil pengamatan ikan yang mati tidak ditemukan parasit yang menempel.

Selama percobaan, parameter fisika - kimia air seperti suhu, oksigen terlarut, kadar garam, pH dan kecerahan secara berturut-turut adalah 28,1 - 30,3 °C, 6,5 - 6,8 ppm., 29,0 - 32,8 ppt., 7,9 - 8,3 dan 1,5 - 4,5 m. Keadaan ini masih dalam batas yang tidak membahayakan bagi kehidupan ikan.

Dari hasil percobaan ini dapat disimpulkan bahwa, pertumbuhan ikan Jenaha (*Lutjanus johni*) relatif cepat dengan laju pertumbuhan harian 0,69 % dan konversi makanannya 6,7. Dengan demikian penelitian selanjutnya akan diarahkan pada pembenihan melalui pemijahan buatan, pemeliharaan dalam kurung-kurung apung dengan pemberian pakan buatan dan dengan padat penebaran yang berbeda-beda untuk mengetahui kepadatan yang optimum per satuan volume air.

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PERBANDINGAN LAJU PERTUMBUHAN BEBERAPA JENIS IKAN KERAPU *Epinephelus* spp. DALAM KURUNG-KURUNG APUNG

Ketut Sugama*, Waspada* dan Hideyuki Tanaka**

ABSTRAK : Pengamatan pertumbuhan beberapa jenis ikan kerapu yaitu kerapu lumpur (*E. tauvina*), kerapu macan (*E. fuscoguttatus*), kerapu balong (*E. bleekeri*), kerapu kowak (*E. merra*) dan kerapu pasir (*E. summana*) telah dilakukan dalam kurung-kurung apung dalam rangka mencari calon jenis ikan kerapu untuk dibudidayakan.

Ikan dipelihara dalam kurung-kurung apung yang berukuran 2x2-2 m dan diberi pakan 2 kali sehari dengan potongan ikan tembang, sardin dan lemuru (*Sardinella* spp.

Hasil percobaan menunjukkan bahwa, ikan kerapu lumpur, *E. tauvina* tumbuh paling cepat dengan konversi makanannya paling rendah.

ABSTRACT : Growth comparison some species of Groupers, *Epinephelus* spp. cultured in floating net-cages. by Ketut Sugama *, Waspada* and Hideyuki Tanaka**.

Observation on the growth of some species of Groupers (*E. tauvina*, *E. fuscoguttatus*, *E. bleekeri*, *E. merra* and *E. summana*) were conducted in floating net-cages. This study was aimed to get candidate species for mariculture.

The fishes were cultured in floating net cage (2x2x2 m.) and were fed twice in a day with *Sardinella* spp.

Result of this study indicate that, estuary grouper (*E. tauvina* grew faster and food conversion ratio lower than other species.

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PENDAHULUAN

Ikan Kerapu, Balong, (*Epinephelus* spp.) termasuk famili Seranidae. Hidupnya biasanya didaerah pantai, karang dan laut dalam sampai kedalamam 60 m., hidupnya soliter, di alam memangsa ikan dan crustacea hidup.(Anonymous,1981)

Di Indonesia ikan Kerapu mempunyai harga cukup tinggi, terutama ikan yang masih hidup dan mempunyai ukuran antara 500 - 1000 g. Pada akhir-akhir ini permintaan akan kerapu hidup semakin meningkat terutama untuk hidangan di restoran-restoran. Selama ini penyediaan kerapu hidup masih dilakukan dengan cara penangkapan dari alam oleh para nelayan yang mana hasilnya tidak dapat dipastikan.

Sebenarnya untuk penyediaan kerapu hidup dapat diusahakan melalui budidaya. Budidaya ikan kerapu lumpur, *Epinephelus tauvina* dan *Epinephelus salmoides* sudah dilakukan di Malaysia dan Singapöre (Chua dan Teng, 1978). Di Indonesia budidaya ikan kerapu sudah dirintis oleh nelayan Kepulauan Riau, namun belum intensif karena penyediaan benih masih tergantung dari alam dan jenis ikan yang dipelihara masih campuran.

Pada Proyek Penelitian dan Pengembangan Budidaya Laut yang merupakan proyek kerja sama tekhnik antara pemerintah Indonesia-Jepang menaruh perhatian pula pada jenis ikan kerapu untuk diteliti. Sebagai tahap awal penelitian yaitu membesarkan beberapa jenis ikan kerapu dalam kurung-kurung apung dalam rangka mencari calon jenis ikan kerapu yang cocok untuk dibudidayakan.

Dalam tulisan ini disajikan hasil pengamatan laju pertumbuhan dan konversi makanan beberapa jenis ikan kerapu, *Epinephelus* spp., yang dipelihara dalam kurung-kurung apung di perairan Teluk Banten. Dari hasil percobaan ini diharapkan dapat dijadikan pertimbangan dalam memilih jenis ikan kerapu untuk usaha budidaya.

BAHAN DAN METODA

Percobaan ini dilakukan di Station Penelitian Bojonegara, Sub Balai Penelitian Budidaya Pantai dari bulan Januari sampai November 1984. Ikan yang digunakan dalam percobaan ini terdiri dari 5 species, yaitu kerapu lumpur (E. tauvina), kerapu macan (E. fuscoguttatus), kerapu balong (E. bleekeri), kerapu kowak (E. merra) dan kerapu pasir (E. summana) yang ditangkap di sekitar perairan Kepulauan seribu dan Teluk Banten dengan menggunakan bubu. Karena terbatasnya hasil tangkapan, maka hanya beberapa ekor ikan saja dari masing jenis ikan tersebut diatas digunakan dalam percobaan ini. Ikan yang kira-kira berukuran sama dari masing-masing jenis dipelihara dalam kurung apung yang berukuran 2x2x2m. (Tabel 1).

Ikan percobaan diberi pakan ikan tembang, sardin dan lemuru (Sardinella spp.) sebanyak 2 kali sehari yaitu jam 10^{00} dan 17^{00}. Setiap pemberian pakan dilakukan sampai ikan percobaan tidak mau makan lagi. Jumlah pakan yang dimakan dicatat untuk menghitung konversi makanannya.

Pengukuran panjang dan berat ikan uji dilakukan setiap bulan dengan mengukur semua ikan uji. Sebagai data penunjang dilakukan pula pengukuran lingkungan perairan seperti suhu, oksigen terlarut, pH, kadar garam dan kecerahan.

Data-data yang terkumpul selama penelitian digunakan untuk menghitung laju pertumbuhan harian dan konversi makanan dengan menggunakan rumus-rumus seperti yang dikemukanan oleh Yamaguchi dalam Sugama (1983).

Tabel 1. Jumlah dan ukuran ikan kerapu, Epinephelus spp., yang digunakan dalam percobaan.

Table 1. Numbers and size of Groupers, Epinephelus spp. were used for experiment.

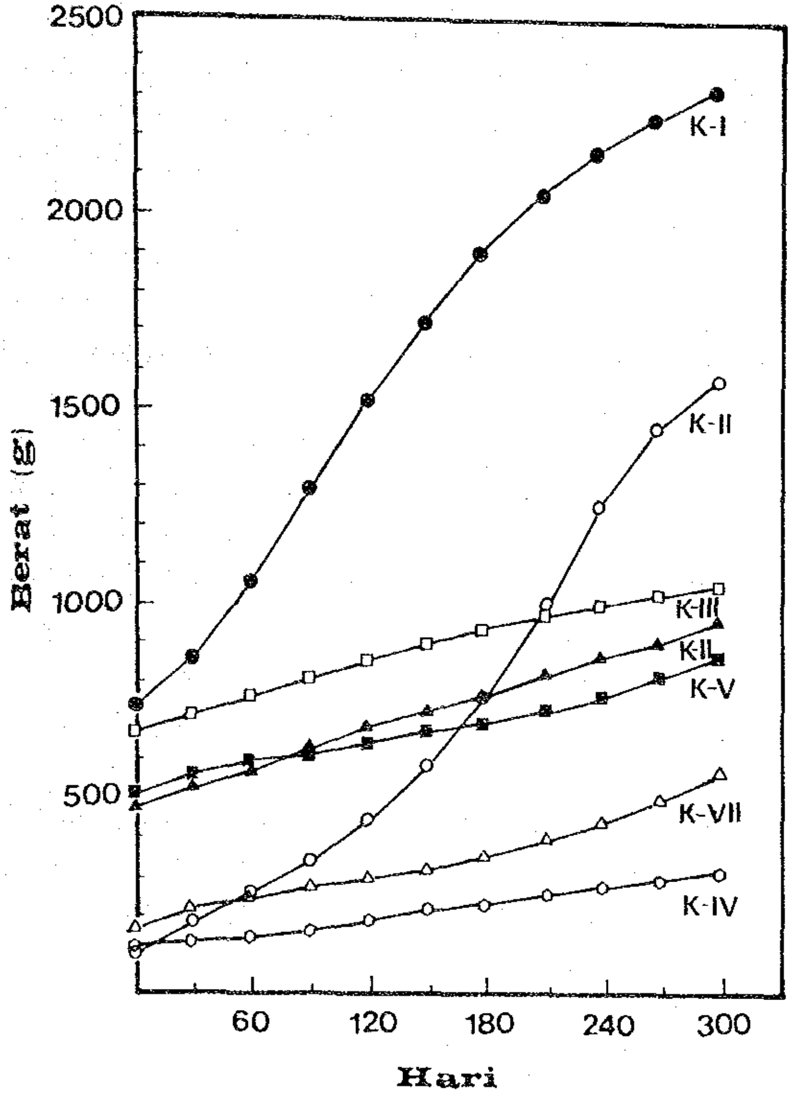
No. kurungan (Cage number)	Jenis (Species)	Jumlah ikan (No.of fish) (ind.)	Panjang (ATL)* (Cm.)	Berat (ABW)** (g)
K-I	Kerapu lumpur (*E. tauvina*)	14	37,0	730,0
K-II	Kerapu lumpur (*E. tauvina*)	29	20,9	110,3
K-III	Kerapu macan (*E. fuscoguttatus*)	22	32,5	655,5
K-IV	Kerapu balong (*E. bleekeri*)	38	20,6	129,1
K-V	Kerapu kowak (*E. merra*)	16	31,0	515,8
K-VI	Kerapu pasir (*E. summana*)	19	28,7	468,2
K-VII	Kerapu pasir (*E. summana*)	23	21,8	170,7

*) Average total length
**) Average body weight

HASIL DAN PEMBAHASAN

Laju pertumbuhan masing-masing jenis ikan yang dipelihara dalam kurung-kurung (K) K-I, K-II, K-III, K-IV, K-V, K-VI dan K-VII secara berturut-turut adalah 0,35, 0,58, 0,15, 0,25, 0,18, 0,22 dan 0,35 % (berat tubuh) perhari (Tabel 2). Untuk lebih jelasnya pertumbuhan masing-masing jenis ikan kerapu disajikan dalam Gambar 2.

Menurut Effendie (1978) bahwa, pertumbuhan ikan dipengaruhi oleh faktor biotik dan abiotik, faktor biotik diantaranya adalan keturunan (gen) dan menurut Chua dan Teng (1980) bahwa, pertumbuhan ikan kerapu lumpur, *Epinephelus salmoides* yang dipelihara dalam kurung-kurung apung diantaranya dipengaruhi oleh ukuran ikan pada awal pemeliharaan, padat penebaran, jumlah dan mutu pakan yang diberikan dan lingkungan



Gambar 1. Kurva pertumbuhan ikan kerapu, Epinephelus spp. dalam kurung-kurung apung.

Figure 1. Growth of Groupers, Epinephelus spp. cultured in floating net-cage

perairan. Dalam percobaan ini adanya perbedaan laju pertumbuhan masing-masing jenis ikan yang dicoba diduga ada hubungannya dengan faktor keturunan (gen). Sedangkan pada ikan yang sama jenisnya seperti pada K-I, K-II dan K-VI, K-VII perbedaan laju pertumbuhan disebabkan oleh adanya berbedaan ukuran awal pemeliharaan (Tabel 2). Hasil pengamatan menunjukkan bahwa, ikan yang berukuran lebih kecil pada awal pemeliharaan dari jenis ikan yang sama menunjukkan ratio pertumbuhan yang lebih tinggi (Tabel 2). Hasil ini sesuai dengan hasil penelitian Danakusumah, _et al_ (1985) pada pemeliharaan ikan kerapu lumpur, _Epinephelus tauvina_ (Forskal) dalam kurung-kurung apung yang mana ratio pertumbuhan hariannya lebih tinggi pada ikan yang berukuran lebih kecil.

Konversi makanan masing-masing jenis ikan yang dicoba pada akhir percobaan adalah 7,6 pada K-I, 5,1 pada K-II, 10,9 pada K-III, 12,4 pada K-IV, 10,2 pada K-V, 10,1 pada K-VI dan 8,9 pada K-VII (Tabel 2). Hasil ini menunjukkan bahwa, konversi makanan ikan kerapu lumpur, _E. tauvina_, adalah yang paling rendah. Chua dan Teng (1980) menyatakan bahwa, nilai konversi makanan pada pemeliharaam ikan kerapu lumpur dalam kurung-kurung apung dipengaruhi oleh padat penebaran, frekuensi pemberian pakan, ratio pemberian pakan, jenis pakan dan lingkungan perairan. Danakusumah dan Imanishi (1984) mengemukakan bahwa, konversi makanan ikan kerapu lumpur, _E. tauvina_ yang dipelihara dalam kurung-kurung apung dengan diberi pakan teri adalah antara 6,7 - 9,3. Sedangkan dalam percobaan ini adalah 5,1 dan 8,5 (Tabel 2). Adanya perbedaan konversi makanan di duga ada hubungannya dengan jenis pakan yang diberikan.

Selama percobaan suhu air berkisar antara 26,7 - 30,5 °C, kadar garam 28,4 - 33,9 ppt., oksigen terlarut 6,4 - 7,7 ppm., pH 8,0 - 8,3 dan kecerahan 1,5 - 5,2 m. Nilai ini masih berada dalam kisaran yang tidak membahayakan bagi kehidupan ikan, karena masih berada dalam batas kisaran yang disarankan oleh Yokokawa (1982) yaitu nilai pH antara 7,0 - 8,3 dan oksigen terlarut lebih besar dari 4,0 ppm.

Tabel 2. Pertumbuhan dan konversi makanan ikan kerapu, *Epinephelus* spp. dalam kurung-kurung apung

Table 2. Growth ratio and food conversion ratio of Groupers, *Epinephelus* spp. cultured in floating net-cage.

Bagian (Items)	K-I *E.tauvina*	K-II *E.tauvina*	K-III *E.fuscoguttatus*	K-IV *E.bleekeri*	K-V *E.merra*	K-VI *E.summana*	K-II *E.summana*
Periode pengamatan (hari) (Period of observation)	300	300	300	300	300	300	300
Jumlah awal ikan (ekor) (Initial No.of fish)	14	29	22	38	16	19	23
Jumlah akhir ikan (ekor) (Final No.of fish)	14	29	22	31	16	16	22
Kematian (%) (Mortality)	0	0	0	18,4	0	15,8	4,3
Berat awal rata-rata (g) (Initial ABW)	730,0	110,3	655,5	129,1	515,8	468,2	170,7
Berat total awal (g) (Initial TBW)	10220,0	3198,7	14421,0	4905,8	8240,0	8895,8	3926,1
Berat akhir rata-rata (g) (Final ABW)	2349,0	1619,2	1051,7	287,7	890,0	930,0	550,1
Berat total akhir (g) (Final TBW)	32886,0	46956,8	23137,4	8918,7	14240,0	14880,0	12102,2
Jumlah makanan (Kg) (Total food consumption)	172,3	223,2	95,0	49,8	61,2	60,4	72,8
Pertumbuhan harian (%) (Daily growth ratio)	0,35	0,58	0,15	0,25	0,18	0,22	0,35
Konversi makanan (Food conversion ratio)	7,6	5,1	10,9	12,4	10,2	10,1	8,9

ABW = Average body weight TBW = Total body weight.

Dari kelima jenis ikan kerapu yang dicoba ternyata bahwa, ikan kerapu lumpur, E.tauvina menunjukkan laju pertumbuhan harian tertinggi dan konversi makanan yang paling rendah. Dengan demikian dalam usaha budidaya ikan kerapu disarankan untuk memelihara ikan kerapu lumpur, E. tauvina.

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PERTUMBUHAN BEBERAPA JENIS IKAN BERONANG, *Siganus* spp. DALAM KURUNG-KURUNG APUNG

Ketut Sugama*, Waspada* dan H. Tanaka**

ABSTRAK: Pengamatan pertumbuhan beberapa jenis ikan beronang, *Siganus* spp. dalam kurung-kurung apung telah dilakukan di Sub Balai Penelitian Budidaya Pantai Bojonegara-Serang dari bulan Mei 1983 sampai bulan Januari 1984.

Empat jenis ikan beronang yaitu *S. virgatus*, *S. canaliculatus*, *S. javus* dan *S. guttatus* digunakan dalam percobaan ini. Ikan diberi pakan campuran bahan pellet ikan mas dengan ikan rucah giling dalam perbandingan 1:1.

Hasil percobaan menunjukkan bahwa, laju pertumbuhan harian ikan *S. virgatus*, *S. canaliculatus*, *S. javus* dan *S. guttatus* secara berturut-turut adalah 0,55 %, 0,59 %, 0,66 % dan 0,68 % berat badan dan konversi makanannya adalah 5,6, 4,1, 3,6 dan 3,3.

ABSTRACT: Growth of some Rabbit fish, *Siganus* spp. cultured in floating net-cages. by Ketut Sugama*, Waspada* and H. Tanaka**

Observation on the growth some species of rabbit fish cultured in floating net-cages were carried out at Sub Balai Penelitian Budidaya Pantai Bojonegara-Serang from Mey 1983 to January 1984.

Four species of Rabbit fish, *S. virgatus*, *S. canaliculatus*, *S. javus* and *S. guttatus* were used in this experiment. Experimental fish were fed with a mixing of artificial diet of carp and chopped trash fish at a ratio of 1:1.

The result showed that daily growth rate of *S. virgatus*, *S. canaliculatus*, *S. javus* and *S. guttatus* are 0.55 %, 0.59 %, 0.66 % and 0.68 % of body weight respectivelly. The food conversion rate are 5.6, 4.1, 3.6 and 3.3 for *S. virgatus*, *S. canaliculatus*, *S javus* and *S. guttatus* respectivelly.

*) Sub Balai Penelitian Budidaya Pantai Bojonegara.
**) Japan International Cooperation Agency Expert.

PENDAHULUAN

Ikan beronang atau samadar (*Siganus* spp., rabbit fish) adalah jenis ikan laut yang tersebar luas di perairan Indo-facific (Lam, 1974). Di Indonesia khususnya di perairan Teluk Banten terdapat 9 jenis ikan beronang, 3 jenis merupakan jenis yang paling dominan yaitu *Siganus canaliculatus*, *Siganus javus* dan *Siganus guttatus* (Tanaka, 1982).

Di perairan Teluk Banten pada musim tertentu juvenil ikan beronang sering ditangkap dalam jumlah besar oleh nelayan bagan atau nelayan jaring (bondet). Untuk pemasaran selanjutnya ikan-ikan beronang kecil tersebut diproses dengan cara pengeringan atau penggaraman dengan harga jual yang murah. Menurut Lam (1974) bahwa, juvenil ikan beronang sebenarnya dapat dibesarkan melalui budidaya sampai ukuran yang mempunyai harga tertinggi. Di Palau, *S. canaliculatus* merupakan jenis beronang yang sangat digemari penduduk (May *et al.*, 1974). Di Indonesia,terutama di Sulawesi Selatan terkenal akan beronang bakarnya yang dapat dinikmati di beberapa restoran. Di Tanjung Pinang, ikan beronang lingkis (*S. canaliculatus*) yang matang telur mempunyai harga yang tinggi terutama pada waktu tahun baru cina.

Menurut Kissil (1972) bahwa, pertumbuhan ikan beronang akan lebih cepat apabila dipelihara dalam kurung-kurung apung dari pada di dalam tangki atau kolam, selanjutnya dikatakan bahwa, ikan yang diberi pakan berupa campuran ikan rucah giling dengan pellet ikan mas (25 % protein) akan tumbuh lebih cepat dibandingkan dengan ikan yang hanya diberi pakan pellet saja.

Dalam tulisan ini disajikan hasil pengamatan pertumbuhan, konversi makanan dan kematian beberapa jenis ikan beronang yang dipelihara dalam kurung-kurung apung. Hasil penelitian ini diharapkan dapat dijadikan bahan masukan dalam usaha budidaya laut khususnya budidaya ikan beronang.

BAHAN DAN METODA

Penelitian ini dilakukan di Sub Balai Penelitian Budidaya Pantai Bojonegara-Serang dari bulan Mei 1983 - Januari 1984. Ikan yang digunakan dalam percobaan ini terdiri dari 4 jenis yaitu beronang kea-kea (S. virgatus), beronang lingkis (S. canaliculatus), beronang samadar (S. javus) dan beronang lada (S. guttatus). Ikan-ikan tersebut ditangkap di sekitar perairan Pulau Lima dan Teluk Grenyang dengan menggunakan alat tangkap jaring pantai. Ikan yang baru ditangkap dari alam dipelihara dalam kurung-kurung apung selama beberapa waktu sambil dibiasakan makan pakan buatan. Padat penebaran dan ukuran masing-masing jenis ikan yang digunakan dalam percobaan ini disajikan dalam Tabel 1.

Ikan uji diberi pakan yang terbuat dari campuran bahan pellet ikan dengan ikan rucah giling (1 : 1). Bahan pellet ikan mas yang digunakan mengandung 25 % protein, 6,0 % lemak, 3,6 % serat kasar, 10,0 % abu, 1,7 % Ca, 1,3 % P dan 2650 K cal/Kg. sedangkan ikan rucah giling berasal dari jenis teri, tembang dan selar.

Ikan uji diberi makan 2 kali sehari yaitu sekitar jam 9^{oo}dan 17^{oo}sebanyak 3 - 7 % total berat tubuh. Setiap pemberian makan ikan, pakan ditempatkan dalam suatu wadah yang digantung pada salah satu sudut kurung-kurung.

Pengukuran ikan uji dilakukan setiap bulan sekali dengan sempel sebanyak 50 ekor ikan. Sebagai data penunjang dilakukan pula pengukuran sifat-sifat fisika-kimia air seperti suhu, kadar garam, pH, oksigen terlarut dan kecerahan air. Pengukuran sifat-sifat fisika-kimia air dilakukan setiap hari sekitar jam 9^{oo}, kecuali oksigen terlarut diukur setiap dua minggu sekali.

Tabel 1. Padat penebaran dan ukuran ikan beronang, *Siganus* spp. yang digunakan dalam percobaan.

Table 1. Stocking density and size of rabbitfish, *Siganus* spp. used in the experiment.

Jenis ikan (Species)	Jml. ikan (No. of fish) (ind.)	Panjang rata-rata (ATL)* (Cm)	Berat rata-rata (ABW)** (g)	Padat penebaran (Stocking density) (ind/m^3)	Ukuran kurung kurung (Size of net-cges) (m)
S. virgatus	340	10,3	17,4	43	2x2x2
S. canaliculatus	454	11,2	20,0	57	2x2x2
S. javus	378	9,8	14,1	47	2x2x2
S. guttatus	3200	9,6	10,9	128	3x3x3

* ATL = Average total length. **ABW = Average body weight.

Data yang terkumpul selama percobaan digunakan untuk menghitung pertambahan berat harian, pertumbuhan harian, konversi makanan dan kematian dengan rumus-rumus(Yamaguchi,1978 dalam Sugama,1983).

HASIL DAN PEMBAHASAN

Selama 270 hari pemeliharaan berat rata-rata ikan *S. virgatus*, *S. canaliculatus*, *S. javus* dan *S. guttatus* secara berturut-turut mencapai 121,1 gr, 177,8 gr, 237,6 gr dan 268,7 gr dengan laju pertumbuhan harian 0,55 %, 0,59 %, 0,66% dan 0,68 % berat tubuh (Tabel 1). Kurva pertumbuhan masing-masing jenis ikan disajikan dalam Gambar 3. Dari hasil percobaan ini menunjukkan bahwa, ikan *S. guttatus* tubuh paling cepat diikuti oleh ikan *S. javus*, *S. canaliculatus* dan *S. virgatus* (Tabel 2 dan Gambar 1).

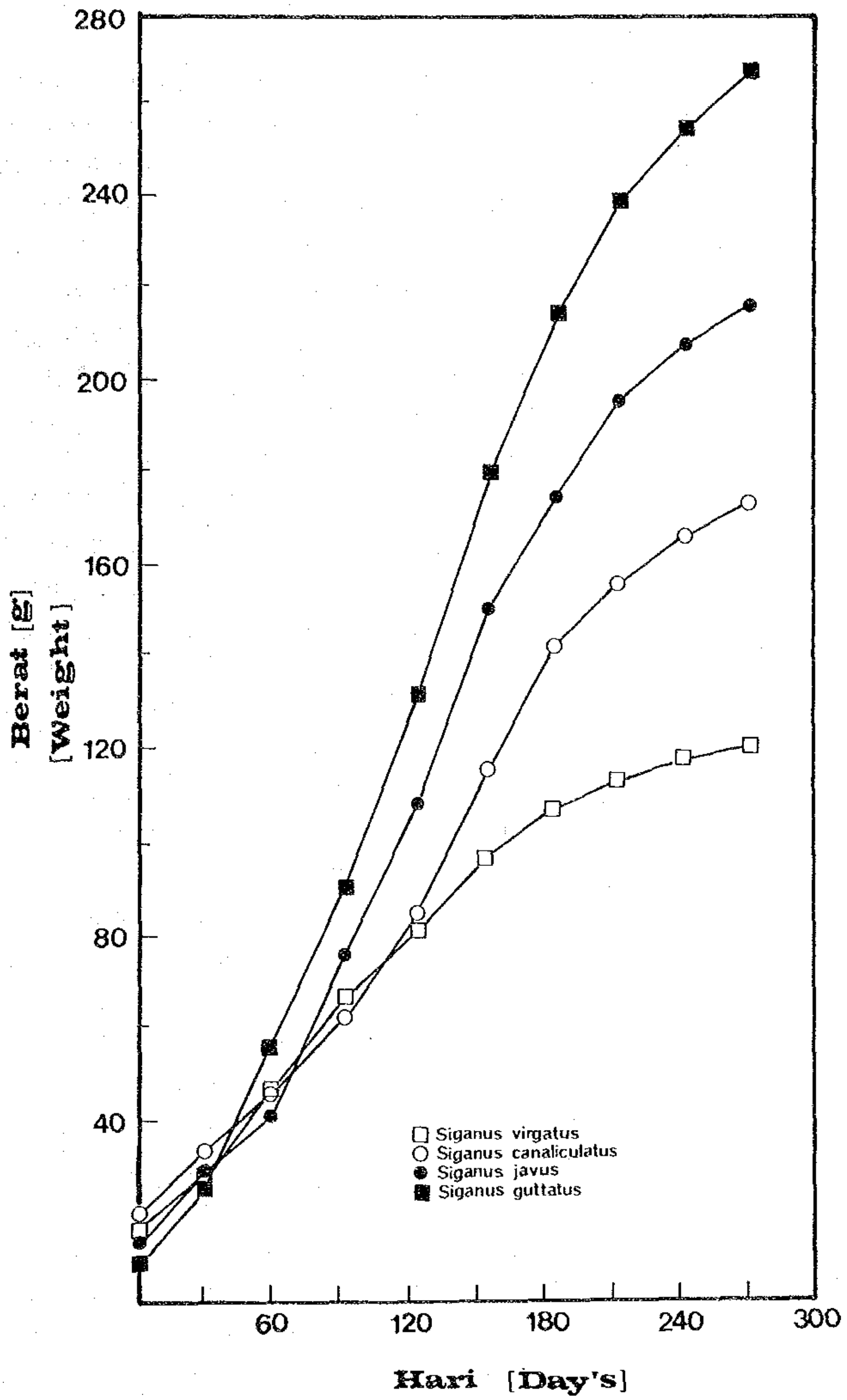
Menurut Effendie (1978) bahwa, pertumbuhan ikan dipengaruhi oleh beberapa faktor yang dapat digolongkan menjadi 2 yaitu faktor luar dan faktor dalam. Faktor luar diantaranya adalah sifat-sifat kimia-fisika air, padat penebaran mutu dan jumlah makanan. Sedangkan faktor dalam diantaranya adalah keturunan (genetik), sex, umur, kematangan gonad dan parasit. Dalam percobaan ini pengaruh faktor luar

Tabel 2. Pertumbuhan, konversi makanan dan kematian ikan beronang *Siganus* spp. dalam kurung-kurung apung.

Table 2. Growth rate, food conversion ratio and mortality of Rabbitfish, *Siganus* spp. cultured in floating net-cages.

Bagian (Item)	Jenis (Species)			
	S. virgatus	*S. canaliculatus*	*S. javus*	*S. guttatus*
Periode pengamatan (hari) (Period of observation)	270	270	270	270
Jumlah awal ikan (ind.) (Initial number of fish	340	454	378	3200
Jumlah akhir ikan (ind.) (Final number of fish)	245	368	301	2500
Kematian (%) (Mortality)	27,9	18,9	20,4	21,8
Berat awal rata-rata (g) (Initial ABW	17,4	20,4	14,1	10,9
Berat total awal (g) (Initial TBW)	5916	9080	5294	34880
Berat akhir rata-rata (g) (Final ABW)	121,1	177,8	237,6	268,7
Berat total akhir (g) (Final TBW)	29670	65430	71518	671750
Kenaikan berat total (g) (Total gained of BW)	23754	56350	66225	636870
Kenaikan berat harian (g) (Daily gained of BW)	0,38	0,58	0,83	0,96
Pertumbuhan harian (%) (Daily growth ratio)	0,55	0,59	0,66	0,68
Total pakan dimakan (g) (Total food consimed)	133020	231035	238410	2101670
Konversi makanan (Food conversion rate)	5,6	4,1	3,6	3,3

TBW = Total body weight. ABW = Average body weight.



Gambar 1. Pertumbuhan ikan beronang, Siganus spp. dalam kurung-kurung apung.

Figure 1. Growth of rabbitfish, Siganus spp. cultured in floating net-cages.

relatif sama, dengan demikian adanya perbedaan laju pertumbuhan masing-masingjenis ikan beronang dalam percobaan ini diduga ada hubungannya dengan faktor keturunan dan kematangan gonad untuk pertama kali. Effendie (1978) mengatakan bahwa, pertumbuhan ikan akan menjadi lambat pada saat mulai matang gonad. Dari hasil pengamatan ikan-ikan pecobaan setelah 8 bulan pemeliharaan menunjukkan bahwa, hampir semua ikan S. virgatus dan S canaliculatus matang gonadnya sedangkan ikan S. javus dan S. guttatus belum menunjukkan tanda-tanda kematangan gonad. Kenyataan ini ditunjang oleh hasil penelitian Tanaka, Sugama dan Basyarie (1984) tentang ukuran minimum awal kematangan gonad ikan beronang dialam yaitu mulai ukuran 100 gr pada S. virgatus, 130 gr pada S. canaliculatus 470 gr pada S. javus dan 320 gr pada S. guttatus.

Selama percobaan konversi makanan ikan S. virgatus, S. canaliculatus, S. javus dan S. guttatus secara berturut-turut adalah 5,6, 4,1, 3,6. dan 3,3 (Tabel 2). Kissil (1972) mengatakan bahwa, konversi makanan ikan Siganus rivulatus yang dipelihara dalam kurung-kurung dengan pemberian pakan campuran pellet (25 % protein) dengan ikan rucah giling berisar antara 2 - 4.

Tingkat kematian ikan selama percobaan adalah 27,9 % pada S. virgatus, 18,9 % pada S. canaliculatus, 20,4 % pada S. javus dan 21,8 % pada S. guttatus (Tabel 2). Menurut Teng dan Chua (1979) tingkat kematian ikan dalam kurung-kurung apung dipengaruhi oleh padat penebaran, selanjutnya dikatakan bahwa, kematian ikan akan lebih tinggi pada padat penebaran yang tinggi. Dalam penelitian ini walupun padat penebaran masing-masing jenis ikan beronang berbeda (Tabel 1) namun perbedaan angka kematian diduga bukan disebabkan oleh perbedaan padat penebaran. Hasil pengamatan selama percobaan menunjukkan bahwa, kematian ikan terutama disebabkan oleh serangan parasit monogenetic trematoda yang menempel pada insangnya. Pembasmiannya dapat diatasi dengan cara merendam ikan 2 kali setiap 7 hari dalam larutan pestisida Difterex 50 ppm. selama 5 menit. Cara ini sesuai dengan yang disarankan oleh Tanaka dan Basyarie (1982).

Selama percobaan, suhu air, kadar garam, oksigen terlarut, pH dan kecerahan air secara berturut-turut berkisar antara 28,7-30,8 °C, 29,2 - 33,4 ppt, 5,2 - 7,2 ppm, 7,9 - 8,2 dan 1,5 - 4,5 m. Keadaan ini masih dalam batas yang tidak membahayakan bagi kehidupan ikan (Yokokawa, 1982).

Dari hasil penelitian ini diperoleh keterangan bahwa, ikan S. guttatus tumbuh paling cepat diikuti S. javus, S. canaliculatus dan S. virgatus. Didalam usaha pengembangan budidaya ikan beronang belum banyak informasi tentang tekhnik-tekhnik budidaya untuk peningkatan produksi. Oleh karena itu, untuk penelitian selanjutnya sebaiknya diarahkan pada padat penebaran, ratio dan frekuency pemberian pakan, jenis pakan dan cara pemeliharaan kurung-kurung apung untuk menhindari ikan lepas dari kurungan.

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EFFECT OF STOCKING DENSITY ON THE GROWTH OF GROUPER, *Epinephelus tauvina* Forskal, CULTURED IN FLOATING NET CAGES

Ketut SUGAMA*, Hiroki EDA and Edward DANAKUSUMAH***

ABSTRACT:

The experiment was conducted to determine the optimum stocking density for growth of grouper. The young fish with an average body weight of 113.5 g were cultured in floating net cage (1.0 x 1.0 x 1.5) m with mesh size of 10.0 mm. Four stocking densities (25, 50, 75 and 100 fish/m^3) were studied. The fish were fed with chopped trash fish (<u>Sardinella</u> spp.) once in a day up to satiation.

Result of the present experiment indicated that fish stocked at density of 50 fish/m^3 grew equally fast and showed no differences on food conversion ratio, mortality rate and condition factor compered to those at stocking density of 25 fish/m^3. At the end of the experiment net yield at stocking density of 50 fish/m^3 were not significant different than those at stocking densities of 75 and 100 fish/m^3. The net yield were 4.26, 8.18, 8,36 and 8.56 kg/m^3 at stocking density of 25, 50, 75 and 100 fish/m^3 respectively.

In order to produce maximum yield with minimum cost, the stocking density of 50 fish/m^3 is recomended as a optimal stocking density.

*) Sub Balai Penelitian Budidaya Pantai Bojonegara-Serang.
**) Japan International Cooperation Agency Expert.

INTRODUCTION

The grouper (*Epinephelus tauvina* Forskal) commonly known as "Kerapu" in Indonesia, is a popular marine food fish of high marketable in Southeast Asia (Chen *et. al.*, 1977, Chua and Teng, 1980, Danakusumah and Imanish, 1984).

In Malaysia, cage culture of estuary grouper (*Epinephelus salmoides* Maxwell) has been found to be of great commercial ~~potential~~ fish (Chua and Teng, 1980). In Indonesia the history of culturing marine fish in floating net cages is fairly new. Research on floating cage culture of marine fish had begun in 1979 under Mariculture Research and Development Project ATA-192. This project under joint cooperation between Indonesia-Japan goverment. The main species of fish studied are Sea Bass (*Lates calcarifer*), Snapper (*Lutjanus* spp.), Rabbitfish (*Siganus* spp.) and Grouper (*Epinephelus tauvina*). At present time, the project choice the grouper (*E. tauvina* as one of comodities for promotion of commercial fish culture in floating net cage.

In fish farming, knowlage on the growth and production of fish per unit culture facility is infortant. Production of fish in net cage is the product of grwth rate and biomass stocked. The growth of fish effected by many factors such as stocking density, feed and feeding, water quality, parasite and canibalsm (Reay, 1979).

In many studies, the total production increases with increase in the initial biomass up to the optimum rate, beyond a certain density the production decrease (Hickling, 1962., Coche, 1976) The optimum stocking density of fish in intensive cage culture varies according to the species,Size of fish and culture sites. In the case of Yellowtail (*Seriola quinqueradiata*) the optimum stocking density was found to be 25 - 50 fish/m^3 with size of fish 100-400 g. in body weight (Fujiya, 1976). For *Tilapia nilotica*, best growth was obtain at stocking density of 10.5 Kg/m^3 with size of fish 20 g. in body weight (Coche, 1977) and for atlantic salmon (*Salmo salar*) at stocking density of 10 Kg/m^3 (Howard, 1974). In the cul- the cultured of estuary grouper (*Epinephelus salmoides* Maxwell)-

the best stocking density for optimal growth has been found to be 60 fish/m^3 (Chua and Teng, 1979).

This paper describes the effect of stocking densities on the growth of grouper(E. tauvina) cultured in floating net cages in Banten Bay.

MATERIAL AND METHODS

The present experiment were carried out from june to September 1985 at Bojonegara Coastal Aquaculture Research Station. The fish for the present experiment were collected from the shallow water at Sekantung bay, in the western part of Banten bay. The fish were kept in floating net cage for several days to condition them to the new enviroment and fed with chopped trash fish mainly consisted of Sardinella spp. Experiment began after all the fish fed voluntarily on the trash fish.

The experimental cage used in the present study was made from bamboo (6.5 x 6.5) m, and floated with cylindrical styrofoam. The size of polyethyline net cages used was 1.0 x 1.0 x 1.5 m., with mesh size of net 10.0 mm. The volume of the net cage wich was always submerged in water was 1.0 cubic meter wich was used for the calculation of the initial stocking densitiy of fish. Detail on the contruction of the net cage have been described in Sugama and Danakusumah (1985, in preparation).

About the same size of fish were sellected and used for experiment. The initial size of fish and four stocking densities tested are shown in Table 1. The fish were fed once in a day at 10 pm. with the trash fish (Sardinella spp.). In each feeding the fish were fed to satiation. Satiation is reached when the excess food given was not taken between 20 - 30 minutes. Uneaten food was weighed and differences between initial weight of food and the weight the weight of uneaten food was takes as the quantity of food consumed by the fish.

Table 1. Initial stocking density, initial biomass and size of grouper, *Epinephelus tauvina* used for experiment.

Initial stocking density ($fish/m^3$)	Initial biomass stocked (kg/m^3)	Size of fish stocked			
		Mean length (cm)	SD*	Mean weight (g)	SD*
25	2.83	19.39	1.05	113.03	15.65
50	5.53	19.32	0.94	110.55	14.33
75	8.72	19.58	1.02	116.26	15.70
100	11.40	19.44	1.23	114.04	15.49

*SD= Standard deviation

Growth in body weight and total length of fish were observed every two week. Water temperature and salinity were recorded everydays, disolved oxygen and pH were recorded weekly in the water outside of net cage.

The data collected were analysed for calculations of the mean fish weight, weight-gain per fish, net yield, food conversion ratio, mortality and condition factor of the fish. These term were defined as follws: (Chua and Teng, 1979,1980).

1. Mean fish weight = Average weight of fish at t-days.
2. Weight-gain per fish = $\overline{W}_t - \overline{W}_o$ (g) $\overline{W}_t$ = mean weight of fish at t-days
   $\overline{W}_o$ = initial mean weight of fish.
3. Net yield = $W_t - W_o$ (kg/m^3)
   W_t = total weight of fish survived in net cage at t-days.
   W_o = initial total weight of fish.
4. Food conversion ratio = weight of food eaten/wet weight gained by fish.
5. Mortality = $N_o - N_t / N_o \times 100$ %.
   N_o = initial total number of fish.
   N_t = total number of fish at t-days.
6. Condition factor = $\overline{W}_t / \overline{L}_t^3 \times 1000$.
   $\overline{W}_t$ = mean weight of fish at t-days
   $\overline{L}_t$ = mean total length of fish at t-days.

Analysis of variance (two-way ANOVA without replication (Sokal and Rohlf, 1969) were used to test the effect of stocking density. Duncan's Multiple Range Test (Gomez and Gomez, 1976) was applied to compare the significance of the means of the growth parameters among the stocking density tested.

RESULT

Result of this experiment showed that, the mean fish weight consistently higher in the lower stocking densities (Fig. 1)

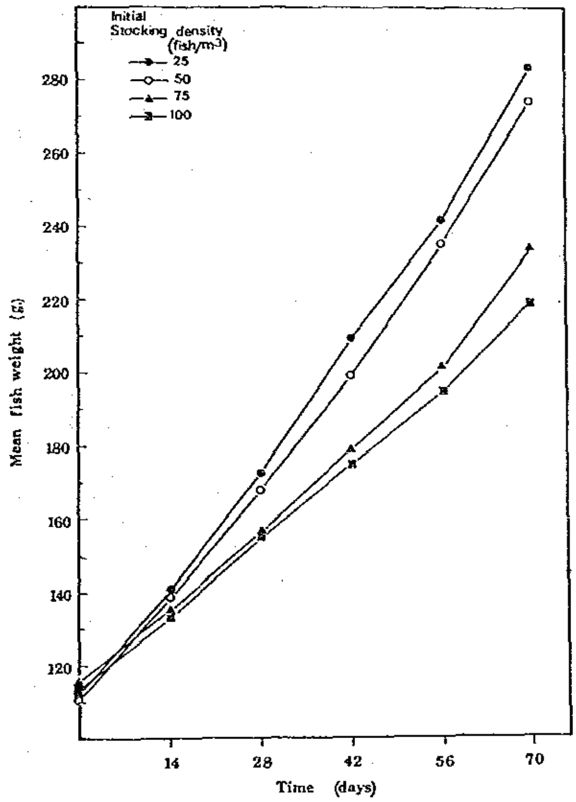

Fig. 1. Mean weight of grouper, Epinephelus tauvina with different stocking density.

In this study, the term of net yield was expressed as biomass gained per cubic meter of rearing capasity of the net cage during a given time interval (Coche, 1976). The net yield at stocking density of 25 fish/m^3 were much lower than those at stocking densities of 50, 75 and 100 fish/m^3 (Fig. 3; $P \leq 0.01$). The differences of the net yield amongst stocking densities of 50, 75 and 100 fish/m^3 were not significant ($P \geq 0.01$). At the and of the experiments, net yield of fish at stocking densities of 50, 75 and 100 fish/m^3 were 8.18, 8.35 and 8.56 kg/m^3 respectively. The increase in net yield at socking density of 50, 75 and 100 fish/m^3 were 192.0 196.0 and 200.9 % over that stocking density of 25 fish/m^3.

Food conversion ratio increased with increasing og stocking density (Fig. 3; Table 2). The differences of food conversion ratio between stocking densities of 25 and 50 fish/m^3 were not significantly ($P > 0.01$). Among the stocking densities of 50, 75 and 100 fish/m^3, the food conversion ratios differed significantly from one another (P 0.01). The highest mean food conversion ratio (5.54) was in fish at stocking density of 100 fish/m^3 and the lowest (3.48) at stocking density of 25 fish/m^3 (Table 2).

Table 2. Food conversion ratio of Grouper, Epinephelus tauvina with different stocking density.

Stocking density (fish/m^3)	Food conversion ratio	
	Mean*	Range
25	3.48	3.43-3.56
50	3.51	3.48-3.54
75	4.58	4.12-4.84
100	5.54	4.86-6.32

*= mean ratio was obtained by averaging all every fortnights measurment during experiment.

During the period of the study, there no mortality of fish were observed at stocking density of 25 and 50 fish/m^3. Mortality occured at stocking densities of 75 and 100 fish/m^3. Higher mortality were found at stocking density of 100 fish/m^3 (Fig. 3). Total mortality at the end of the experiment were [illegible] and [illegible] % at stocking density of 75 and 100 fish/m^3 respectively.

The condition factor of fish for all stocking densities tested increased with time (Fig. 3). The differences of condition factors amongst the stocking density tested are relative small and were statistically in significant ($P > 0.01$).

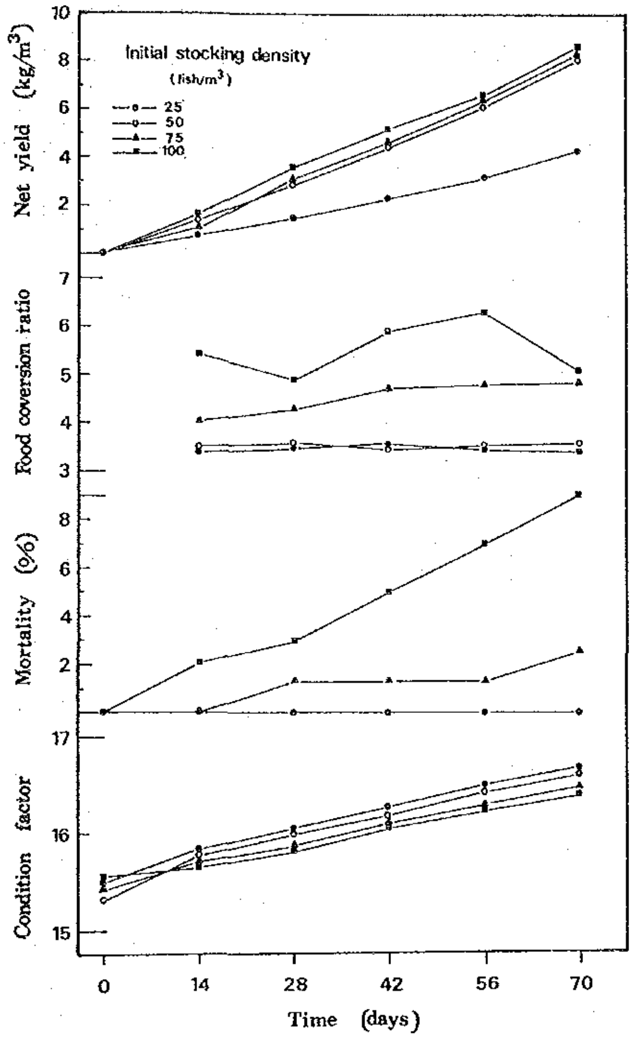

Fig 3. Net yield, food conversion ratio, mortality and condition factor of grouper, Epinephelus tauvina cultured with different stocking density.

Analysis of variance of the effect of stocking density on the growth parameter in this experiment showed that, the stocking density significantly effect on the mean fish weight, weight gain per fis, net yield, food conversion ratio and mortality. However there is no significant effect on the condition factor of the fish (Table 3).

The range of water temperature, salinity, dissolved oxygen and pH during the period of study, cheked in outside of net cage were 29.8 - 31.3^{o}C, 30.8 - 32.9 ppt, 4.25 - 5.64 ppm and 8.[illegible] - 8.28, these range were relative constant and still tolerable by the fish.

Table 3. Analysis variance (F-value) of the effect of stocking density on the various growth parameter of groupers, Epinephelus tauvina cultured in floating net cage.

	Mean weight	Weight gain per fish	Net-Yield	Food conversion ratio	Mortality	Condition factor
Stocking density	6.47**	12.26**	18.00**	45.93**	16.06**	4.32(NS)

** P 0.01; (NS) = Not significant.

DISCUSSION

The growth of fish cultured in floating net cage directly influence by biotik and abiotic factors (Reay, 1979). Rifai (1980) stated that the fish will grow rapidly when the food or space are plentiful, and grow slowly when when either or both are scarce. It is often stated that, the degree to wich fish are crowded together will affect growth (Weatherley, 1972). In the cultured fish the best growth rate is attained at a particular stocking density, above which growth rate is considerable reduce and below which the fish do not grow as well as at optimal stocking density (Chua and teng,1979). In the present study the mean fish weight and weight gain per fish or its growth at low stocking densities were higher than that in at high stocking densities. The growth of fish at stocking density-of 50 fish/m^3 was much higher than at higher stoking densities of 75 and 100 fish/m^3, but grew equally fast with that of lower stocking density of 25 fish/m^3. This idicates that the optimal stocking density to the optimal growth was 50 fish/m^3. The optimal stocking density may thus vary with species and size of fish. In the case of Yellowtail (<u>Seriola quinqueradianta</u>) the optimum stocking density in the cage was found to be 25 - 50 fish/m^3 with size of fish 100 - 400 gr in body weight (Fujiya, 1976). In the cultured of estuary grouper (<u>Epinephelus salmoides</u> Maxwell) the best stocking density has been found to be 60 fish/m^3 (Chua and Teng, 1979).

In many studies, the total production increases with increase initial biomas up to the optimum rate, beyond a certain density the production decrease (Hickling, 1962, Coche, 1976). In the present study, the net yield of fish at stocking density of 50 fish/m^3 showed no differences from those at stocking densities of 75 and 100 fish/m^3 (Fig. 3). The reduce growth rate and increased mortalities of fish at stocking densities of 75 and 100 fish/m^3 may have caused the net yield decreased.

The mean food conversion ratios increased with increasing of stocking densities (Table 2). Food conversion ratio was less efficient at stocking densities of 75 and 100 fish/m^3. Chua and Teng (1979) stated that types of feed olso effect the food conversion ratio, He has been found that, in the cultured of estuary grouper (<u>E. salmoides</u>) at stocking density of 60 fish/m^3, the food conversion ratio was 3.69 when the fish fed with trash fish such as <u>Engraulis mystax</u>, <u>Pseudosciaena acuta</u> and <u>Belaroides leptolepsis</u>. In this experiment, at stocking density of 50 fish/m^3 the food conversion ratio was 3.51 when the fish were fed with <u>Sardinella</u> spp.

In fish culture, differences individual growth within species can be a problem because size hierarchies developed, with the largest fish inhibiting the growth of smaler one and sometimes eating them (Keay, 1979). Brown (1957) stated that overcrwding could be easily induce such association as size hierarchies. In the present study the fish at stocking densities of 75 and 100 fish/m^3, size hierarchies was occured, and were observed when the fish were measured.

The mean weight of fish at stocking density of 25 fish/m^3 were significantly higher than those at stocking densities of 75 and 100 fish/m^3 ($P < 0.01$). The differences of mean fish weight between the stocking densities of 25 and 50 fish/m^3 as well as between the stocking densities of 75 and 100 fish/m^3 were not significant ($P > 0.01$). This indicates that the fish at stocking density of 50 fish/m^3 can grow as fast as those at stocking density of 25 fish/m^3.

Weight-gain per fish at stocking densities of 25 ang 50 fish/m^3 were much higher thanthose at the higher stocking densities of 75 and 100 fish/m^3 (fig. 2; $P < 0.01$). The differences of weight-gain per fish between the stocking densities of 25 and 50 fish/m^3 aswel as between the stocking densities of 75 and 100 fish/m^3 were not significant ($P > 0.01$)

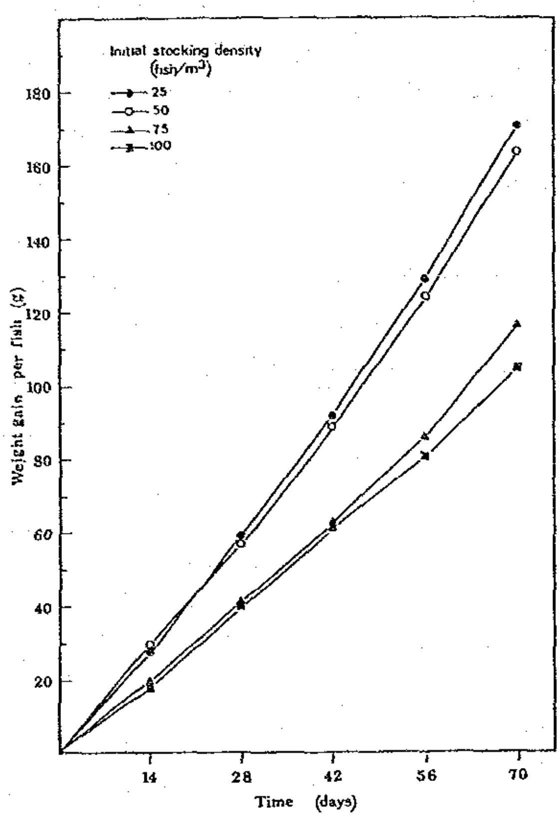

Fig. 2. Weight gain of grouper, *Epinephelus tauvina* with different stocking density.

The grouper is canibalism species (Chua and Teng, 1980). At stocking density of 100 fish /m^3 most of mortality caused by canibalism.

Stocking density may inffluence the condition factor of the fish but not body shape (Chua and Teng, 1979). In the present study, the condition factor of fish did not different amongst the stocking densities tested. Similar result were obtain by Chua and Teng (1979) in the cultured of estuary grouper (E. salmoides)

From the result of this study, in order to produce maximim yield with minimum cost, the stocking density of 50 fish/m^3 is recomended as optimal stocking density.

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EFFECT OF FEEDING FREQUENCY ON THE GROWTH OF ESTUARY GROUPER, *Epinephelus tauvina* (Forskal) CULTURED IN FLOATING NET-CAGES

Ketut Sugama*, Edward Danakusumah*, Pramu Sunyoto* and Hiroki Eda**

ABSTRACT: Studies on the effect of feeding frequency on the growth of estuary grouper, Epinephelus tauvina (Forskal) were conducted in floating net cages. Three of feeding frequency (one, two feeding per day and one feeding in 2-days) with fish size ranging from 80.9-83.3 g in body weight were studied. The fish were fed to satiation in each feeding.

Result of the pressent study indicates that fish fed once in 2-days grew equally fast and showed best food conversion ratio than those at fish fed once and twice daily. At the end of the experiment the net yield in feeding frequencies twice, once daily and once in 2-days are 6.93, 6,36 and 5.93 Kg/m^3 respectively. During experiment there are no mortality were observed for all feeding tested.

ABSTRAK: Pengaruh Frekuensi Pemberian Pakan Terhadap Pertumbuhan Ikan Kerapu Lumpur, Epinephelus tauvina (Forskal) dalam Kurung-kurung Apung oleh: Ketut Sugama* Edward Danakusumah* Pramu Sunyoto* Hiroki Eda.

Studi pengaruh frekuensi pemberian pakan terhadap pertumbuhan ikan kerapu lumpur, Epinephelus tauvina (Forskal) telah dilakukan dalam kurung-kurung apung. Ikan dengan berat tubuh antara 80,9-83,3 g digunakan dalam percobaan ini dan diberi perlakuan dengan frekuensi pemberian pakan yang berbeda yaitu pemberian pakan 1, 2 kali sehari dan 2 hari sekali. Ikan diberi pakan hingga kenyang pada setiap pemberian.

Hasil percobaan menunjukkan bahwa, laju pertumbuhan ikan pada semua perlakuan relatif sama namun konversi makanan pada ikan yang diberi pakan 2 hari sekali lebih baik dari pada perlakuan lainnya. Pada akhir percobaan produksi bersih ikan pada perlakuan pemberian pakan 2,1 kali sehari dan 2 hari sekali secara berturut-turut adalah 6,93, 6,36 dan 5,93 Kg/m^3. Selama percobaan tidak ada ikan yang mati pada semua perlakuan.

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INTRODUCTION

The estuary gruper (Epinephelus tauvina Forskal) is a popular marine foodfish of hight market value in Southeast Asia (Chen, Chow, Chao and Lim, 1977). In Jakarta, price of live estuary grouper is Rp. 5.500,- per kilogram (about US $ 5.0/Kg) for the fish size range of 0.5 - 0.9 Kg. in body weight.

Cage culture of estuary grouper (Epinephelus salmoides Maxwell) in Malaysia has been reported by Chua and Teng (1980). In Indonesia, Danakusumah, Imanishi and Sugama (1985) in preperation) tested the growth of estuary grouper (E. tauvina) fed with trash fish in floating net cages. in Banten Bay.

The estuary grouper is carnivorous fish, like a Yellowtail and Red Snapper, but different mode and life in nature. Its behaviour and mode of feeding in net cage also differ from Yellowtail and Red Snapper. For example, Yellowtail move around net cages at the surface while estuary grouper stay at the bottom; hence, their energy utilization and food required may differ considerable.

For Yellowtail, Ishiwata (1969) has been found that the daily food ration directly change with frequency of feeding. and optimum feeding frequency for optimal growth is 1-2 times per day till satiation each feeding.

Development of estuary grouper floating cage culture, in order to attain optimal growth and economic production, it is still necessary to have complete knolage of feeding regime.

The studies discribed in this paper were conducted to examine the effects of feeding frequency to the growth of estuary grouper cultured in floating net cages.

MATERIAL AND METHODS

Experiment were caried out from June to August 1985 at Bojonegara Coastal Aquaculture Research Station. The fish for the present experiment were collected from the shallow water at Sekantung bay, (in the western part of Banten Bay) The fish were kept in floating net cages for several days to condition them to the new enviroment and fed with chopped trash fish mainly consist of caranx (Selaroides spp) and sardine (Sardinella spp). Experiment began after all the fish fed voluntarily on the trash fish.

The experimental cage used in present study was made from bamboo (6.5 x 6.5) m, and floated with cylindrical styrofoams. The size of the polyethyline net cages used was 1.0 x 1.0 x 1.5 m. with mesh size of net 8.0 mm. The volume of the net cage, which was always submerged in water was 1.0 cubic meters. Detail on the contruction of the net-cage have been discribed in Sugama and Danakusumah (1985) in preperation).

About the same size of fish were randomly selected and allocated to 3 net-cages. In each cage 50 fish were stocked. The size, number and feeding frequencies tested are shown in Table 1. The fish were fed to satiation in each feeding. Satiation is reached when the excess food given was not taken within 20 - 30 minutes. Uneaten food was weighed and differences between initial weight of food and the weight of uneaten food was taken as the quantity of food consumed by the fish. When the fish were given once feeding per day and once feeding in 2-days, the food was given between 4 - 5 pm., and for twice feeding per day the food were given at 9 am. and 5 pm.

Table 1. Feeding frequency, size and number of estuary grouper used for experiment.

Feeding frequency	Size of fish				Number of fish stocked
	Mean length (Cm)	SD*	Mean weight (g)	SD*	
2 times daily (2/1)**	17.4	0.77	80.9	8.1	50
1 time daily (1/1)	17.5	0.82	83.2	8.3	50
1 times in 2-days (1/2)	17.5	0.98	83.3	8.4	50

SD*= Standard deviation of the mean. ( )** Notation.

Growth in body weight and total length of fish were observed every two weeks. Water temperature, salinity, disolved oxygen and pH were recorded everyday.

The Data were analysed for calculation of mean weight, net yield, food conversion ratio, mortality and condition factor. These term were difined in Chua and Teng (1978, 1979).

Analysis of variance (two-way ANOVA without replication) Sokal and Rohlf, (1969) were used to test the effect of feeding frequency. Duncan's Multiple Range Test (Gomez and Gomez, 1976) was applied to compare the significance of the means of the growth parameters among the feeding frequency tested.

RESULT AND DISCUSSION

At the end of this experiment, the mean fish weight were higher in the hiher feeding frequency (Fig.1). The differences mean fish weight amongst feeding frequency tested are relativelly small (P>0.01; Table 3)

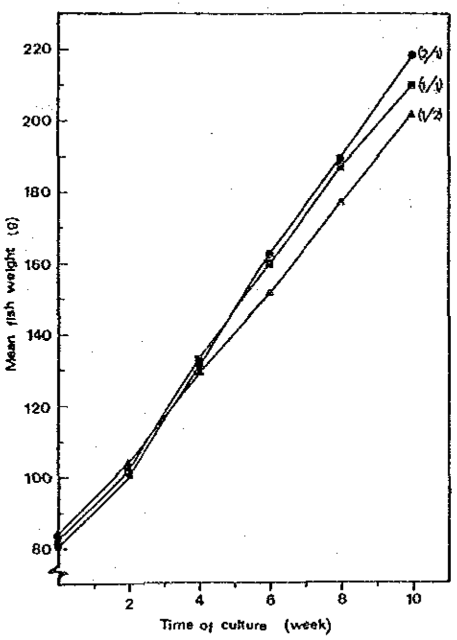

Fig. 1. Mean weights of estuary groupers with different feeding frequency.

The average growth rate of fish in different feeding frequency are shown in Table 2. The growth rate of fish was clearly effected by the frequency of feeding. In the higher feeding frequency the growth was faster than in the lower feeding frequency. The differences in growth rates in those fish which were fed one, two time daily or one in 2-days were relatif small. Over 10 week of culture the growth rate varying from 1.69 g per fish per day to 1.92 g per fish per day (Table 2).

Table 2. Average growth rate (increased body weight per day) of estuary Grouper with different feeding frequency

Feeding frequency	Number of weeks					
(No.of feeding/day's)	0-2	2-4	4-6	6-8	8-10	0-10
	(g/day)					
2/1	1.40	2.23	2.13	1.98	2.17	1.98
1/1	1.42	2.14	2.03	1.87	1.62	1.82
1/2	1.47	1.85	1.56	1.79	1.78	1.69

In this study, net yield is expressed as the biomass gained in kilogram of fish per cubic meter of rearing capacity during a given time interval (Coche,1976). Net yields of fish for all feeding frequencies tested are shown in Fig.2. The net yield was high in the higher feeding frequency. The differences amongst feeding frequency tested were not significant ($P \geqslant 0.01$; Table 3). At the end of the experiment net yield of fish fed twice daily, once daily and once in 2-days are 6.93, 6,36 and 5.93 Kg/m^3,respectively.

The food conversion ratio was consistetly hihger in the hinger feeding frequency. The different of food conversion ratio amongst feeding frequency tested were statistically significant ($P \leqslant 0.01$; Table 3). The fish which were fed once in 2-days showed best food conversion ratio ranging from 3.13 to 3.82 and the fish were fed twice daily and once daily the food conversion ratio ranging from 4.13 to 5.14 and 3.47 to 4.88 respectively (Fig.2).

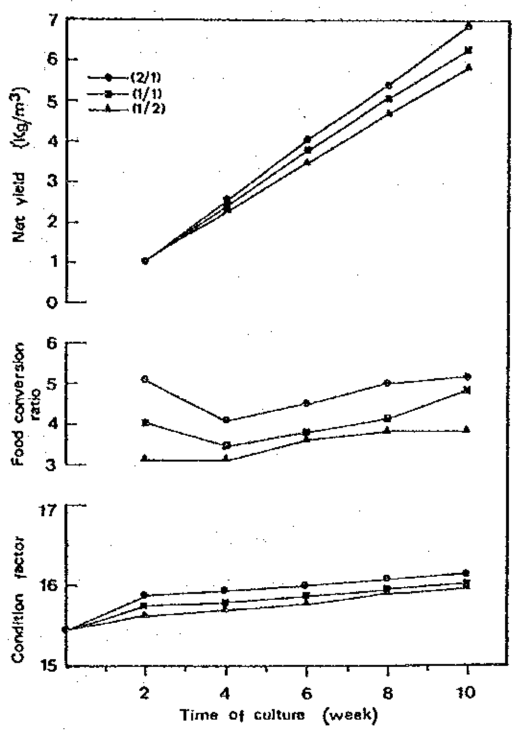

Fig.2. Net yield, food conversion ratio and condition factor of estuary grouper with different feeding frequency.

During the period of experiment there are no mortality were observed for all feeding frequency tested. It is apperent that under the experimental conditions, the mortality rate of fish did-not appear to be affected by the quantity of food given.

The condition factor of the experimental fish are shown in Fig 2. The condition factor of fish increased with the time and condition factor high in the higher feeding frequency. The differences condition factor among those were relatively small and were statistically insignificant ($P \geqslant 0.01$; Tabel 3)

The range of water temperature, salinity, disolved oxygen and pH were 29.8 - 31.2 ^{o}C, 30.8 - 32.7 ppt., 4.63 - 5.64 ppm and 7.97 - 8.25. These ranges are still tolerable by the fish.

Table 3. Analysis of variance (F-values) of the effect of feeding frequency on the net yield, mean fish weight, food conversion ratio and condition factor of estuary grouper

	Net yield per cage	Mean fish weight	Food conversion ratio	Condition factor
Feeding frequency	0.23 (NS)	2.14 (NS)	27.78**	5.36 (NS)

** P 0.01. NS= Not significant.

Growth of fish in floating net cage dipendent on quality and quantity of food supplied, the fish grow rapidly when the food are plentiful and grow slow when the food are scarce (Warren, 1971). Ishiwata (1969) has been reported that increasing feeding frequency of the fish could be improve the growth rate. In present study increasing of feeding frequency from once feeding in 2-days to one and two feeding per day dit not show good in growth rate. This fact indicates that increased of feeding frequency in estuary grouper is meaningless.

The experimental fish were fed to satiation in each feeding, the actual quantity of food eaten per fish per feeding in the higher feeding frequency much less than those taken by fish in the lower feeding frequency while the quantity of food eaten per fish per 2 week was high in the higher feeding frequency (Table 4) The food conversion ratio clearly different amongst the feeding frequency tested. The best food conversion ratio was noted for fish which were fed once in 2-days. This indicates that at high feeding frequency a portion of food consumed might have waste. Chua and Teng (1978) carried out experiment on gastric digestion of food in estuary grouper. He has been found that when the fish fed to satiation, within 36 hours after feeding over 95 % of food digested and less than 5 % body weight of food remained in the stomach. Feeding the estuary grouper at 48 hour intervals (once in 2-days) greatly enhanced maximum intake and efficient utilization of food (Chua and Teng, 1978).

Table 4. Food consumption of estuary grouper in floating net-cages with different feeding frequency.

Food consumption	Number of week	Feeding frequency (No of feeding/day)		
		2/1	1/1	1/2
Weight of food eaten per fish (g/2-week)	0-2	101.0	80.0	59.0
	2-4	129.0	104.0	81.0
	4-6	135.0	108.8	84.6
	6-8	139.0	110.0	91.6
	8-10	155.6	111.0	95.0
	Av.*	131.9	102.6	82.2
Weight of food eaten per fish per feeding (g)	0-2	3.9	6.2	9.8
	2-4	4.9	8.0	13.5
	4-6	5.2	8.3	14.1
	6-8	5.3	8.5	15.3
	8-10	5.9	8.5	15.8
	Av.*	5.0	7.9	13.7

Av.* = Average.

Dawes (1930) found that in Pleuronectes is second meal is taken a short interval after first, the food leaves the stomack and passes down the elementary track more quickly. Under such circumtaces digestion may will be less efficient. Hence, the fish supplied with intermediate of food would make better use of it than those maximum ration.

Smith (1978) stated that there are large differences in the ability of different species of fish to digest feed material, the food requirement of different species of fish olso vary greatly. Food intake by fish as gross energy which is used for maintenance, physical activity and growth. Active fish such as Yellowtail might have required much food than inactive fish such as estuary grouper In the case of Yellowtail to obtain higest growth rate the optimum feeding frquency was 1-2 times per day (Ishiwata, 1969).

Comparing the feeding frequency tested, for economic production and taking into consideration food conversion ratio, mortality rate, and condition factor, optimal production could be attained when the fish fed once in 2-days, Which is recomended as optimal feeding fre quency for estuary grouper cultured in floating net cage in banten bay.

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EFFECT OF DIFFERENT FOOD RATION ON THE GROWTH OF YOUNG ESTUARY GROUPER, *Epinephelus tauvina* (Forskal), CULTURED IN FLOATING NET CAGE

Ketut SUGAMA*, Edward DANAKUSUMAH* and Hiroki EDA**

ABSTRACT

The experiment was conducted to determine the optimum food ration for the growth of young estuary grouper, Epinephelus tauvina (Forskal). Young fish with an average body weight of 10.5g were stocked in four floating net cages(1.0 x 1.0 x 1.5^{m}) at stocking density of 60 fish per cage. The fish in each net cage were given different food ration ranging from 5 to 20% wet weight of fish. The fish were fed once in a day.

The result showed that the maintenance, optimum and maximum food ration were 1.3, 8.8 and 19.0% wet weight of fish respectively. At the end of experiment the net yield were higher with the higher food ration. For the economic production, the ration should be approximately 8.8% body weight supplied every day.

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INTRODUCTION

The estuary grouper or *Kerapu* in Indonesian, *Epinephelus tauvina* (Forskal) is one of the most important expensive marine fish in Indonesia, especially live one with 0.5-0.9 Kg in body weight (Danakusumah and Imanishi,1984).

Recently, the estuary grouper (*Epinephelus salmoides* Maxwell) culture in floating net-cages became very popular and has been found to be of great commercial potential in Malaysia (Chua and Teng, 1980). The method of floating net cage culture is generally proposed as culture fish with intensive feeding. In Indonesia, the price of feed fish not so much differ than cultured fish, however culture of expensive fish such as estuary grouper, *Epinephelus tauvina* (Forskal) would be promissing to culture.

Chua and Teng (1982) stated that, the estuary grouper grow fast depending on eviromental condition of culture site and production of fish in cage dependent on operational and management function. In attemp to reduce of feed cost, one of infortant aspect is found the quantity of feed requied by fish in each size to the best growth and yield.

This paper discribed the effect of varying food ration on the growth of estuary grouper cultured in floating net-cages.

MATERIAL AND METHODS

Experimental fishes used for pressent study were collected from the Sekantung Bay in the western part of Banten Bay. The young grouper were found in shallow water amongst the green algae, *Enhalus* spp. and were collected by beach seine. The fishes were kept several days in floating net cage to condition them to the new enviroment and fed with chopped trash fish (dominated by *Sardinella* spp.)

The frame of net cage for the culture experiment were made from bamboo (6.5 x 6.5 m) and floated with cylindrical styrofoams. The size of the polyethyline net cage used for the pressent study was 1.0 x 1.0 x 1.5 M., with mesh size 8.0 mm. The volume of net cage which was always submerged in water, was measured at 1.0 cubic meter (Fig.1).

The ~~trash~~ fish used as feed consisted of anchovy (Stolephorus spp.), caranx (Selaroides sp.) and sardine (Sardinella spp.) The fish in each net cage were ~~given~~ different food ration, ~~ranging from 5 -~~ 20 % wet weight of fish. The ~~fish~~ were fed once in a day at 1^{00} pm. The size and number of fish used for each food ration are showen in Table 1.

~~The total of food gi~~ven was adjusted every 15-days after caunted number of fish and determining the mean weight and length of 30 fish sample at random in each cage.

~~The weighed food~~ given to the fish at one corner of each net cage, after 1 hour uneaten food were carefully collected with scoop net especially in 20 % food ration. Uneaten food were weighed and the difference between initial weight of food and weight of uneaten food was taken as quantity of food consumed by fish.

Water temperature and salinity were recorded every day ~~and~~ Disolved oxygen and pH ~~every week~~.

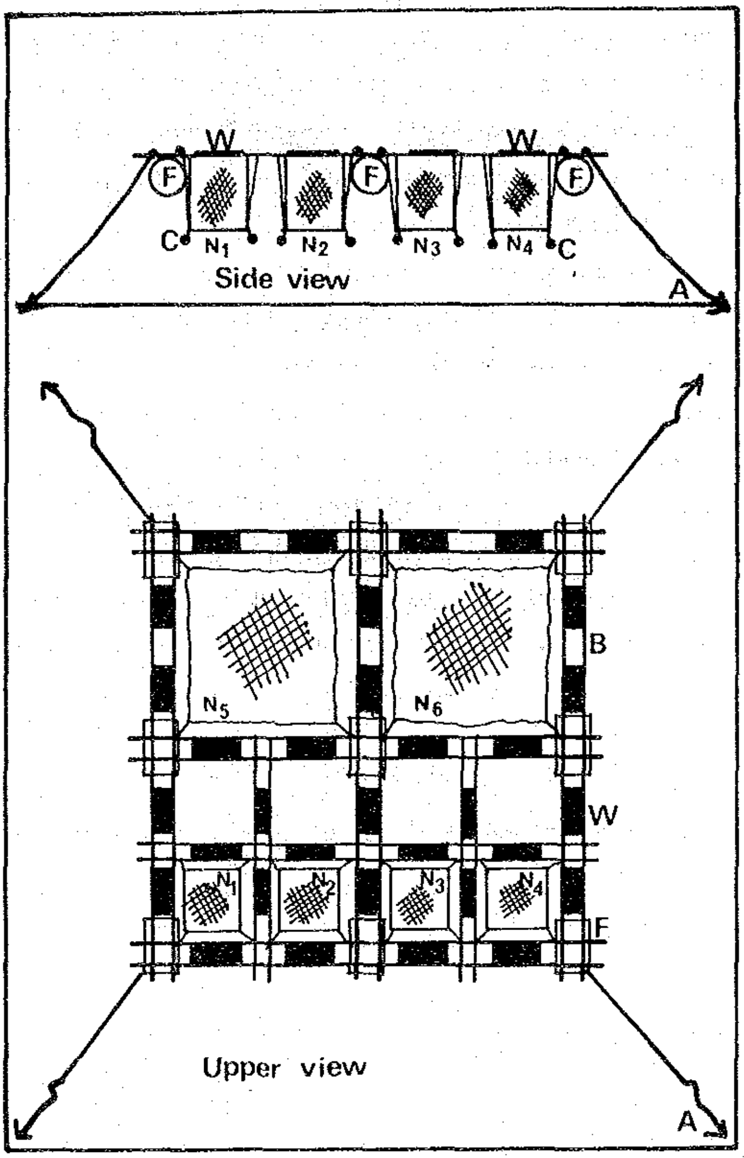
Table 1. Initial data for experimental fish

Food ration (% wet weight of fish)		Size of fish				Number of fish (ind.)
Pre-scribed	Actual (mean ± SD*)	Total length (Cm)		Body weight (g)		
		Mean	SD*	Mean	SD*	
5	5	9.2	0.72	10.9	2.46	60
10	10	9.2	0.80	10.6	2.31	60
15	15	9.0	0.74	10.1	2.10	60
20	19.5 ± 1.03**	9.1	0.82	10.5	2.23	60

* SD = Standard deviation

** During experiment, 20 % food ration was in exess, the amount of food consumed was calculated.

The data collected were analyzed for the mean fish weight, mortality rate, condition factor, net yield, food conversion ratio and food efficiency of the fish. These term are defined as


W
W
F
F
F
C
N1
N2
N3
N4
C
Side view
A
B
N5
N6
W
N1
N2
N3
N4
F
Upper view
A

follows:(Chua and Teng, 1979).

1. Mean fish weight = average weight of fish at time t (g)
2. Mortality rate = $N_o - N_t/N_o \times 100$ (%)
   where N_o = initial total number of fish,
   N_t = total number of fish at time t.
3. Condition factor = $W_t/L_t^3 \times 1000$.
   where L_t = mean total length of fish at time t.
   W_t = mean weight of fish at time t.
4. Net Yield = $B_1 - B_o$
   Where B_t = Biomass of fish in a given period of time
   B_o = Initial biomass of fish.
5. Food conversion ratio = wet weight of food eaten/wet weight gained by fish.
6. Food efficiency = Food conversion ratio^{-1} x 100 (%).

The above growth parameter were test by Analysis of variance (two-way ANOVA without replication) Sokal and Rohlf (1969), Duncan's Multiple Range Test was applied to compere the significant of the mean of the growth parameters among the food ration tested (Gomez and Gomez, 1976).

RESULT AND DISCUSSION

The mean fish weight on 10, 15 and 20 % food ration were significantly higher than those on 5 % food ration ($P \leq 0.01$). The differences amongst the mean fish weight on 10, 15 and 20 % food ration are relatively small ($P \geq 0.01$) (Fig.2).

Highest mortality rate were found on 5 % food ration and lowest in 15 % food ration (Table 2). Increased in food ration from 15 to 20 % resulted higher mortality although food is adequate, this is difficult to explain. According to our observation most of fish died caused by canibalsm. Chua and Teng (1980) olso obserbed that the grouper with less than 15.0 Cm. in total length are canibalism and canibalism seldom observed in fish exeeding 15.0 Cm. in total length.

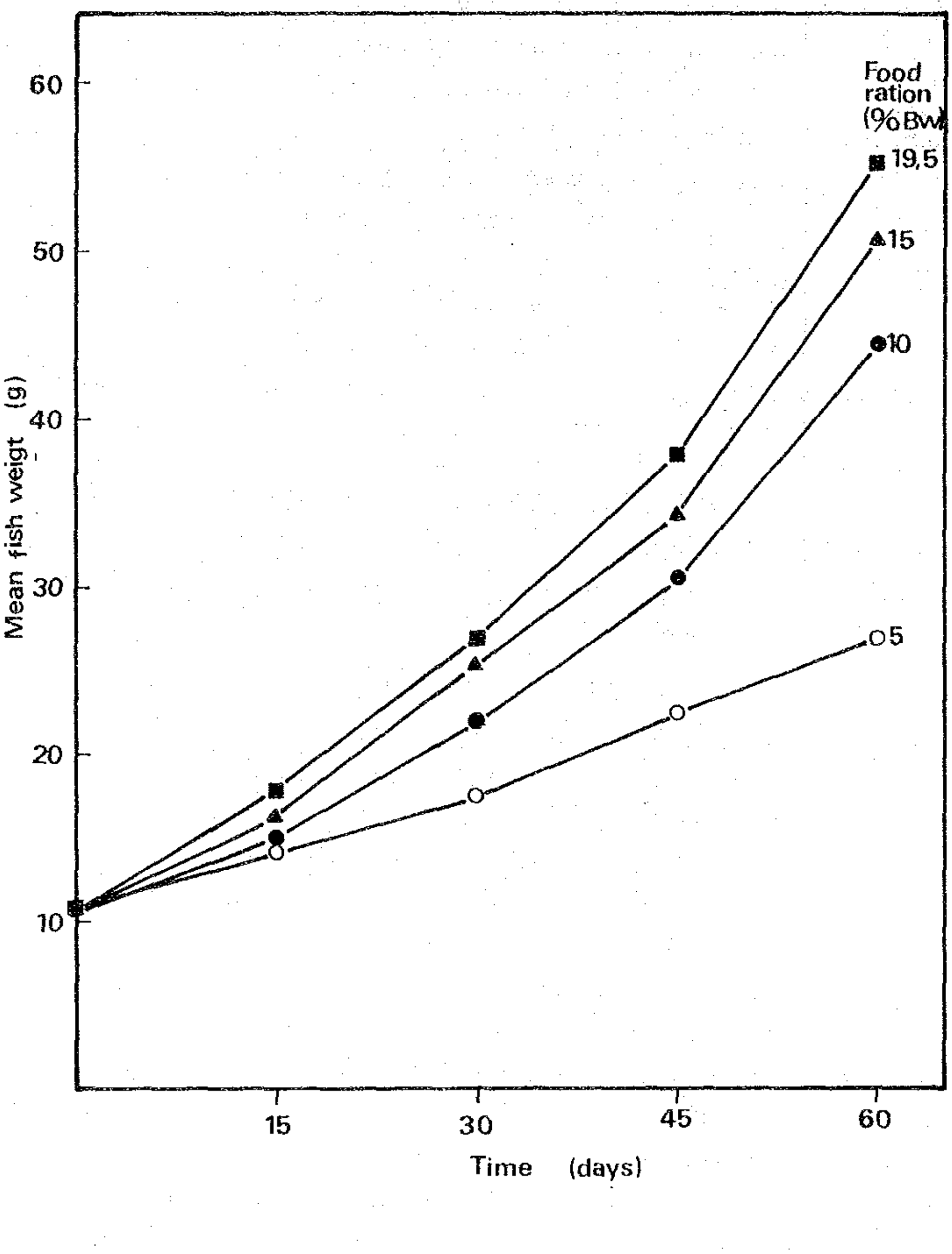

Food ration (%Bw)
19,5
15
10
5
60
50
40
30
20
10
Mean fish weigt (g)
15
30
45
60
Time (days)

Table 2. Mortality rate with different food ration

Time (days)	Food ration (% wet weight of fish)			
	5	10	15	19.5
0	0	0	0	0
15	6.67	1.67	0	3.33
30	6.67	1.67	0	3.33
45	10.00	3.33	0	5.00
60	16.67	5.00	1.67	6.67

The condition of the fish on 10, 15 and 20 % food ratiion increased with time and among them unsignificantly different ($P > 0.01$). Increased in food ration resulted in higher condition factor (Tabel 3.), since the fish grow well when the supply of food is adequate. The condition factor on 2 % food ration decreased consistently with time (Tabel 3), some fish may have lost of weight due to inadequate feeding.

Table 3. The condition factor with different food ratioon

Time (days)	Food ration (% wet weight of fish)			
	5	10	15	19.5
0	13.93	13.79	14.83	13.82
15	13.93	14.89	14.84	14.88
30	13.89	14.92	15.74	15.66
45	13.83	15.93	16.06	16.42
60	13.75	16.23	16.55	16.71

Net yield affected by the amount of food fed to the fish, at the end of of the experiment the net yield much higher at ration 20, 15 and 10 % than 2 % food ration. Yielding 3.10, 3.02, 2.52 and 1.36 Kg per cage respectively.

The ralationship between food conversion ratio, food efficiency and food ration is given in Fig. 3. Each point solid and open is the mean of 15-days measurments with the standar deviation From the curves :

$$Y_1 = 4.9957 - 0.3387\,X + 0.0195\,X^2 \quad (r^2 = 0.9870)$$
$$Y_2 = 23.6246 + 1.2966\,X - 0.082\,X^2 \quad (r^2 = 0.9446)$$

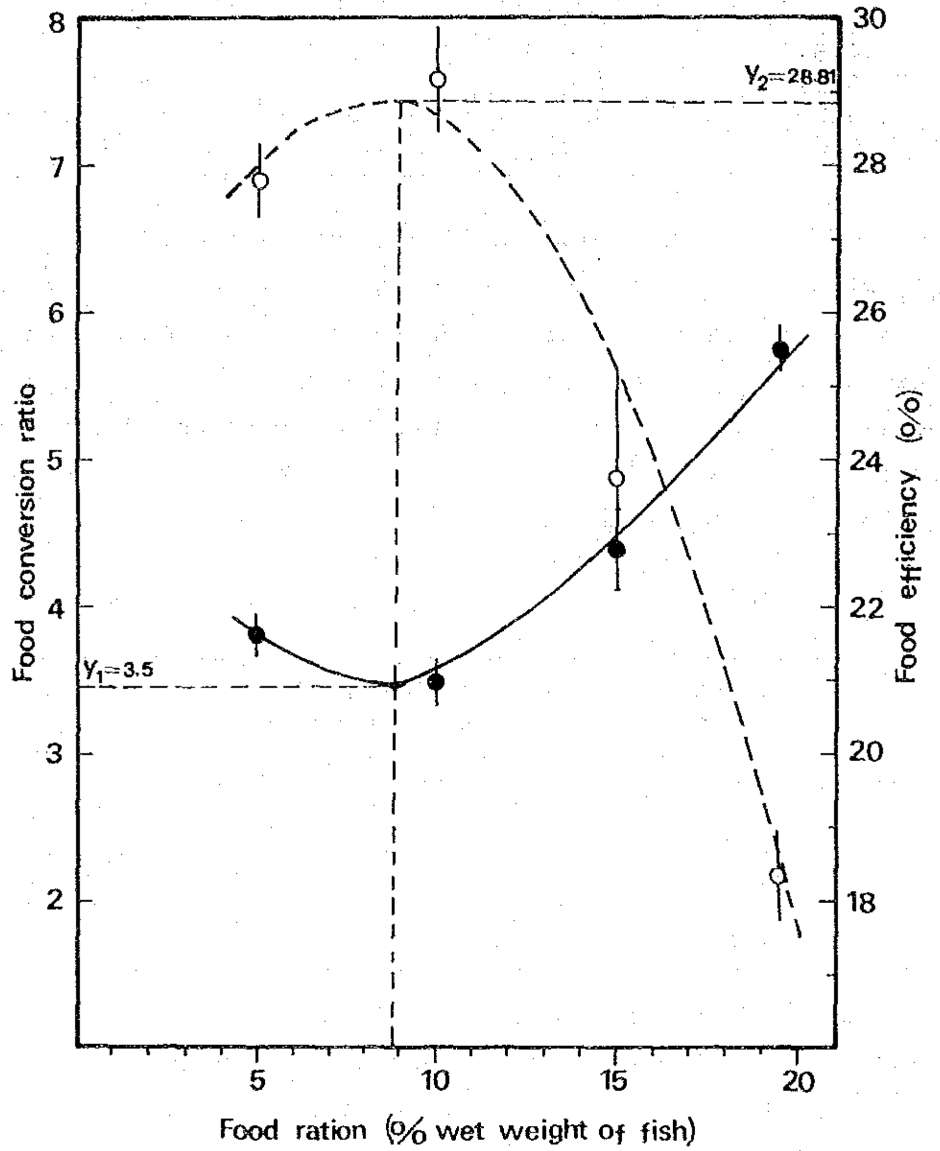
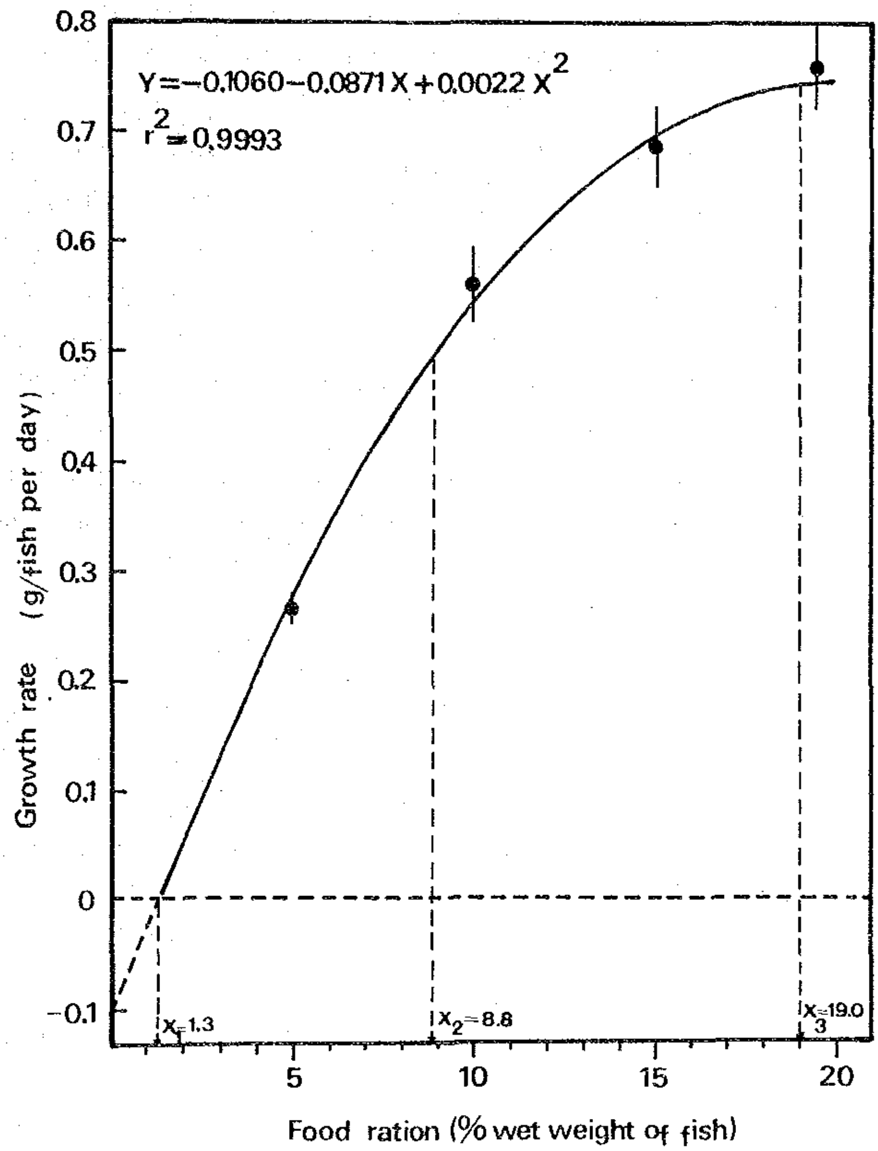


Figure 3. The relationship between the *food conversion* ratio, food efficiency and the food ration


Y=−0.1060−0.0871 X + 0.0022 X2
r2 = 0.9993
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
−0.1
Growth rate (g/fish per day)
X1=1.3
X2=8.8
X3=19.0
5
10
15
20
Food ration (% wet weight of fish)

The average growth rate over two month was much higher in the higher food ration (Fig. 2). The average growth rate (g/fish/day) in relation to different food ration are showen in Fig. 4, there is quadratic relationship. This relationship anables to determine the optimum, maximum and maintenance food ration for the estuary grouper (Chua and Teng, 1982).

Brett et.al. (1969), difined that, the optimum food ration is that ration providing the greatest growth for the least intake of food, and can be determined by drowing tangent to the growth curve from origin. The maximum ration is that ration which give the maximum growth rate and the maintenance ration is that ration which just maintain the fish without any change of weight. In this experiment the optimum, maximum and maintenance food ration of estuary grouper are 8.8, 19.0 and 1.3 % wet weight of fish respectivelly. The optimum ration were determined with the greatest of food efficyency or lowest food conversion ratio (Fig. 3).

In general, daily feeding ratio cultured fish decreasing with increasing size of fish (Harada, 1965; Smith, 1978; and Kafuku and Ikenoue, 1983). It is apperent that both maintenance and optimum food rations vary with size, species and water temperature (Tyler and Dun,1976; Frame, 1972). In Estuary grouper (Epinephelus salmoides Maxwell) the maintenance, optimum and maximum food ration are 1.41, 5.75 and 9.1 % wet weight of fish respectivelly with fish 190.0 - 444.0 g. in weight, fed once in two days (Chua and Teng, 1982). Harada (1965) found that, the maintenance, optimum and maximum food ration of Yellowtail (Seriola quingeradiata) to be respectivelly 2.5, 11.5 and 17.5 % wet weight of fish per day with fish size 66 - 500 g. cultured in floating net cage for water temperature 26.0 - 30.2 ^{o}C. Both the maintenance and optimum food ration in estuary grouper (E. salmoides Maxwell) higher than those recorded for young estuary grouper (E. tauvina Forskal) in this experiment. Although both of them are carnivorous fish. The small fish produce more heat per unit weight than do large fish, so that small fish requied higher food ration than large fish (Smith,1978).

In Yellow tail olso both maintenance and optimum food ration higher than those recorded in this experiment, although Yellowtail is carnivorous fish. The Yellowtail is an active fish while Estuary grouper are inactive. The metabolism of an active fish is high, therefore they requied a greater amount of food to maintenance its body (Smith, 1978).

During experiment, the range of water temperature, salinity, disolved oxygen and pH were 28.5 - 30.5 ^{o}C, 31.8 - 32.9 ppt., 5.6-6.2 ppm and 7.97 - 8.27.

From the result of this experiment and talking into consideration growth rate, food conversion rate, food efficiency, mortality and net yield. For the culturing of estuary grouper, *E. tauvina* Forskal, with 10 - 50 g in weight, the food ration approximatly 8.8 % weight of fish per day which is recomended as a optimal food ration in Banten Bay.

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STUDI PENDAHULUAN PENGARUH PAKAN BUATAN TERHADAP PERTUMBUHAN BENIH IKAN KAKAP MERAH, *Lutjanus altifrontalis* (Chan, 1970) DALAM KURUNG-KURUNG APUNG

Kutut Sugama*, Pramu Sunyoto* dan Hiroki Eda**

ABSTRAK : Percobaan ini dilakukan di Stasiom Penelitian Budidaya Pantai Bojonegara-Serang, dengan tujuan untuk mengetahui pengaruh pakan buatan (pellet pasta)terhadap pertumbuhan benih Kakap merah.

Benih ikan Kakap merah dengan ukuran berat rata-rata 11,05 g. dan panjang rata-rata 8,4 cm, masing-masing sebanyak 102 ekor dipelihara dalam 2 buah kurung-kurung apung yang berukuran 1,0x1,0 x1,5 M. Pada kurung-kurung-I (K-I) ikan diberi pakan pellet pasta dan K-II ikan diberi pakan ikan rucah basah (selar dan teri) sebagai kontrol. Ikan diberi makan 2 kali sehari sebanyak 11 - 20 % berat total tubuh perhari.

Hasil percobaan menunjukkan bahwa, ikan yang diberi pakan pellet Pasta tumbuh lebih lambat dari pada ikan yang diberi pakan ikan rucah basah. Pengaruh kedua jenis pakan terhadap pertumbuhan berbeda sangat nyata ($P<0,05$).

ABSTRACT : Preliminary Study on Effect of Artificial Diet on the Growth of Red Snapper, Lutjanus altifrontalis (Chan, 1970) in the Floating Net-Cages. by Ketut Sugama *, Pramu Sunyoto* and Hiroki Eda**

The experiment was carried out at Bojonegara coastal Aquaculture Research Station. This study was aimed to get information on the effect of artificial diet on the growth of Red Snapper fry cultured in floating net-cages.

Red Snapper fry with an average body weight 11.05 g. and average total length 8.4 cm. were cultured in two floating net-cages (1.0x1.0x1.5)M. at a rate of 102 fish/cage. In cage-I the fishes were fed moisture pellet and cage-II were fed chopped row trash fish. The fishes were fed twice in a day at a rate of 11-20 % total body weight/day.

The result of this study showed that, the fishes fed with moisture pellet grew slower than fed with chopped row trash fish and were statisticaly significant different ($P<0.05$).

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PENDAHULUAN

Ikan Kakap merah, Lutjanus altifrontalis Chan, 1970, merupakan salah satu jenis ikan laut yang mempunyai nilai ekonomis penting, dipasarkan dalam bentuk segar maupun sebagai produk olahan (Anonymous, 1979).

Pemeliharaan jenis ikan ini sudah dilakukan sejak tahun 1983 dengan melakukan percobaan pembesaran dalam kurung-kurung apung dengan diberi pakan ikan rucah basah seperti teri (Stolephorus spp.), selar (Selaroides sp) dan Tembang (Sardinella spp.) di perairan Teluk Banten (Sugama, 1983).

Chua dan Teng (1979), mengemukakan bahwa, pertumbuhan ikan yang dipelihara dalam kurung-kurung apung dipengaruhi oleh beberapa faktor diantaranya; lingkungan perairan, padat penebaran, ukuran ikan pada awal pemeliharaan, mutu dan jumlah pakan yang diberikan. Dalam usaha budidaya ikan, salah satu cara yang diterapkan untuk mempercepat pertumbuhan dan meningkatkan produksi adalah memperbaiki mutu pakan dengan membuat formulasi pakan yang harganya relatif lebih murah (Coche, 1976) dan (Huet, 1979).

Dalam tulisan ini disajikan hasil percobaan pemeliharaan ikan Kakap merah dengan diberi pakan pellet dalam bentuk pasta (moisture pellet) dan ikan rucah basah sebagai pembanding (kontrol). Percobaan ini bertujuan untuk memperoleh informasi tentang pertumbuhan ikan Kakap merah yang diberi pakan buatan.

BAHAN DAN METODA

Percobaan ini dilakukan di Stasion Penelitian Bojonegara Serang pada bulan Mei - Agustus 1985.

Benih ikan Kakap merah, Lutajus altifrontalis, Chan 1970, yang digunakan dalam percobaan ini di tangkap di perairan Teluk Sekantung yang banyak ditumbuhi rumput laut (Enhalus spp.). Alat tangkap yang digunakan untuk mengumpulkan benih ikan ini adalah jaring pantai (beach seine). Ikan yang baru tertangkap dari alam dipelihara selama beberapa waktu dalam kurung-kurung apung sehingga terbiasa pada kondisi tersebut. Setelah terbiasa baru digunakan untuk percobaan.

Dalam percobaan ini digunakan 2 buah kurung-kurung yang masing-masing berukuran 1 x 1 x 1,5 M. dengan ukuran mata jaring 0,8 cm. Volume air dalam kurungan yang selalu terendam di air sekitar 1 M^3. Masing-masing kurungan ditebar sebanyak 102 ekor benih ikan dengan berat rata-rata 11,05 gr. dan panjang total rata-rata 8,4 cm. Pada kurung-kurung I (K-I) ikan diberi pakan pellet ikan mas dalam bentuk pasta (P-I) dengan kandungan protein 40,0 %, lemak 4,5 %, karbohidrat 2,0 %, abu 14,5 %, Ca 3,0 % dan P 2,0 % (hasil analisa pabrik pembuat pellet tersebut, PT BINA SATWA). Pada kurung-kurung II (K-II) ikan diberi pakan ikan teri (Stolephorus spp.) dan selar (Selaroides sp) basah yang telah disimpan dalam alat pendingin pada suhu - 20 ^{o}C (P-II), dan dipotong-potong sesuai dengan lebar mulut ikan. Ikan diberi pakan 2 kali sehari, sekitar jam 9^{oo} dan 17^{oo}, sebayak 11 - 20 % berat total tubuh perhari.

Pengukuran panjang dan berat ikan percobaan dilakukan setiap dua minggu dengan mengukur sebanyak 30 ekor ikan contoh. Sebagai data penunjang dilakukan pula pengukuran lingkungan perairan seperti suhu, kadar garam, pH dan oksigen terlarut dalam air.

Data-data yang terkumpul selama penelitian digunakan untuk menghitung berat rata-rata, kenaikan berat, produksi, konversi makanan, faktor kondisi (fatness) dan kematian dengan rumus-rumus seperti yang telah dikemukakan oleh Chua dan Teng (1978). Untuk membandingkan perbedaan pengaruh jenis pakan tersebut diatas terhadap parameter-parameter pertumbuhan digunakan analisa variance Anova dua arah tanpa ulangan (Sokal dan Rohlf, 1969).

HASIL DAN PEMBAHASAN

Hasil percobaan menunjukkan bahwa, pertumbuhan ikan Kakap merah yang diberi pakan pellet pasta (P-I) lebih lambat dari pada ikan yang diberi pakan ikan teri, selar (P-II). Selama percobaan berat-rata-rata ikan pada perlakuan P-I selalu lebih rendah dari pada P-II (Gambar 1) dan menunjukkan perbedaan yang sangat nyata ($P<0,01$)

Tabel 1. Kenaikan berat, produksi bersih, konversi makanan dan kematian ikan Kakap merah, Lutjanus altifrontalis dengan pakan yang berbeda.

Table 1. Weight gain, net yield, food conversion ratio and mortality of Red Snapper, Lutjanus altifrontalis with different diet.

Bagian (Item)	Jenis pakan (Diet)	
	Pellet pasta (P-I) (Moisture pellet)	Ikan basah (P-II) (Row fish chopped)
Kenaikan berat (g) (Weight gain)	50,76	90,71
Produksi bersih (Kg/M^3) (Net yield)	4,25	8,66
Konversi makanan (Food conversion ratio)	6,76	4,64
Kematian (Mortality)	14,71	11,74

Pada akhir percobaan kenaikan berat rata-rata pada perlakuan P-I dan P-II adalah 50,76 dan 90,71 g. (Tabel 1), hasil ini menunjukkan bahwa, kenaikan berat rata-rata pada perlakuan P-II 192 % lebih tinggi dari pada perlakuan P-I.

Produksi bersih dinyatakan dalam berat total ikan persatuan kurungan (Kg/M^3) dalam periode tertentu dikurangi berat total awal pemeliharaan (Coche, 1976). Dalam percobaan ini produksi bersih pada perlakuan P-I dan P-II disajikan dalam Gambar 2. Pada akhir percobaan produksi bersih pada perlakuan P-I dan P-II adalah 4,25 dan 8,66 Kg/M^3 (Tabel 1). Hasil ini berbeda sangat nyata yang mana produksi bersih pada perlakuan P-II 204 % lebih tinggi dari pada perlakuan P-I ($P < 0,05$)

Konversi makanan pada perlakuan P-I berkisar antara 4,90-8,65 (rata-rata 6,76) dan pada perlakuan P-II berkisar antara 3,49-5,39 (rata-rata 4,64) (Gambar 2 dan Tabel 1). Hasil ini berbeda sangat nyata ($P < 0,01$).

Faktor kondisi (kegemukan) ikan selama percobaan menunjukkan bahwa, pada perlakuan P-I lebih rendah dari pada perlakuan P-II

(Gambar 2) dan berbeda sangat nyata ($P \leq 0,01$). Dengan demikian dapat dikatakan bahwa, ikan pada perlakuan P-I lebih kurus dari pada perlakuan P-II.

Kematian ikan selama percobaan disajikan dalam Gambar 2. Hasil ini menunjukkan bahwa, kematian ikan pada perlakuan P-I lebih besar dari pada perlakuan P-II ($P \leq 0,01$). Pada akhir percobaan kematian ikan pada perlakuan P-I dan P-II adalah 14,71 dan 11,74 % (Tabel 1).

Selama percobaan dilakukan suhu air berkisar antara 28,7-30,1 ^{o}C, kadar garam antara 30,1-32,2 ppt., oksigen terlarut antara 4,73 - 5,82 ppm. dan pH 7,97- 8,21. Nilai fisika-kimia air ini masih berada pada batas yang tidak membahayakan bagi kehidupan ikan, seperti yang disyaratkan dalam budidaya laut (Yokokawa, 1982).

Pertumbuhan ikan yang dipelihara dalam kurung-kurung apung dipengaruhi faktor biotik dan abiotik (Chua dan Teng, 1979). Diantara faktor tersebut mutu dan jenis pakan yang diberikan secara langsung akan mempengaruhi pertumbuhan, produksi, konversi makanan, faktor kondisi dan kematian ikan. Dalam percobaan ini pengaruh kedua jenis pakan yang diberikan yaitu P-I dan P-II terhadap berat-rata-rata, produksi, konversi makanan, kegemukan dan kematian berbeda sangat nyata (Tabel 2).

Menurut Halver (1976) bahwa, protein merupakan salah satu nutrient yang diperlukan oleh ikan untuk pertumbuhan. Kebutuhan akan protein yang optimal untuk pertumbuhan tidaklah sama pada setiap sepecies ikan. Sebagai contoh kebutuhan optimum protein untuk pertumbuhan optimal pada ikan mas (Cyprinus carpio) adalah 38 % (Ogino dan Saito,1970), eel (Anguilla japonica) 48 % (Nose dan Arai,1972), Channel catfish (Ictalurus punctatus 40 % (Dupree dan Sneed, 1966) dan Estuarine Grouper,(Epinephelus salmoides) 40-50 %. (Chua dan Teng, 1980). Sedangkan menurut Hastings (1976) bahwa, pertumbuhan ikan bukan hanya dipengaruhi oleh kandungan nutrient (Protein, lemak, karbohidrat, vitamin dan mineral) yang memadai dalam pakan yang diberikan, tetapi tergantung pula dengan daya cerna dan kesenangan ikan terhadap pakan yang diberikan.

Tabel 2. Analisa variance (Nilai-F) pengaruh jenis pakan terhadap produksi bersih, berat rata-rata, konversi makanan, faktor kondisi dan kematian ikan Kakap merah.

Table 2. Analysis of variance (F-value) on the effect of diet on the net yield, mean fish weight, food conversion ratio, fatness and mortality of Red Snapper.

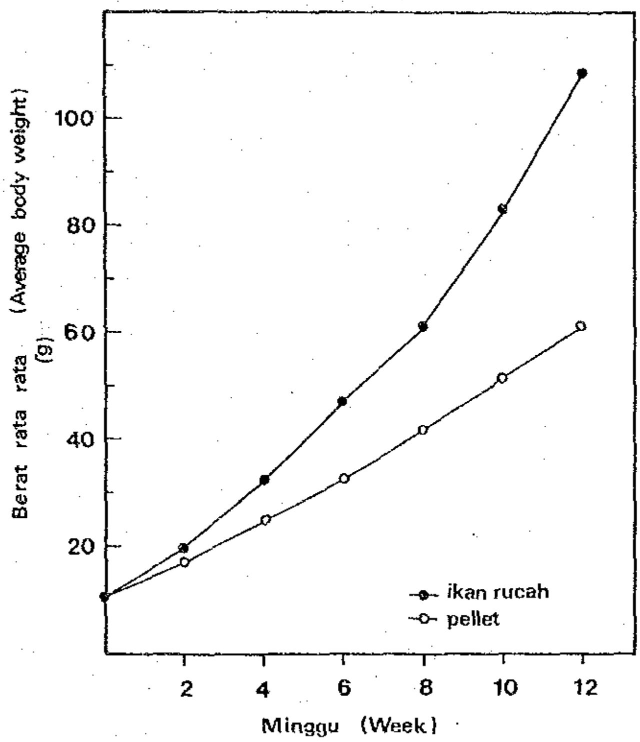
	Produksi bersih (Net yield)	Berat rata-rata (Mean weight)	Konversi makanan (FCR)*	Faktor kondisi (Fatness)	Kematian (Mortality)
Pakan (Diet)	12,65**	69,10**	21,08**	25,25**	35,97**

*) Food conversion ratio. **) $P<0,01$

Dilihat dari kandungan protein kedua jenis pakan yang digunakan dalam percobaan ini yaitu pellet pasta mengandung 40 % protein sedangkan ikan rucah basah (teri, selar) mengandung 16,65-18,75 % protein (Chua dan Teng, 1978), namun hasil percobaan menunjukkan bahwa, jenis pakan ikan basah berpengaruh lebih baik terhadap pertumbuhan ikan Kakap merah. Hal ini mungkin disebabkan oleh kebiasaan makanan ikan Kakap merah di alam, yamg mana menurut Anonymous (1977) bahwa, ikan ini di alam memangsa crustacea, invertebrata dan ikan hidup (carnivora). Kemungkinan lain adalah pellet pasta yang digunakan dalam percobaan ini kurang dapat dicerna oleh ikan, hal ini sesuai dengan pendapat Hasting (1976) tersebut diatas.

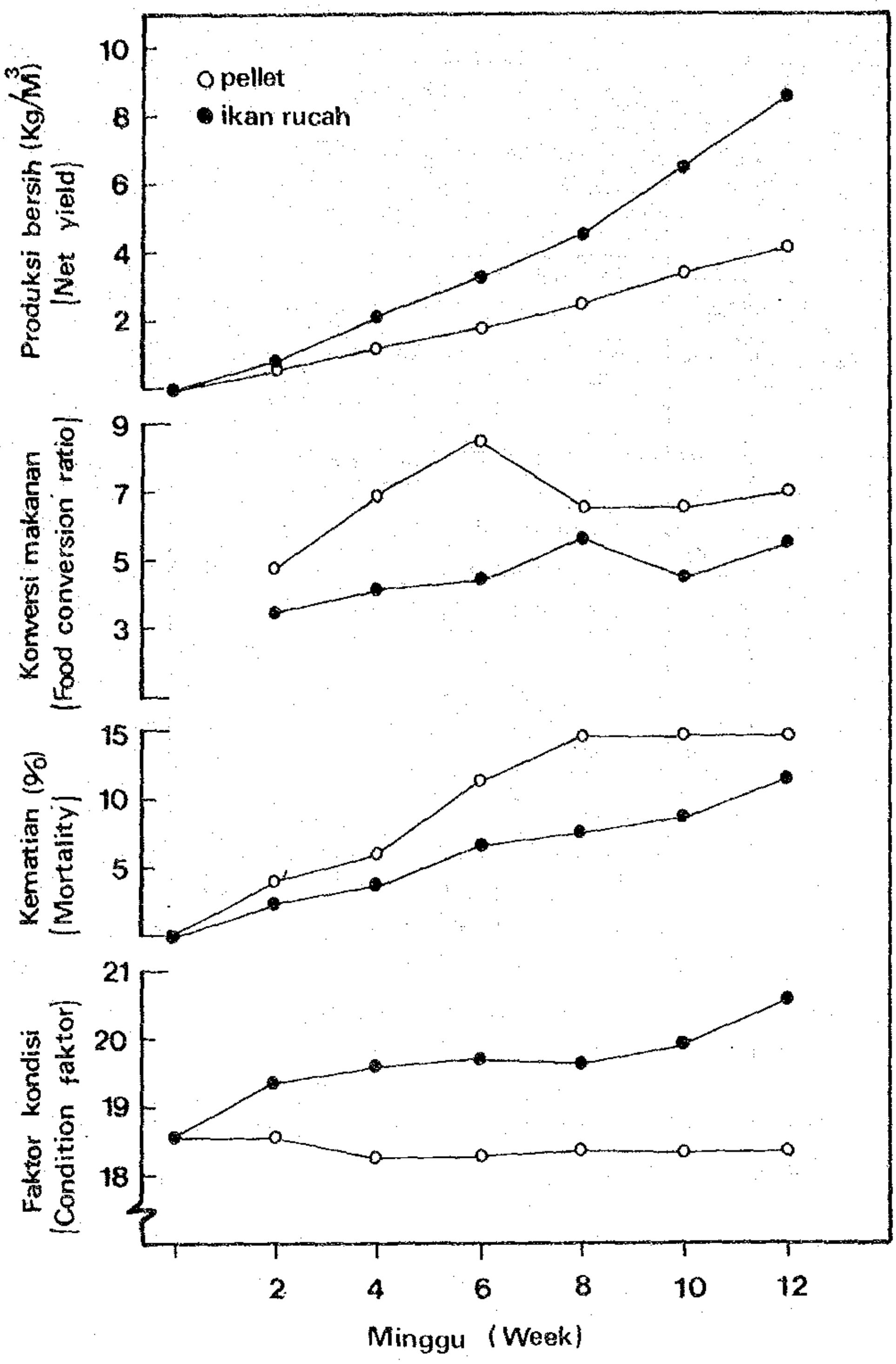
KESIMPULAN

Dari hasil percobaan ini dapatlah disimpulkan bahwa, benih ikan Kakap merah yang diberi pakan pellet pasta dengan kandungan protein 40 % tumbuh lebih lambat dari pada yang diberi pakan ikan rucah basah seperti selar dan teri.



Gambar 1. Berat ikan rata-rata pada pemberian pakan yang berbeda selama percobaan.

Figure 1. Average body weight with different kind of food carried out during experiment.



Gambar 2. Faktor kondisi, kematian, konversi makanan dan produksi bersih pada pemberian pakan yang berbeda selama percobaan.

Figure 2. Condition factor, mortality, food conversion and net-yield with different kind of food carried out during experiment.

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SALINITIES TOLERANCE ON SHORT NECKED CLAM
(*Ruditapes philipinarum*)

Marukus Juli Purwanto*

ABSTRACT : Experiment on the salinities tolerance of Short Necked Clam (Ruditapes philipinarum) had been conducted under laboratory conditions. The clams (7.9 g in body weight) were cultured under six levels of salinities namely 2, 5, 10, 15, 20 and 30 ppt. The treatments were duplicate. This experiment were conducted in constant temperature of 15 ± 1^{0}C.

The result showed that the clams began to die on third day. No salinities tolerance occured at 2, 5 and 10 ppt. On 15 ppt of salinity, after five days their mortality were stable (17.5%) until the experiment period of 12 days. No mortality has occured on 20 and 30 ppt.

ABSTRAK : Toleransi Salinitas Terhadap Short Necked Clam (Ruditapes philipinarum).

Pengamatan toleransi salinitas terhadap Short Necked Clam (Ruditapes philipinarum) telah dilakukan di Laboratorium. Kerang ini dipelihara pada suhu 15 ± 1^{0}C dengan salinitas yang berbeda (2, 5, 10, 15, 20 dan 30 ppt).

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*) Research Station for Coastal Aquaculture (Sub Balai Penelitian Budidaya Pantai) Bojonegara, Serang, INDONESIA.

Kerang uji mempunyai berat rata-rata 7.9 gram per ekor.

Hasil pengamatan menunjukkan bahwa kerang mulai mati pada hari ketiga. Kerang ini sama sekali tidak menunjukkan toleransi terhadap salinitas 2, 5 dan 10 ppt. Pada salinitas 15 ppt mortalitasnya tetap 17.5% setelah hari ke-5. Pada salinitas 20 dan 30 ppt tidak dijumpai kerang yang mati selama 12 hari pengamatan.

INTRODUCTION.

In Japan, asari or short necked clam (*Ruditapes philipinarum*) is one of the shellfishes which has been exploited since long time ago. KAN-NO and HAYASHI (1971), reported that asari production was occupied second rank in Japan's Shellfish production. In 1969, the production was 116.572 tons, while the production of oyster (*Crassostrea gigas*) was 245.458 tons.

SCHINK *et al.* (1983), demonstrated that the clams are living in habitats such as fresh, brackish and sea water environments in various substrate types from the upper intertidal zone to the abyss. ANDERSON *et al.* (1982), found that asari usually survives and grows well at a higher tide level in Puget Sound, USA. In Japan, this clam is found widely and in abundance in shallow inlets or gulfs (Ohba, 1959). NICOL (1960), reported that intertidal zone has diversity of habitats and range of physical conditions. Salinity is one of the environmental variable condition, as large variations of salinity occur in the intertidal zone. Spring tide and tidal ebb are subject to considered fluctuations in salinity.

Asari which lives in intertidal zone are endevour to against the fluctuation of salinities. So, there are a range of suitable salinity for their life, which one they can tolerate in either low or high salinity.

This study wants to know the limitation of salinity for them. It is important to secured farming ground to enlarge exploitation.

MATERIAL AND METHOD.

This study was conducted at Nansei Regional Fisheries Research Laboratory, Hiroshima, Japan. Clams of 7.9 gram in body weight (32.5 mm in shell length) were collected from Hiroshima bay, Seto Inland Sea. Clams cultured under different salinities (2, 5, 10, 15, 20 and 30 ppt) in 2 litres containers at a density of 10 ind. per litre. The containers were kept in the constant water temperature of 15 ± 1^{O}C.

Water exchange was done every day. Aeration was provided using glass pipe during experiment. Observation of opening-shell rate, moribund and decease were conducted daily. The moribund and unhealthy clams were examined by thrusting a soft needle to a part of their flesh. Dead clam shows no reaction. But moribund and unhealthy clams shows weak reaction as the response. The condition of moribund and unhealthy clams are shown in Fig-1.

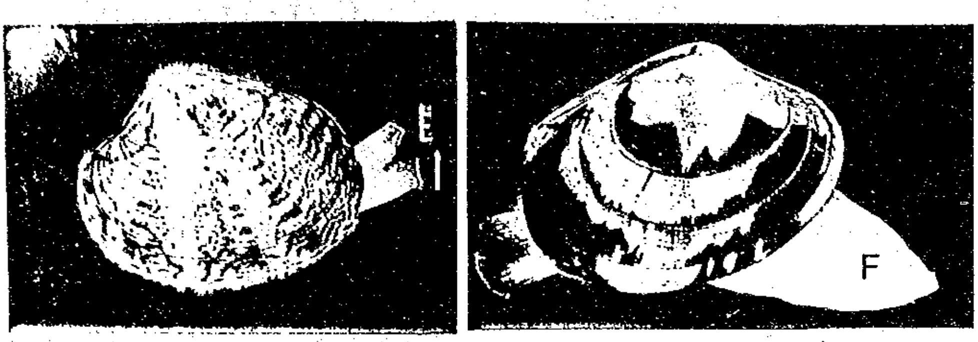

Figure-1. Moribund and unhealthy condition of Short Necked Clam (Ruditapes philipinarum).
I : Inhalent siphon, E : Exhalent siphon
F : Foot.

Gambar-1. Keadaan mati dan tidak sehat dari kerang Ruditapes philipinarum.

RESULT AND DISCUSSION.

The percentage of opening-shells and mortality rates of those cultured under six level of salinities are shown in Fig.-2. Group of clams cultured under 2, 5 and 10 ppt of salinity were closed their shells during 12 days of experiment. While clams cultured in 20 and 30 ppt were opening their shells continuesly. It was found that environment condition was suitable for their life.

On salinity of 15 ppt, some animals opened their shells for initial three days, 2.5% on first day and 5% on third day and then gradually increased.

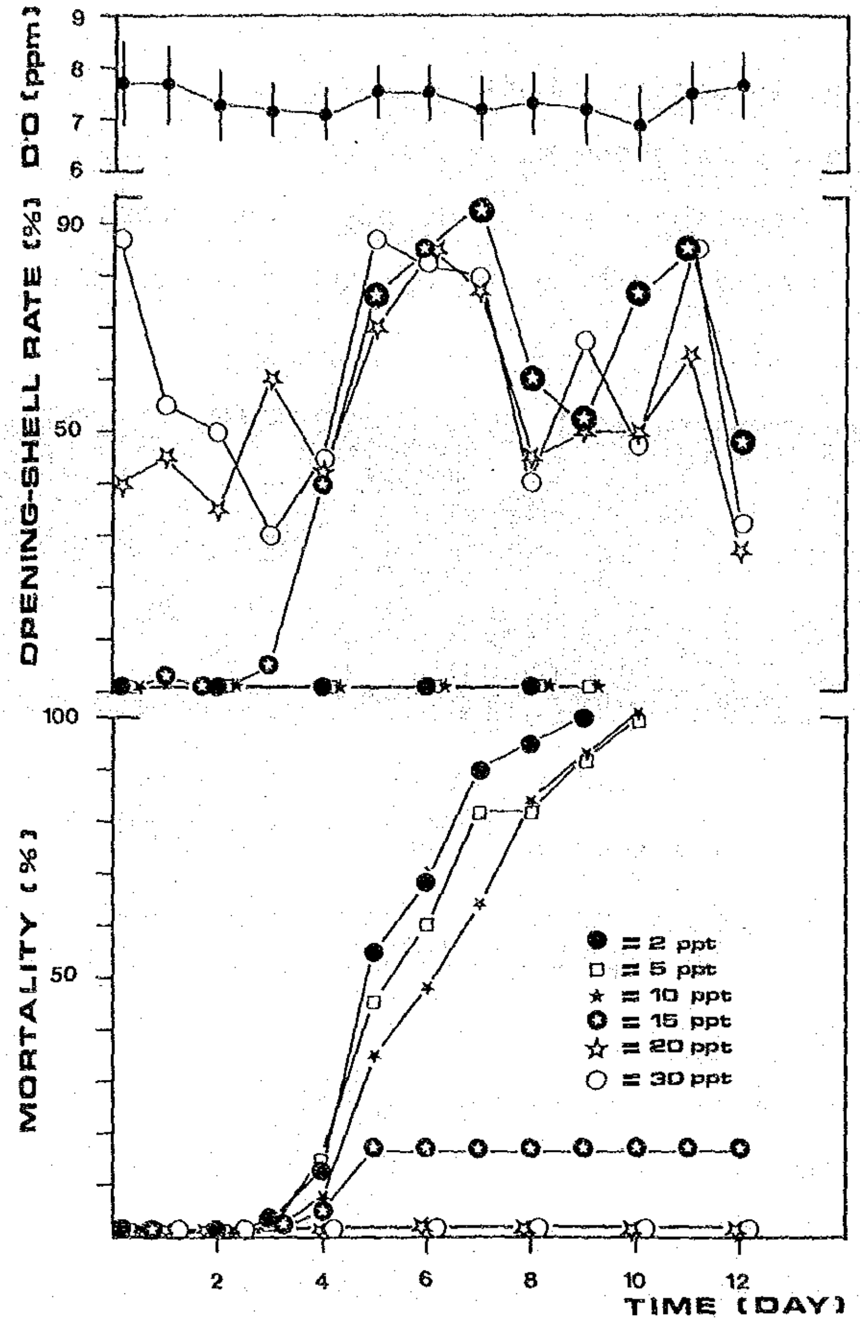

Figure-2. Mortality and opening-shell rates of short-necked clam (*Ruditapes philipinarum*) cultured under different salinities at 15 °C.

Gambar-2. Tingkat mortalitas dan persentase cangkang terbuka kerang *Ruditapes philipinarum* yang dipelihara pada salinitas berbeda pada suhu 15° C.

So, they needs time to adapt themselves to the lower salinity condition. ROBERTSON (1964), reported that marine bivalves often close their valves tightly when placed in dilute sea water or fresh water and prolong their period of disequilibrium. Mytilus spp. on salinity of 20 ppt became isosmotic within four to five days and equilibrium was rapid when the valves were opened. In Fig.-2, they tended to open their shells on third day and then gradually increase rapidly. The maximum number has reached on seventh day (94%).

On 20 and 30 ppt, their valves were opening continuesly until experiment period of 12 days. The maximum number has reached on sixth day (85%) and fifth day (87%) and one week later again. There were periodicity of opening-shell for them on suitable environment condition as mentioned by FUJII (1979), that Japanese Short Necked Clam opened shell in about seven days interval.

Mortality had occured gradually on 2, 5 and 10 ppt of salinity three days after cultured. Their valves often closed tightly nevertheless they needs to exercise respiration. ROBERTSON (1964), demonstrated that oxygen consumption of aquatic animals was usually found to be influence by the salinity of the medium. Mytilus edulis and Mytilus galloprovincialis showed decreases in oxygen consumption in dilute sea water. So, they became in a weak condition because lacking of oxygen. When their valves were opened for exercise respiration there were water current flows to mantle cavity and they open out their syphons, especially inhallent syphon which was water through in. Osmoregulation has occured in their body fluids. They were in moribund condition, open their shells, frown their mantle and put out their foot and then no reaction absolutely to response a stimulation. They completely died on nineth day for 2 ppt and tenth day for 5 and 10 ppt of salinity.

In the case on salinity of 15 ppt, we has found slimy condition in medium during three to four days after cultured. It was evidence that these clams reacted to against abnormal environment, until they became isosmotic. Some animals could not tolerate and died during three to four days. On fifth day, no mucous or slime were found in the medium. It means all animals can tolerate and living in. The constant mortality has reached until the experiment priod of twelveth day were 17.5%.

Thus, it is appear that 15 ppt of salinity is border of salinity tolerance for Short Necked Clam (Ruditapes philipinarum). HIGGENS (1969), reported that Manila clam (Ruditapes philipinarum) can tolerate salinities at least as high as 35 ppt and as low as 13.5 ppt for period of fourty days. BARDACH et al.(1972), reported that the optimum salinity ranged for Manila clam's growth between 24 and 32 ppt.

CONCLUSION.

Diluted sea water, 2, 5 and 10 ppt of salinity are not recommended for living media of Short Necked Clam (Ruditapes philipinarum). All animals died completely on nine to ten days, whereas no mortality has occured on 20 and 30 ppt of salinity during twelve days of experiment period.

On salinity of 15 ppt all animals has adapted to the environment condition on fifth day. Their mortality became constant, 17.5% until 12 days of experiment period.

ACKNOWLEDGEMENTS.

We would like to thanks to Dr. Osamu Fukuhara and his staff for their helpful guidance during the course of this study at Nansei Regional Fisheries Research Laboratory, Hiroshima, Japan. Thanks are also express to Mr.E.Danakusumah Msc. for their valuable critics and comments.

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EARLY DEVELOPMENT OF *Crassotrea gigas* AND *Crassostrea iredalei* UNDER DIFFERENT SALINITIES

Markus Juli Purwanto[1), and Masahiro Hosoya[2)

ABSTRACT : In order to select suitable of oyster for commercial culture in Banten Bay, physiological characteristic such as condition of early development under various salinities was observed in laboratory. Three levels of salinities were 18, 27 and 35 ppt used to culture from fertilized egg to D-shape veliger of C. gigas and C. iredalei.

The result showed after one year acclimatization period, early development of japanese oyster (C. gigas) was almost impossible under the natural condition of Banten Bay. They were in abnormal morphogenesis in Trocophore stage and died in D-shape veliger. They were grew well on 18 ppt of salinity.

Local oyster (C. iredalei) was recommended as the suitable species for commercial culture in the bay. Its early development grew well until D-shape veliger has reached on 35 ppt of salinity.

ABSTRAK : Pengamatan perkembangan awal larva tiram, Crassostrea gigas dan Crassostrea iredalei pada beberapa salinitas.

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Untuk menentukan spesies tiram yang cocok di budidayakan di Teluk Banten, telah diamati ciri khas sifat physiologinya dengan jalan pengamatan terhadap kondisi perkembangan awal larva pada beberapa salinitas di laboratorium. Tiga tingkatan salinitas masing-masing 18, 27 dan 35 ppt digunakan untuk membudidayakan dari telur yang terbuahi sampai D-shape veliger terhadap dua spesies tiram yaitu Crassostrea gigas dan Crassostrea iredalei.

Hasilnya menunjukkan bahwa walaupun telah di aklimatisasi selama lebih kurang satu tahun, perkembangan awal larva tiram Jepang (C. gigas) sukar bertumbuh pada kondisi alam Teluk Banten. Pada phase Trocophora mengalami abnormal morphogenesis dan mengalami kematian pada phase D-shape veliger. Akan tetapi mereka bertumbuh baik pada salinitas 18 ppt.

Tiram lokal, C. iredalei merupakan spesies yang cocok untuk di budidayakan di teluk Banten. Perkembangan awal larvanya bertumbuh baik sampai D-shape veliger pada salinitas 35 ppt.

INTRODUCTION.

The existence of spats in natural is very important for oyster culture, and abundance of spats is define by the succesful of early development of oyster larvae. There are many environmental factors can influenced the development of larvae and each species has a characteristic tolerance to the environment.

RAVEN; LOOSANOF AND DAVIS; COLLIER *in* SASTRY (1969), reported that some oceanographic factors such as temperature, salinity and chemicals are affected on the succesful development of embryos to the veliger stage. Normal development of embryos to the veliger stage tended to occur within a range of environment condition depending on the characteristic of a species. If the environment conditions felt beyond the tolerance range, development was followed by either death or abnormal morphogenesis.

Furthermore QUAYLE (1975), stated that temperature in relation to oyater culture is not as important in the tropics as it is in temperate eaters. Salinity is more dominant factor in the tropics particularly in relation to breeding but also to growth.

In this observation, developmental stages of *C.gigas* and *C. iredalei* were observed under different salinities. So, the suitable salinities for the developmental stages was known. This case will be help for propagation of oyster culture.

MATERIAL AND METHOD.

Local oyster (*C. iredalei*) was collected from the es tuary of Cengkok River and Japanese oyater (*C. gigas*) was transplanted from Japan in 1981. They were cultured at Tarahan Island waters using raft method. Oysters were induced spawning by cross stimulation method on October 1982 and fertilized artificially. The early development was observed under three different salinities of 18, 27 and 35 ppt.

Conditions of each developmental stage such as morula, gastrula, trocophore and D-shape veliger stage were observed and presented into three conditions such as, normal, abnormal and dead condition.

RESULT AND DISCUSSION.

Condition of the early development of both oysters are shown in Table-1 and Figure-1.

Table-1. Conditions of early development of *Crassostrea gigas* and *Crassostrea iredalei* at different salinities.

Stage	*Crassostrea gigas*			*Crassostrea iredalei*		
	18 ppt	27 ppt	35 ppt	18 ppt	27 ppt	35 ppt
Morula	N	N	N	N	N	N
Gastrula	N	N	N	N	N	N
Trocophore	N	A	A	A	A	N
D-shape veliger	N	A	D	D	A	N

Notes : N = Normal, A = Abnormal and D = Died.

C. iredalei showed normal development until D-shape veliger stage only at 35 ppt. But they showed abnormal and dead condition in 27 and 18 ppt. This species was

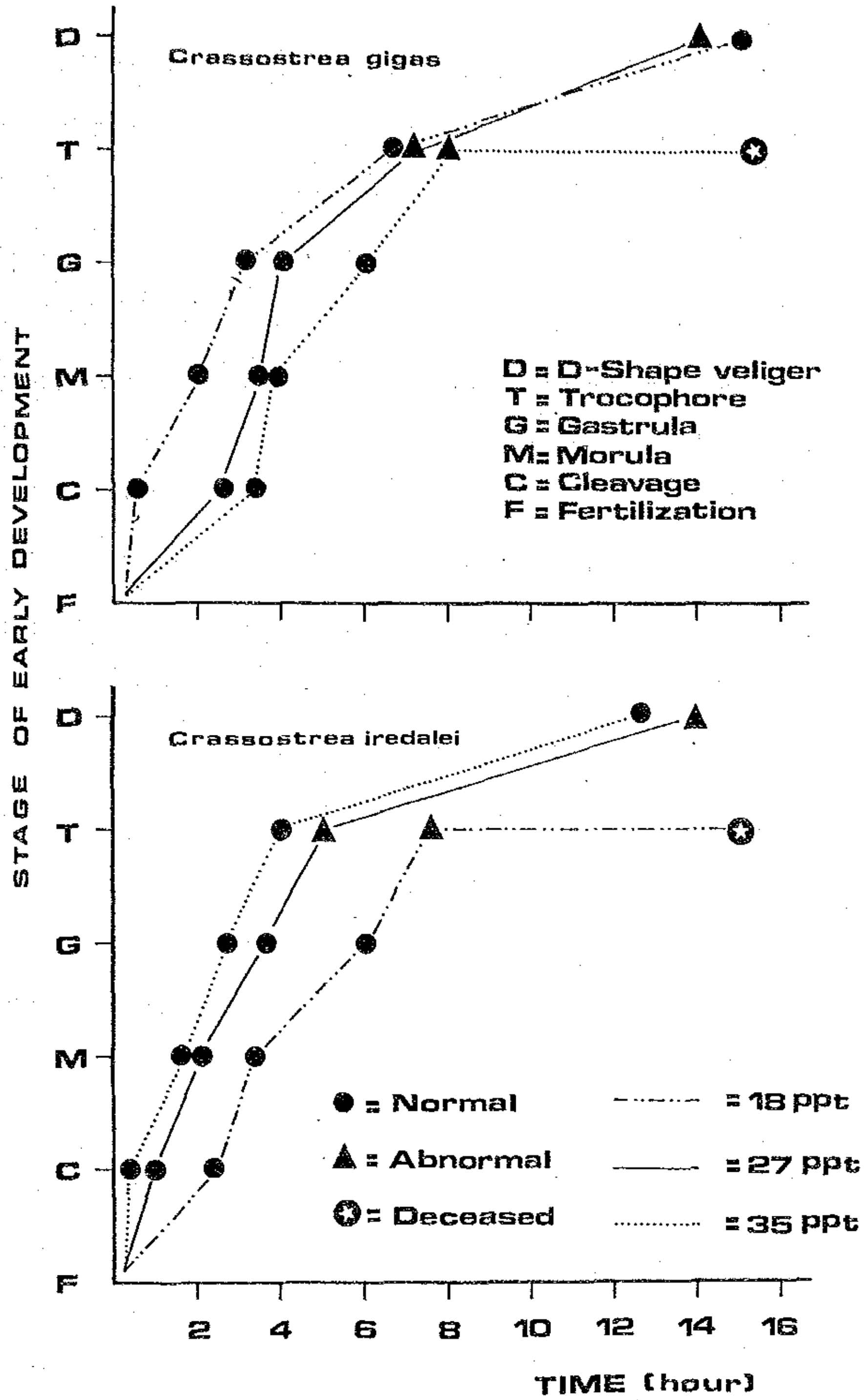

Figure-1. Early development of *Crassostrea gigas* and *Crassostrea iredalei* at different salinities.

Gambar-1. Perkembangan awal larva tiram, *Crassostrea gigas* dan *Crassestrea iredalei* pada beroagai tingkat salinitas.

considered as euryhaline species for its natural bed (estuary). However, high salinity was suitable for their early development rather than low salinity.

C. gigas showed normal development until D-shape veliger stage only at 18 ppt of salinity. But they showed abnormal morphology and dead condition in 27 and 35 ppt. NUMACHI (after FATUCHRI,1981), reported that early development of C. gigas grows normally at salinity of 18 - 28 ppt and water temperature of 20^0 to 25^0C. Also KORRINGA (1976), said that the optimal temperature range for larval development of C. gigas is 23^0 to 25^0C and optimal range for salinity is 23 to 28 ppt. Result showed the same tendency, even after one year acclimatization period in the tropical waters.

Banten Bay is a tropical waters which are no seasonal change of water temperature. The water temperature almost same throughout the year. One of important thing is salinity. HOSOYA AND MUCHARI (1982), reported that fluctuation of salinity in Banten Bay was ranged between 30 to 35 ppt. In this case, early development of C.gigas on natural conditions probably could not be succesful. They could only reach the stage of gastrula and died at the next stage of D-shape veliger. Thus, it will be impossible to collect the spat on natural conditions although spawners are available in the waters.

Early development of C. iredalei showed more tolerance to higher salinity. They can grow normally in Banten Bay.

ACKNOWLEDGEMENT.

We would like to express our thanks to Prof.Dr. Horikoshi and Dr. Kan-no, the short-term experts of the Mariculture Research and Development Project in Serang. Thanks are also express to Mr. Fatuchri MS, Mr. Muchari and Mr. E.Danakusumah Msc. for their valuable critics and comments.

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SURVEY ON THE OCEANOGRAPHICAL CONDITION IN BANTEN BAY, OCTOBER 1979 TO SEPTEMBER 1980

M. Hosoya and M. Nuchari

ABSTRACT

For obtaining fundamental aspect on the environmental conditions for mariculture in Banten Bay, the first survey on seasonal fluctuation of the oceanographical conditions was conducted during the period October 1979 to September 1980.

The survey was conducted twice a month regularly at ten points fixed in the Bay. The data on rainfall were obtained from weather station in Serang. Standard thermometer were used for atmospheric and water temperature. Kitahara water sampler and electric thermometer were used for samplings of the deeper layers. Secchi disk was used for transparency and a colorimeter for pH. A hydrometer and refractometer were used for salinity and current drougues for the current direction.

In the first survey, ordinary rainfall ranged between 66mm and 130mm, but during the period December to April, ranged between 111mm and 420mm. Atmospheric temperature ranged mainly between 28°C to 31°C, falling during the period January to February and in May and August. Water temperature varied from 29°C to 31°C, falling from January to February and in May and August. Transparency ranged between 2m and 4m, falling from January to February and in May and June. PH ranged between 8.1 and 8.4 and fell to the range between 7.9 and 8.0 from February to March.

Salinity varied from 26°/oo to 31°/oo, falling in February.

Main current in the bay changed in Februery and August.

Since Banten Bay is opentype and the current inflow from the open sea seems to control its environmental variation, it is assumed that the environmental conditions of Banten Bay for mariculture are stable as a whole except for a part of the coastal area unlike the tropics.

ABSTRAK

Survei kondisi oceanografy di Teluk Banten dari bulan Oktober 1979 sampai bulan September 1980.

Oleh : M. Hosoya dan M. Muchari.

Survei tahap pertama yang mempelajari kondisi lingkungan oseanografis Teluk Banten, telah dilaksanakan dari bulan Oktober 1979 hingga Seotember 1980.

Survei dilaksanakan dua kali sebulan di sepuluh tempat pengambilan contoh tertentu. Data curah hujan didapatkan dari dinas meteorologi Serang. Pengukuran suhu udara dan air digunakan thermometer standar.

Pengambil contoh air Kitahara dan thermometer elektrik digunakan untuk pengamatan contoh air dalam. Piringan secchi digunakan untuk mengukur kecerahan air sedangkan colorimeter untuk pH. Hydometer dan refraktometer digunakan untuk mengukur kadar garam sedangkan "current drogues" untuk mengamati arah arus.

Hasil pengamatan menunjukkan bahwa curah hujan bulanan umumnya berkisar antara 66mm sampai 103mm, kecuali pada bulan Desember sampai April yang berkisar antara 111mm sampai 420mm. Suhu udara berkisar antara 28°C - 31°C dan rendah pada bulan Januari, Pebruari, Mei dan Agusutus.

Suhu air berkisar antara 29°C - 31°C dan rendah pada bulan Januari, Pebruari, Mei dan Agusutus. Kecerahan air laut berkisar antara 2m - 4m dan rendah pada bulan Januari - Pebruari dan Mei - Juni. PH berkisar antara 8.1 - 8.4 dan turun hingga 7.9 dan 8.0 pada bulan Pebruari dan Maret.

Kadar garam berkisar antara 31°/oo sampi 34°/oo dan rendah pada bulan Pebruari. Perubahan arah arus terjadi pada bulan Pebruari dan Agustus. Teluk banten merupakan sebuah teluk terbuka dan menerima arus laut Jawa yang mengontrol variasi lingkungannya. Hal ini menyebakan kondisi lingkungan di Teluk Banten stabil untuk budidaya laut. Di daerah tropis kondisi perairan pantai seperti ini merupakan suatu hal pengecualian.

INTRODUCTION

Banten Bay is located on the northern coast of Serang,West Java, 90 km west from Jakarta. The Bay is an open-type one facing the Java Sea and its entrance is 16 km wide. The coastal slope is gentle, most of its bottom consists of silt and its depth does not exceed 13 m. Mountains centering on Mt.Gede of 595 m above the sea are on the west coast of the Bay. Other coastal areas are flat and covered with mangroves and fish culture ponds extend over the wide range of its coastal area. Large river such as the Pontang river and the Soge river are on the east coast of the Bay.

Mariculture Research and Development Project has been carried out by the Governments of Indonesia and Japan International Cooperation Agenncy since August 1978 and now research activities on fish and shellfish culture are under way in this Bay. This report is a compilation of the results from the first observation on environmental conditions in Banten Bay which was conducted from October 1979 to September 1980 under this Project.

MATERIAL AND METHOD

The first environmental observation was conducted from October 1979 to September 1980 twice a month periodically for one year. Ten stations were fixed in the bay (Fig.1).

- Rainfalls were referred to the data from Serang meteorological observatory.
- Atmospheric temperature was measured by Yoshino's mercury thermometer, and waters were sampled by a sampling bucket and Kitahara water sampler from the surface to bottom layers.
- Transparency was measured by the conventional method using secchi disk.
- Hydrogen ion concentration (pH) was measured by colorimetric method, while thimol blue and cressol red were used as indicators.
- Salinity was measured by Akanuma hydrometer and American Optical's refractometer.
- Current direction was measured by current drogues and bearing compass.

RESULTS

Rainfall

Monthly rainfall during the period of the observation and the average monthly rainfall of five years 1975 to 1979 in the Serang distric are shown in Fig. 2.

Monthly rainfall was 111 mm to 420 mm in the rainy season (December to April), and 66 mm to 103 mm for the other months. Annual rainfall in this distric during this first observation was as much as 1,850 mm, while that of five years average is 1,332 mm.

Maximum monthly rainfall during the observation was 420 mm in February, 201 mm more than that of five-year average. Narmally maximum monthly rainfall is seen in January.

Atmospheric temperature

Average atmospheric temperature in the Bay from ten stations and its last five year average from 1975 to 1979 in Serang region are shown in Fig.3.

Average atmospheric temperature of the Bay ranged between 28°C and 31°C. The rainy season of January to February showed the lowest temperature of 28°C and lowered in May and August. Temperature of the Bay was higher 2°C to 3°C than that of the inner part of Serang district.

Atmospheric temperature in Serang district was low at around 26°C from December to February and in August, while its ordinary temperature is around 27°C. Temperature in normal years are also low during the same period (Fig. 3).

Water temperature

Seasonal change of average temperature of ten stations in the Bay is shown in Fig. 4. Seasonal changes at each station are shown in Fig. 5.

Horizontal distribution of surface water temperature is shown in Fig. 6.

Seasonal changes of water temperature in the Bay were stable between 29°C and 31°C, while temperature lowered to 28°C in January and February. In May and August it also lowered (Fig. 4).

Water temperature fluctuated sharply at station 1, 2 and 3 of coastal area, and sometimes lowered below 27°C in the rainy season (Fig.5).

Horizontal distribution indicated that water masses of high or low temperature were often appeared at Station 9. The stagnation of water masses was often seen at Station 10.

Transparency

The Annual fluctuation of the average transparencies of ten stations in the Bay and the averages of Stations 1 - 4 of coastal area and stations 5 - 8 of off-shore area are shown in Fig. 7. The annual fluctuation at each station and the horizontal distributions are shown in Fig.8 and 9 respectively.

Transparency of the Bay was stable between 2 m and 4 m. Low transparency was seen from January to February and May to June, i.e: 2.0 to 2.6 m and 2.0 to 2.9 m respectively. Higher transparency of 2.7 to 4.1 m was seen from July to November. Transparency of coastal area was always lower 1 - 3 m than that of off-shore (Fig.7).

High transparency was found in off-shore, but sometimes decreased to 4 m in January-February and May-June. Transparency in Station 10 tend to be a mean value of the coastal and off-shore areas.

Fig. 9 shows that low transparency can be seen on the coastal area and higher transparency around the Panjang Island.

Hydrogen ion concentration (pH)

Annual fluctuation of average pH in the Bay are shown in Fig.10. Annual fluctuation of pH at each station is shown in Fig.11 and its horizontal distributions are shown in Fig. 12.

PH of the Bay is stable between 8.1 and 8.4, while it lowers between 7.9 and 8.0 from February to March (Fig. 10). Station 1, 2, 3 and 9 had a large fluctuation of pH and sometime decreased to below 7.7. Station 1 and 3 frequently showed low values of pH under 8.1. PH of Station 9 often indicates high values of over 8.4 (Fig. 11).

These high or low values of pH sometimes covered in the wide area of the Bay. Those were seen in October, From February to Maech, from April to May and in July (Fig. 12).

Salinity

Annual fluctuations of average salinity in the Bay are shown in Fig. 13. Annual fluctuations of salinity at each station are shown in Fig. 14 and the horizontal distributions are shown in Fig. 15.

Fig. 13 showed that the salinity of the Bay was stable between $31^{\circ}/_{\circ\circ}$ and $34^{\circ}/_{\circ\circ}$. A very low salinity of $26^{\circ}/_{\circ\circ}$ was occured from January to February in the rainy season.

Station 3 often showed have a very sharp fluctuation and also at station 2 (Fig.14).

The horizontal distributions of salinity at the surface layer showed a low value from January to February in the most part the Bay. For the other periods, salinity was stable in the whole bay except Stations 2 to 4, especially, the salinity of Station 3 was variable. Usually Station 3 was representative of low salinity.

Current direction

The current directions in the Bay are shown in Fig. 16. Main current of the Bay changed its direction. The main current flowed from north east to north west during the period of October to January. The change of current occured from Februery to March and it flowed from north west to north east. The change of current occured again from August and it flowed from north east to north west (Fig. 16).

DISCUSSION

Rainfall

The Indonesian archipelagos extend over 5,000 km from east to west, and rainy season varies from island to island. Generally, rainy season sets in during the period from December to March by the west monsoon of the South China Sea, while dry season usually sets in during the period from June to October by the east monsoon from Australia.

From the data of the last five years, the rainy season in Serang distric including Banten Bay is from December to March with the monthly rainfall of over 200 mm or from December to April with the monthly rainfall of over 100 mm.

Rainfall is a great characteristic of the tropics and it seems to influence the transfer of nutriens, the fluctuation of plankton and the migration and spawning of the coastal marine animals. During the observation period, the monthly rainfall of February 1980 was 420 mm doubling that in the normal years. Therefore, it seems to be necessary to put into consideration its influence upon other environmental data.

Water temperature

There is a correlation between water temperature and atmospheric temperature. Atmospheric temperature usually stands between 28°C and 31°C and lowers to 28°C from January to February, while water temperature usually stands between 29°C and 31°C and similarly lowers to 28°C for the same period.

It seems that water mass of high temperature at station 9 is due to the influence of nearby weedy area and it can also effect pH. Stagnant water mass at station 10 seems to occur due to the condition that station 10 is near the central small island of the Bay, which is conditioned topographically to generate whirling currents. Water temperature largely fluctuated at stations 1,2 and 3 on the coastal shallow area near the rivers because of the influence of low atmspheric temperature in the inner area.

Transparency

Transparncy depends on the amount of silt,detritus and plankton. Transparency decreases from January to February in rainy season, which seems to be due to the suspended mud inflows from rivers. Transparency also decreases from May to June, while the environmental conditions are stable, which seems to be due to the propagation of plankton.

Fatuchri, Ismail and Wasilun (1975) mention that low transparency on the east coast of the Bay is due to muddy particles from rivers. The correlation between transparency and plankton should be studied because planktons propagate frequently in this Bay.

Observation on the fluctuation of planktons was initiated in September 1980. The high value of transparency always seen around the Panjang Island is considered to be brought about by the influence of the inflows of the oceanic waters.

Hydrogen ion concentration (pH)

The cause of sharp decrease of 7.9 to 8.0 from Februery to March seems to be due to the inflows of fresh water in the rainy season. Rivers flowing in the area of laterite often show acidity. The value of pH decrases on the coastal areas of the Bay in October, February to March, April to May and in July, which seems to be due to fish culture ponds and tennin of decomposed branches of nearby mangrove.

High value of pH recorded at Station 9 is considered that the station is near the weedy area, Temperature is liable to rise and it is also due to photosynthesis of sea weeds. PH of the whole Bay except for coastal area is stable between 8.1 and 8.4 and the big change is not recognized. PH of the midle layer water seems more stable than that of the surface water.

Salinity

Sharp drop to 26°/oo of salinity which occurred from January to February seems to be due to heavy rainfall. Station 3 was most influenced because of the inflow of the Soge river. Salinity of the whole Bay usually stands stable between 31°/oo and 34°/oo.

Current direction

It is known that the current of Sunda Strait near Banten Bay always flows from the Java Sea to the Indian Ocean because of the difference of water level. The tidal current flowing into Banten Bay, which has the current direction converted, can be assumed as a branch of this main current flowing from east to west. Observation of this current was not conducted in detail but strong current flows at station 5 and 8 in the off-shore. This current seems to give agreat influence upon the environments in the Bay. Therefore, it is desireble to make a close survey on the water movement of the whole Bay including tidal currents.

CONCLUSION

The inflow of river as well as fish culture ponds and mangroves is one of important factors that influence the surroundings such as pH, salinity, transparency and others. Banten Bay is an open-type bay with strong current inflows from the open sea, which seems to control environmental conditions of Banten Bay. From the result of this survey, the environmental conditions are stable except for the part of the coastal area. Therefore, the area of Banten Bay seems to be suitable for mariculture.

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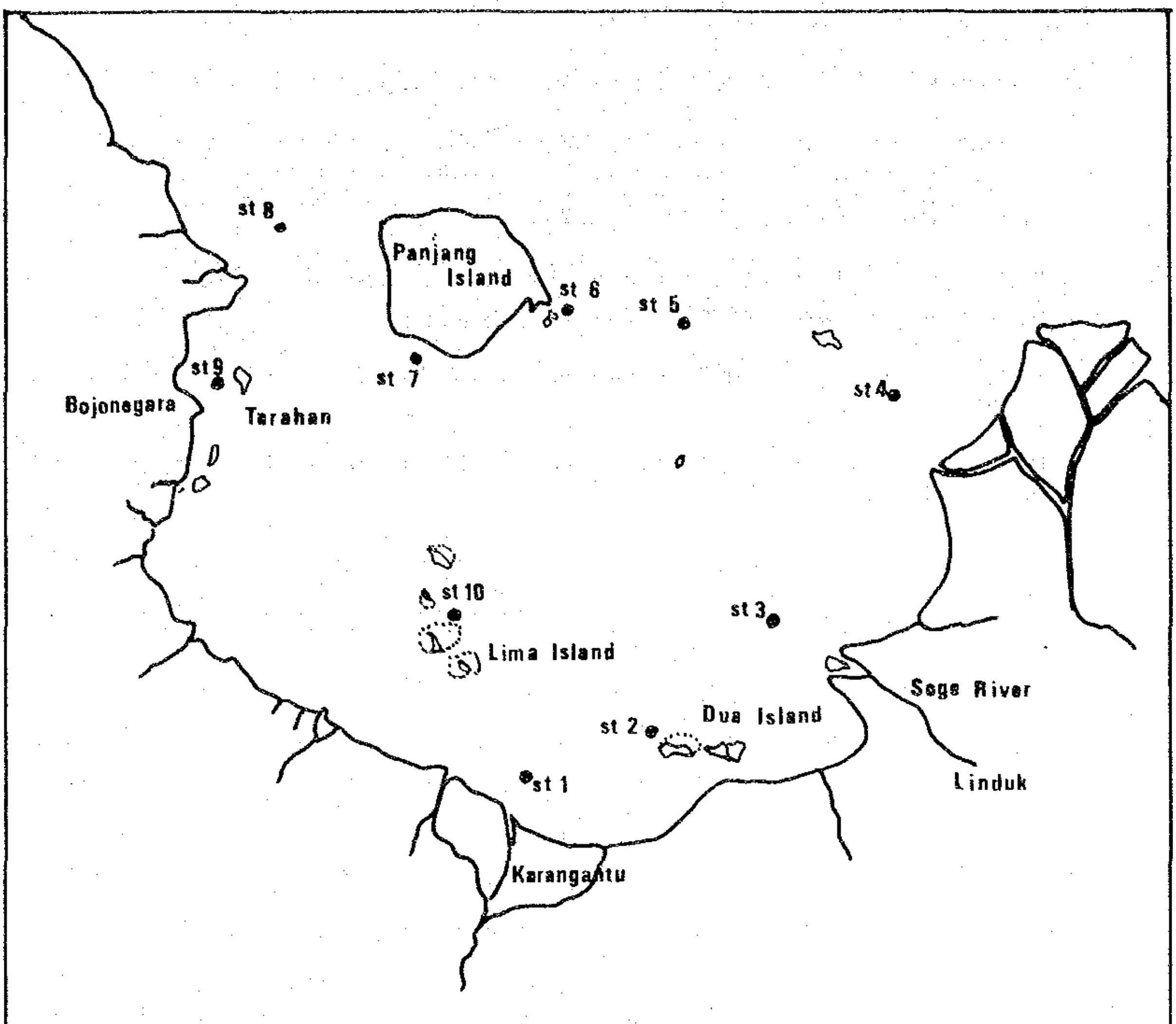


Stations	Latitude	Longitude
1	06° 01′ 15″ S	106° 09′ 54″ E
2	06° 00′ 37″ S	106° 11′ 28″ E
3	05° 59′ 31″ S	106° 13′ 11″ E
4	05° 57′ 14″ S	106° 13′ 44″ E
5	05° 56′ 12″ S	106° 11′ 49″ E
6	05° 56′ 24″ S	106° 09′ 51″ E
7	05° 56′ 49″ S	106° 08′ 51″ E
8	05° 55′ 23″ S	106° 07′ 28″ E
9	05° 57′ 06″ S	106° 06′ 35″ E
10	05° 59′ 20″ S	106° 09′ 27″ E

Fig.1. Banten Bay and the location of observated stations

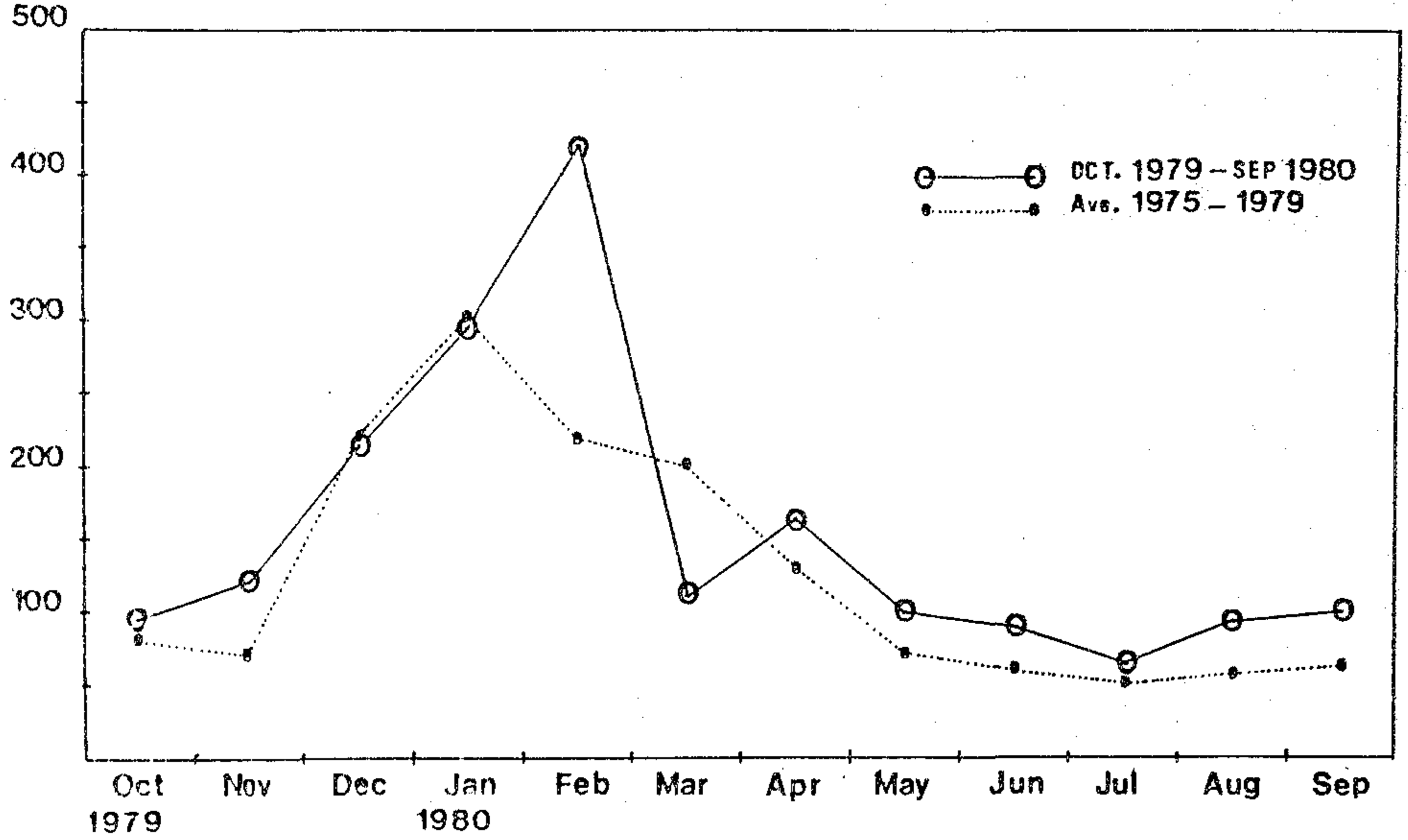


Figure 2. Seasonal change of monthly rainfall (mm) in Serang, Oct.1979 – Sep.1980

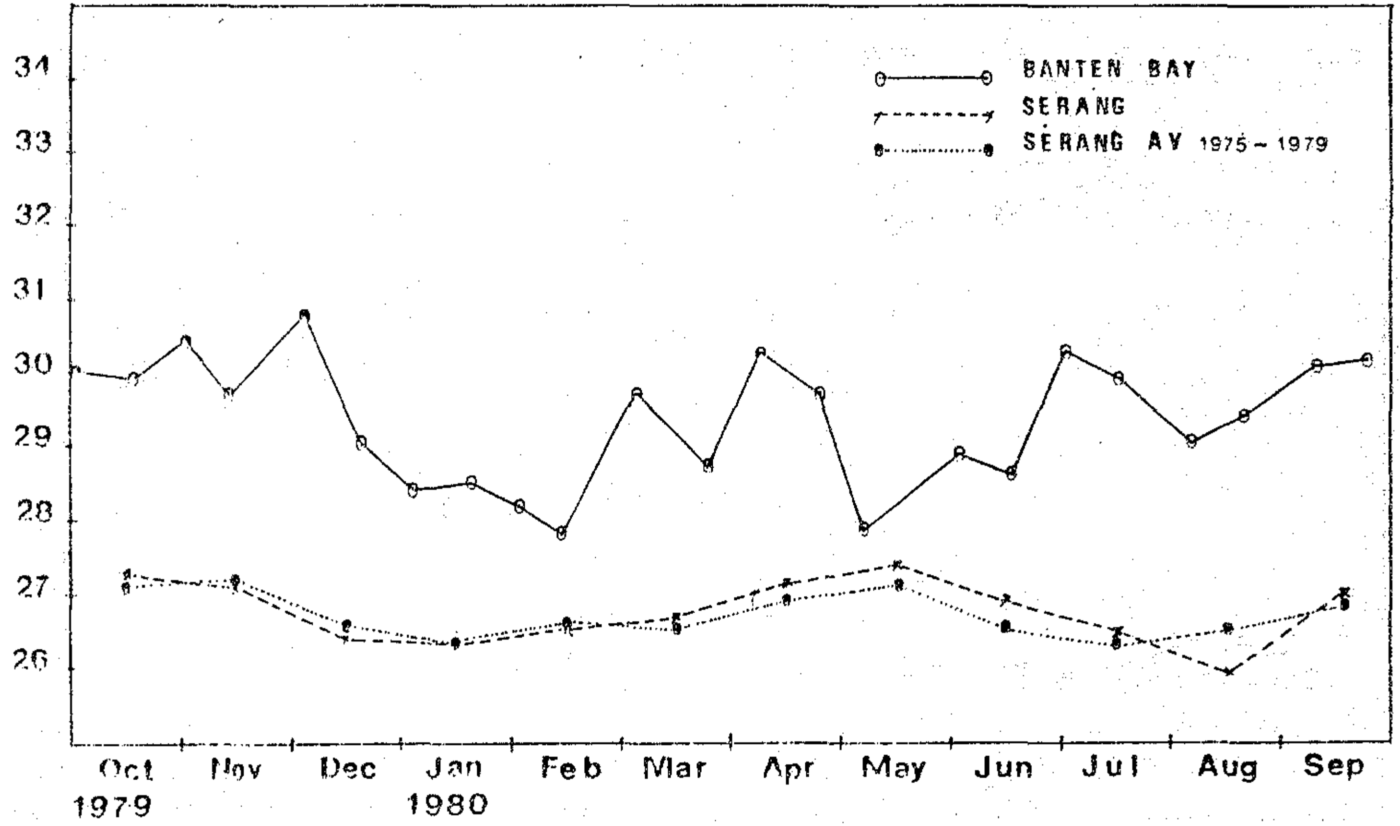


Figure 3. Seasonal change of atmospheric temperature (°C) in Banten Bay and Serang, Oct. 1979 – Sep. 1980

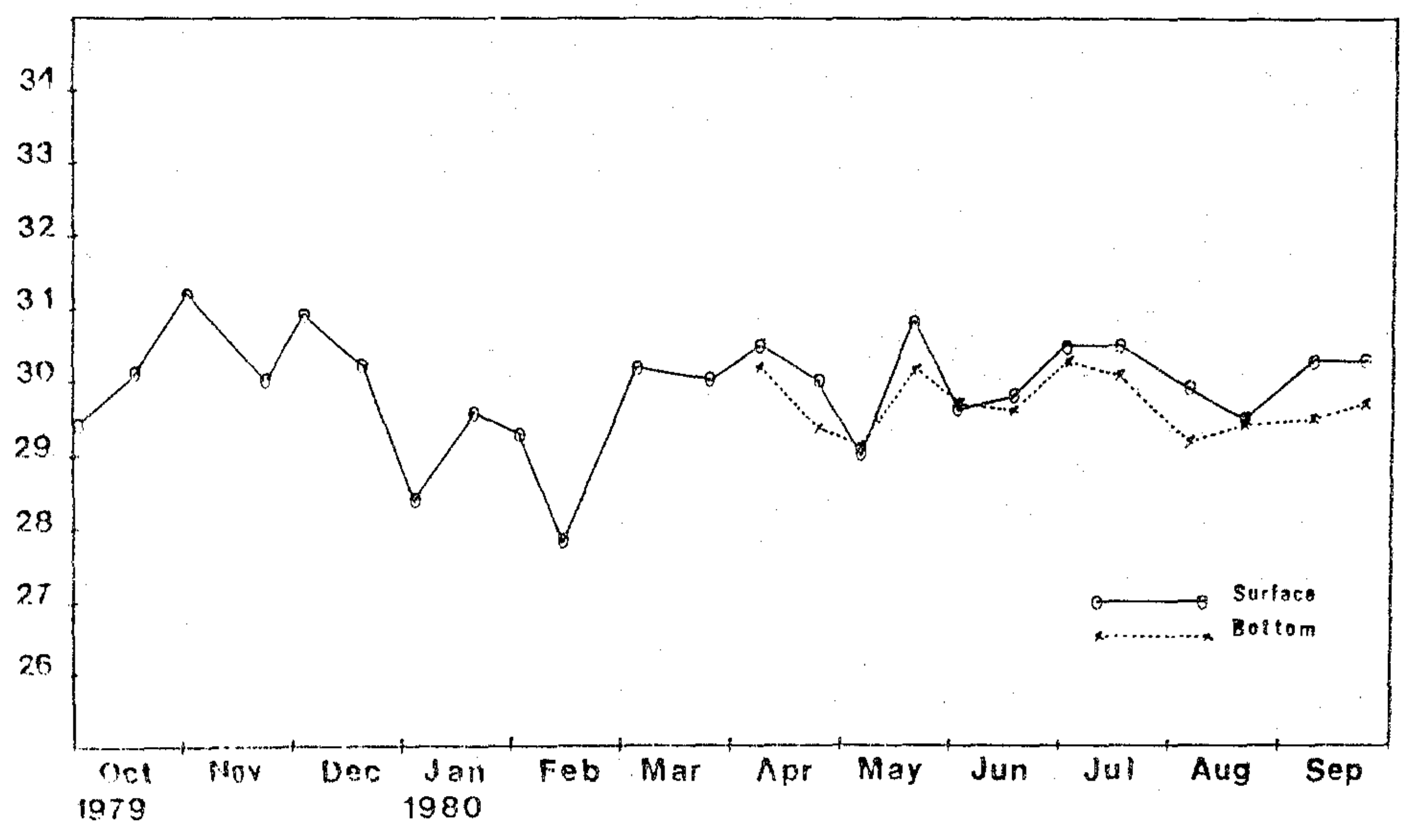


Figure 4. Seasonal change of water temperature(°C) in Banten Bay, Oct.1979 – Sep.1980

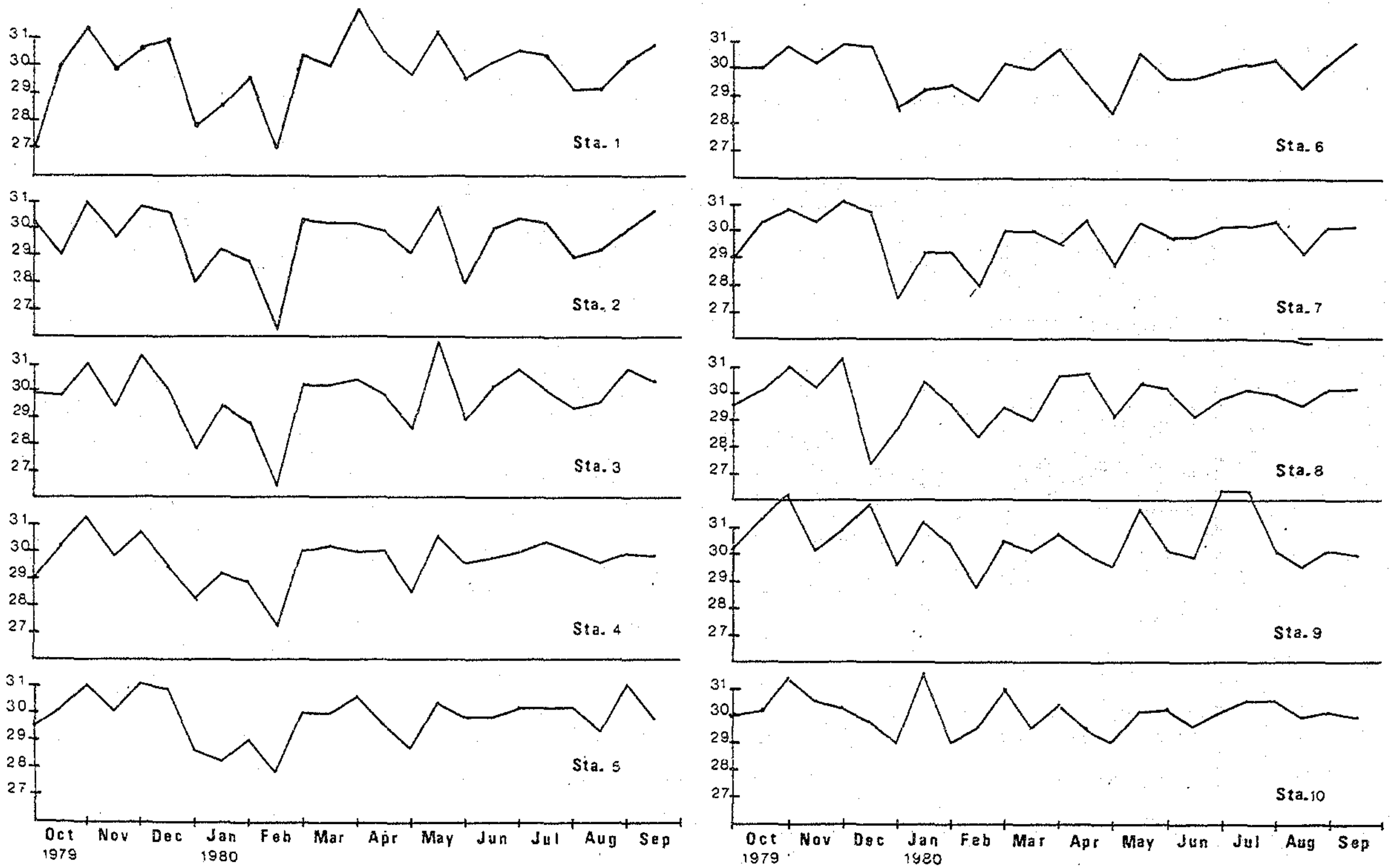


Figure 5. Seasonal change of water temperature (℃) in each stations in Banten Bay, Oct. 1979 – Sep. 1980

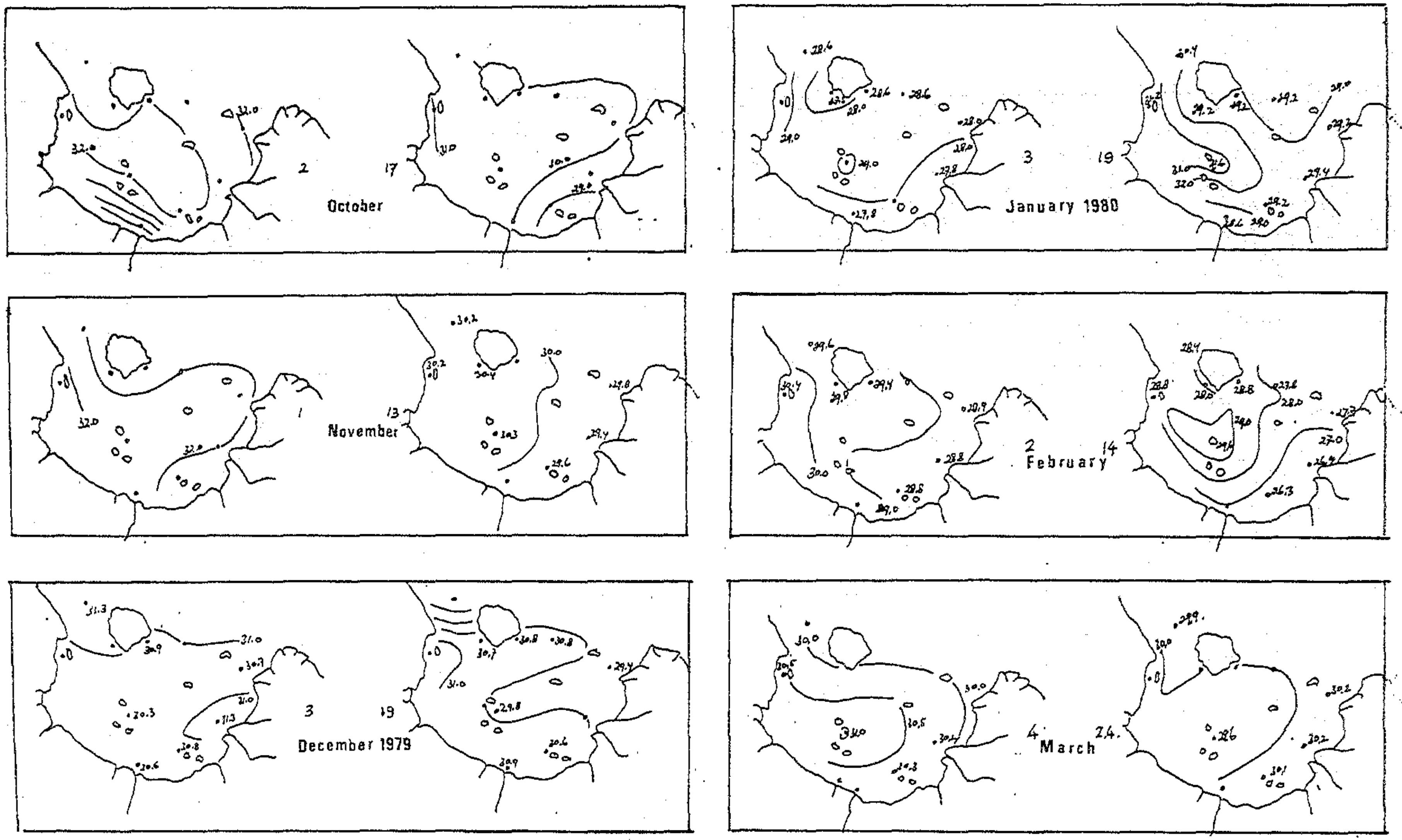


Figure 6. Horizontal distribution of water temperature (°C) in the surface layer in Banten Bay, October 1979 – March 1980.

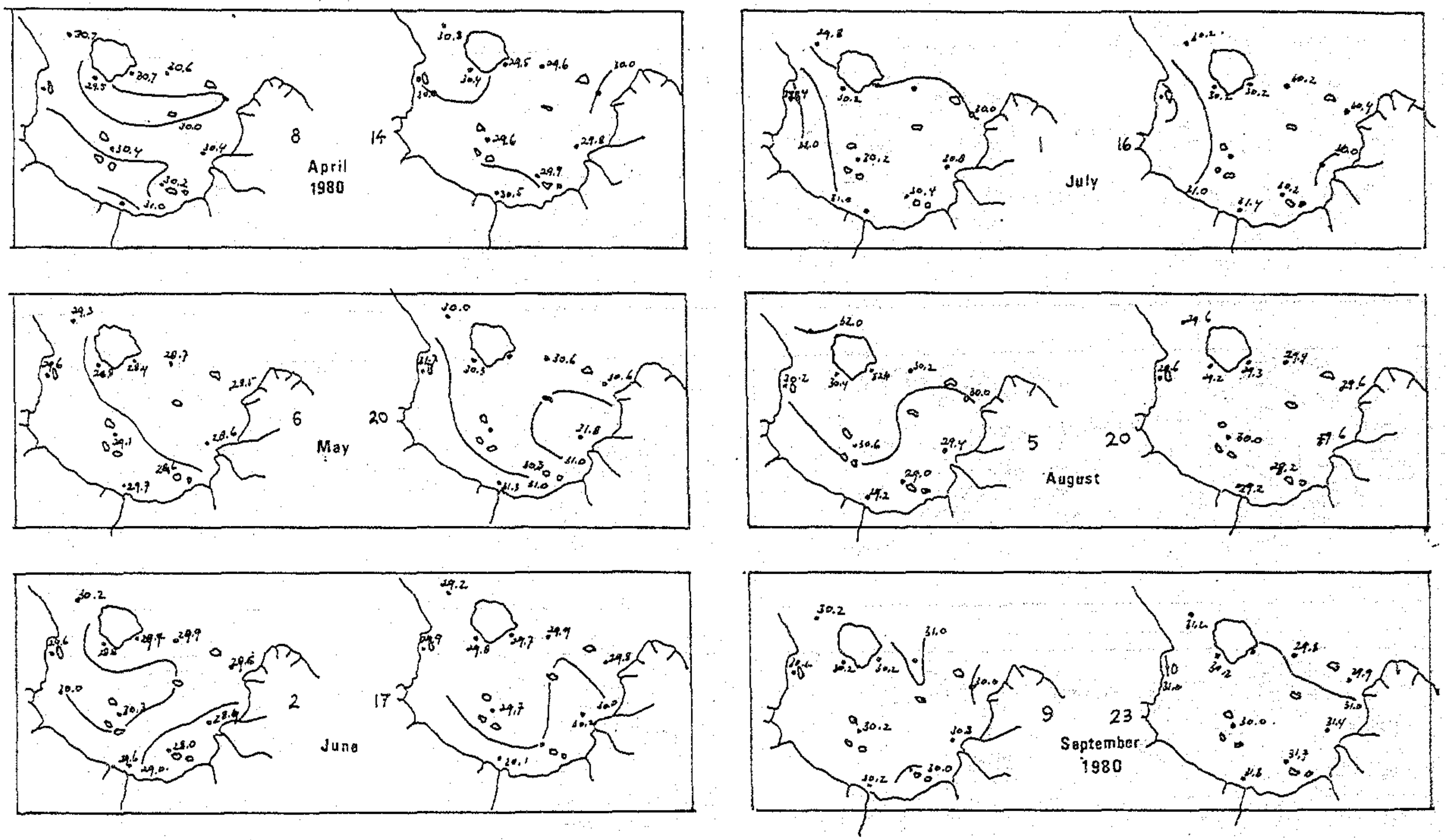


Figure 6. Continued

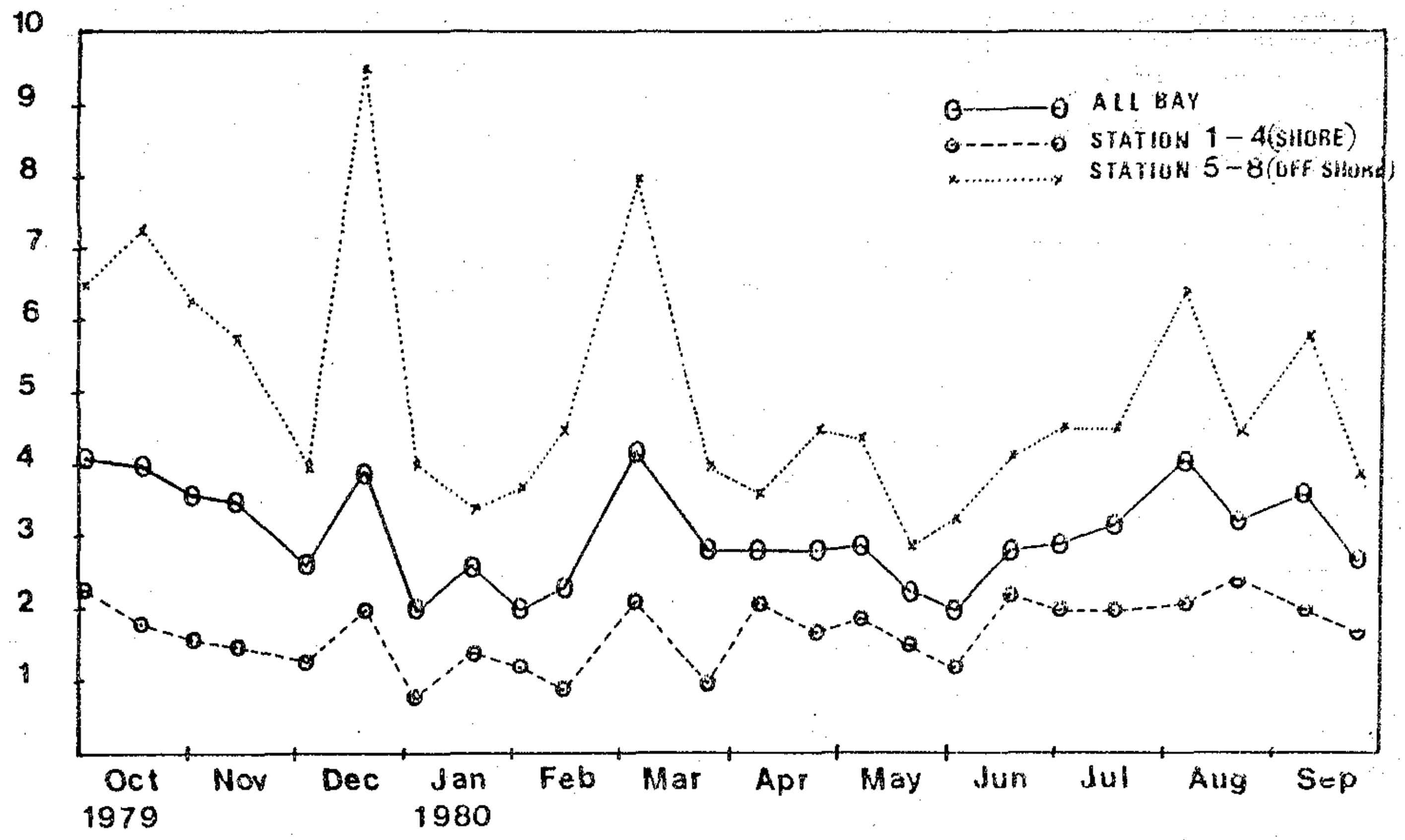


Figure 7. Seasonal change of tranparency (m) in Banten Bay, October 1979 – September 1980

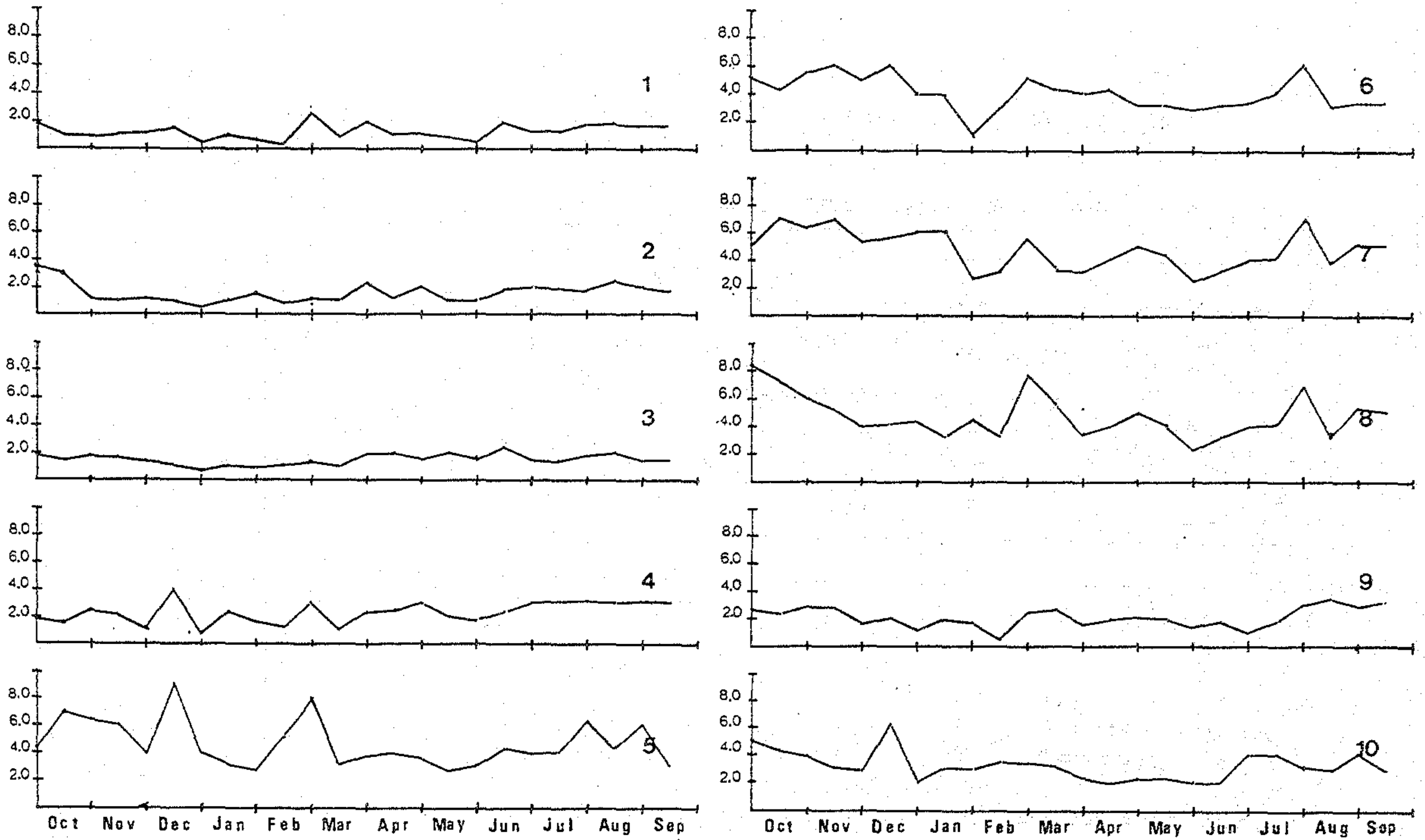


Figure 8. Seasonal change of transparency (m) in each stations in Banten Bay, October 1979 - September 1980

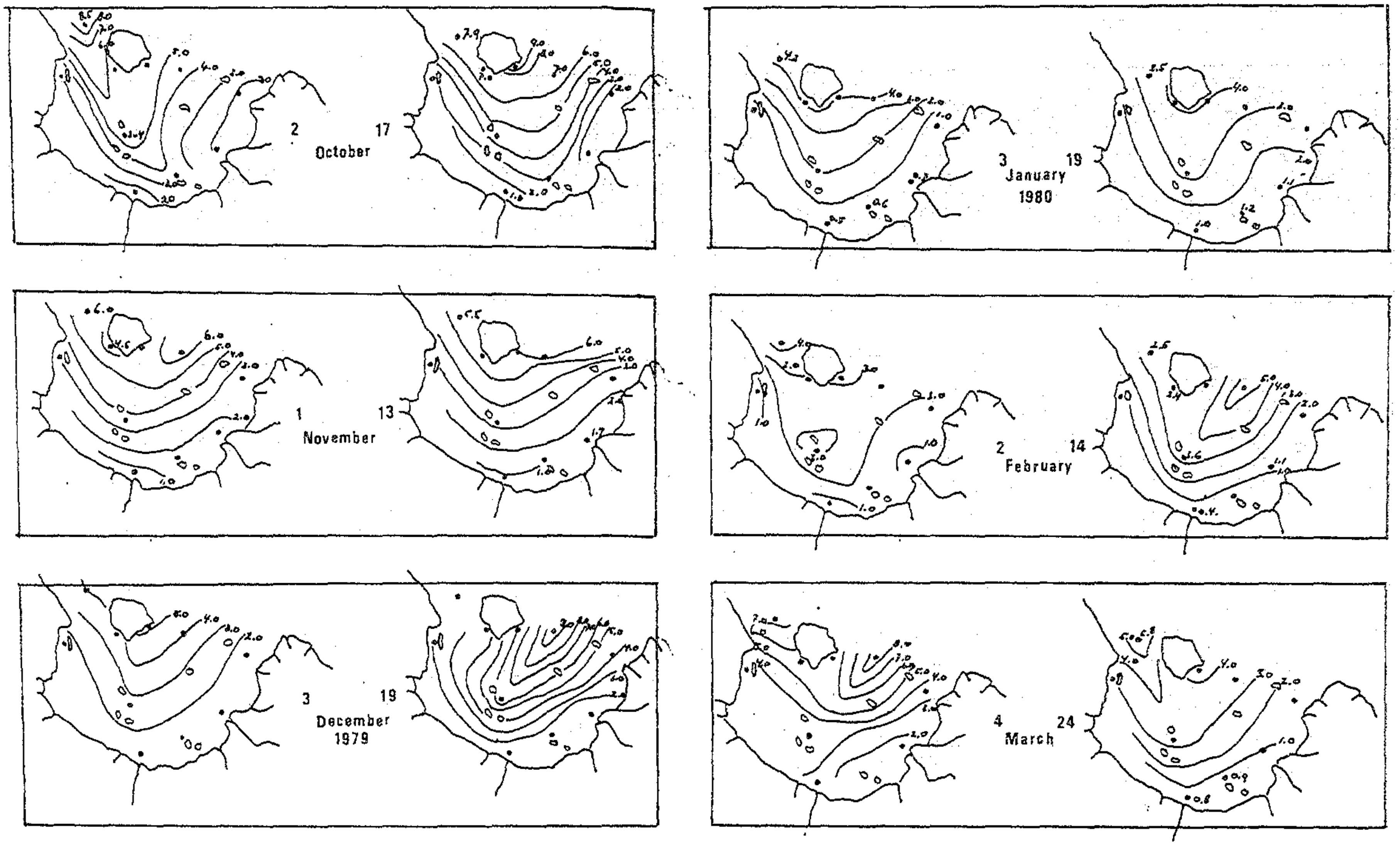


Figure 9. Horizontal distribution of transparancy (m) in Banten Bay, Oct.1979_Mar1980

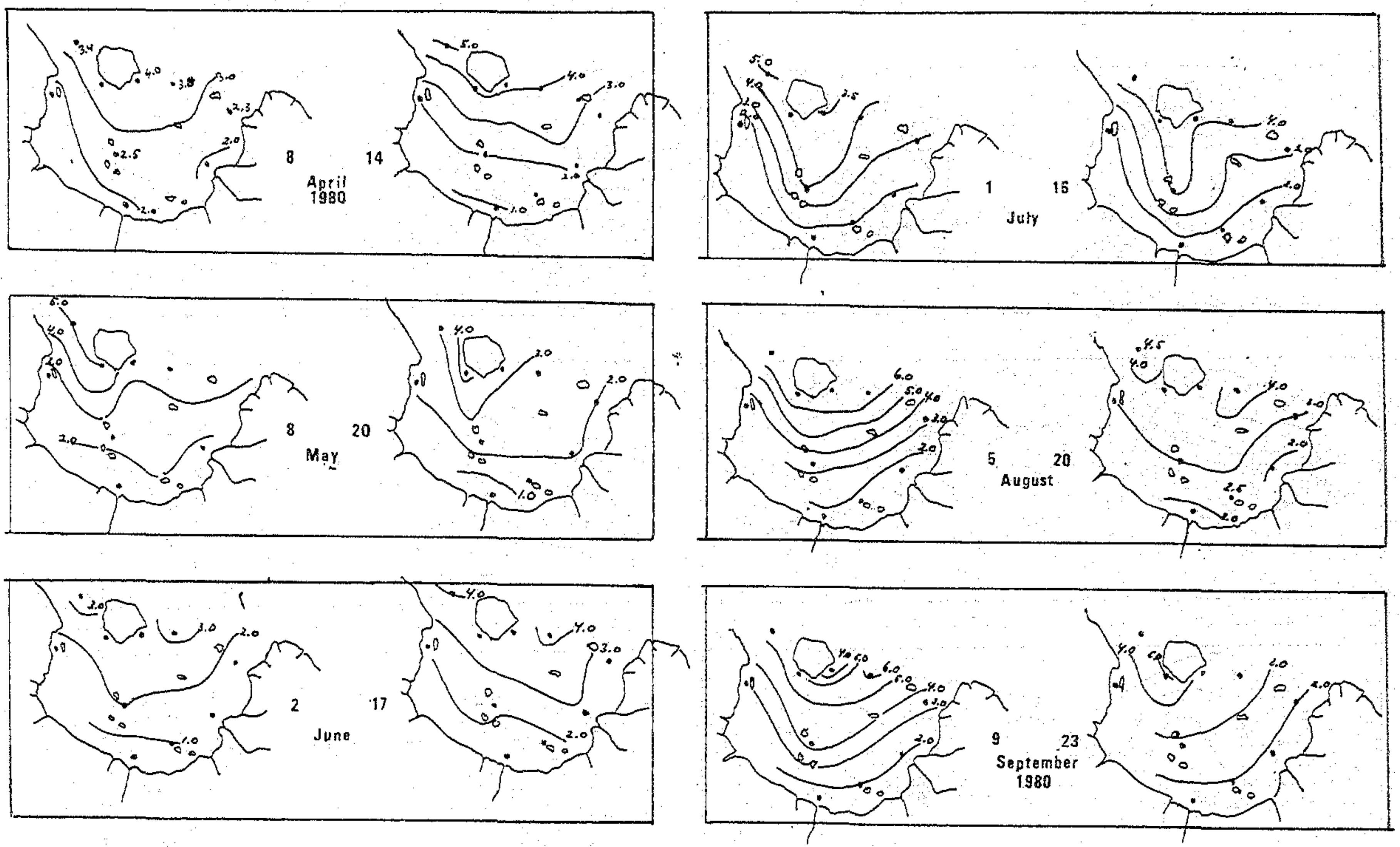


Figure 9. Continued

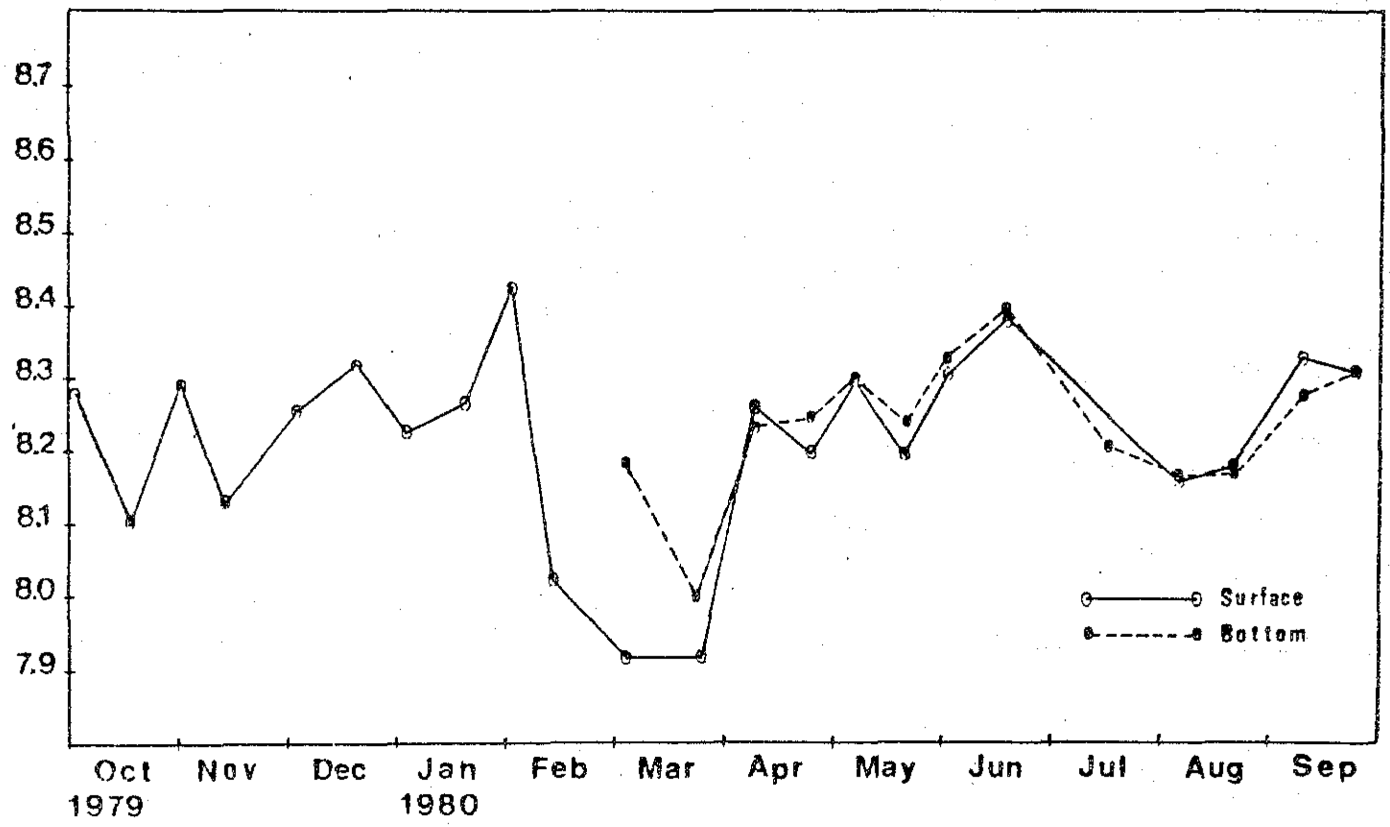


Figure 10. Seasonal change of pH in Banten Bay, October 1979 – September 1980

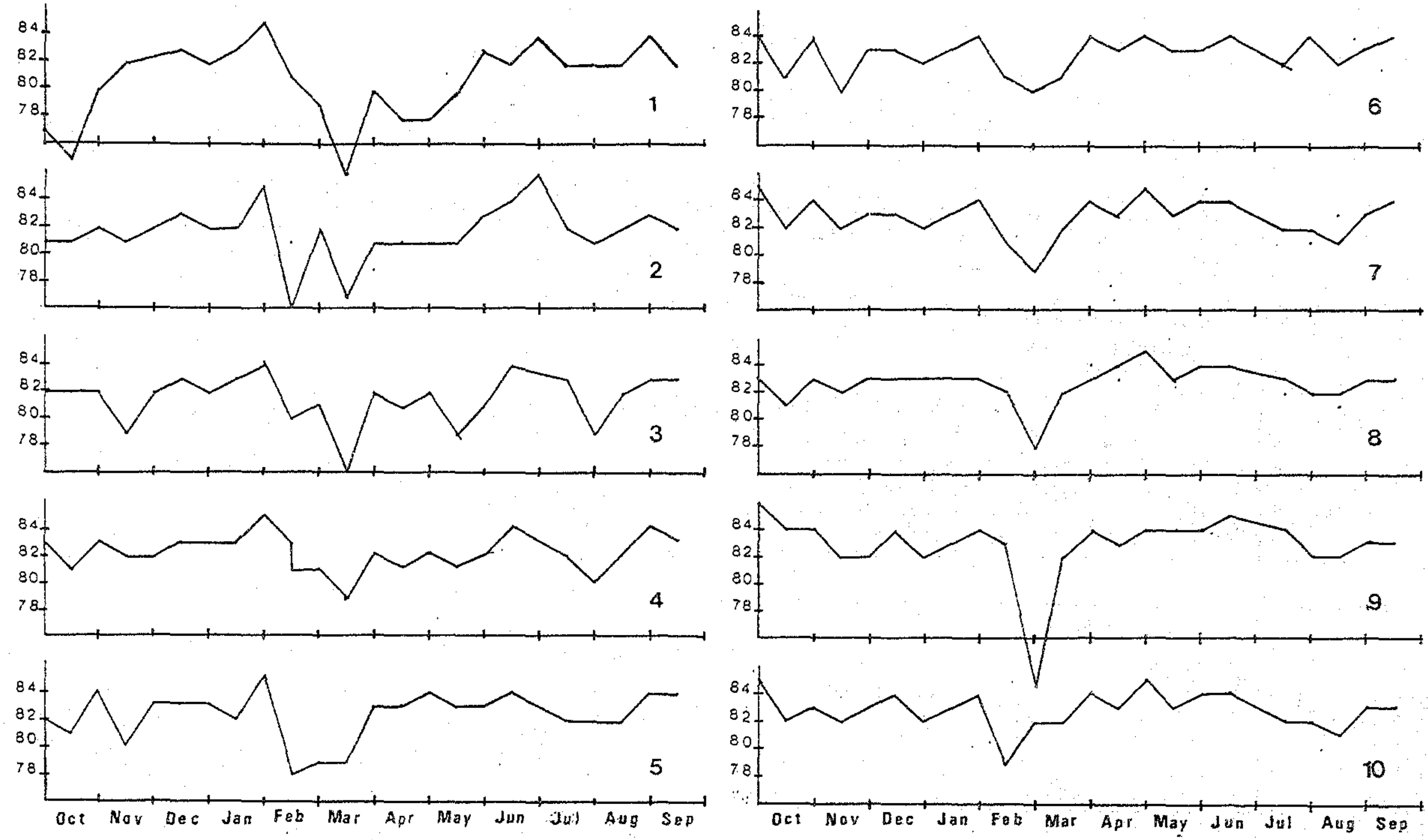


Figure 11. Seasonal change of pH in each stations in Banten Bay, October 1979 – September 1980

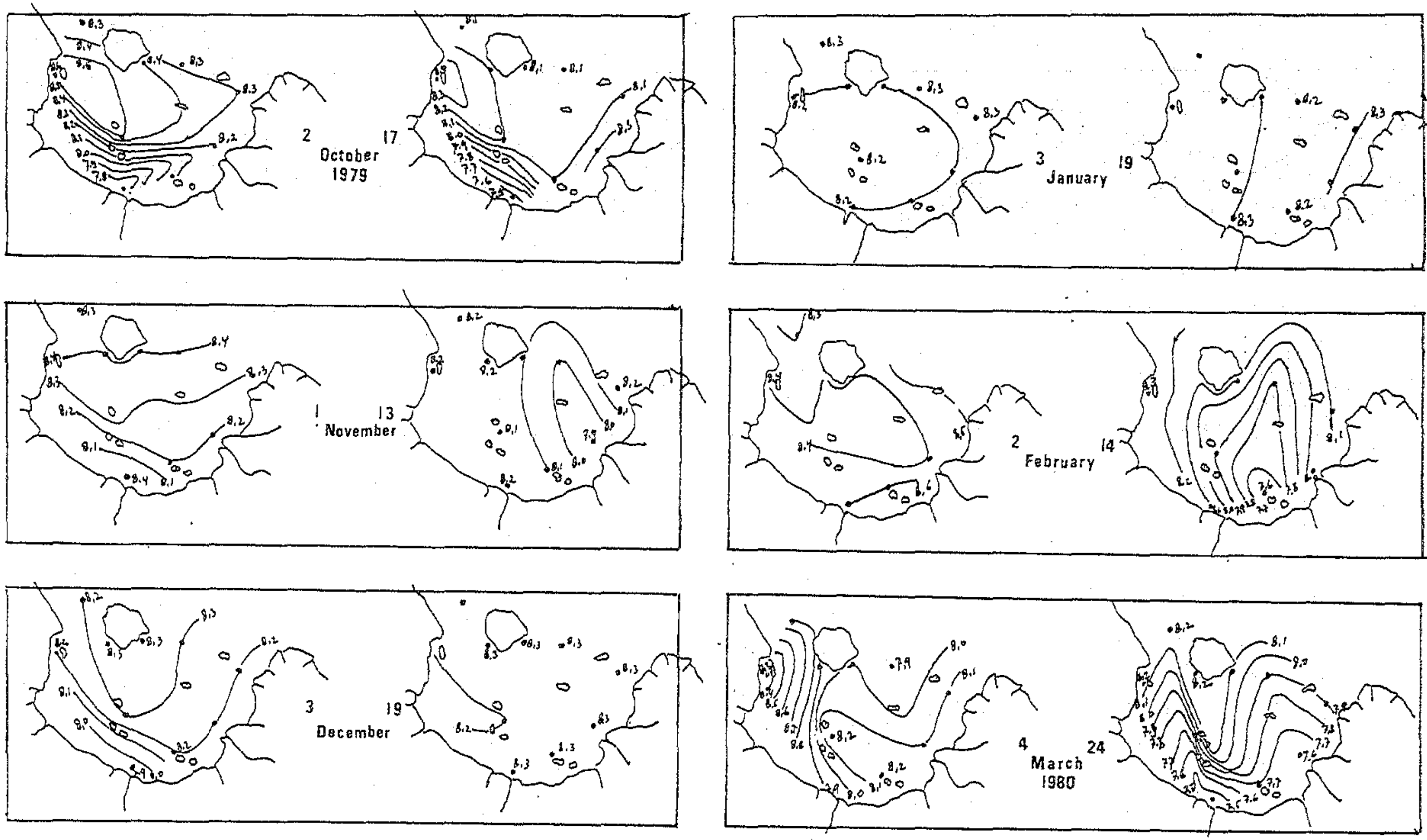
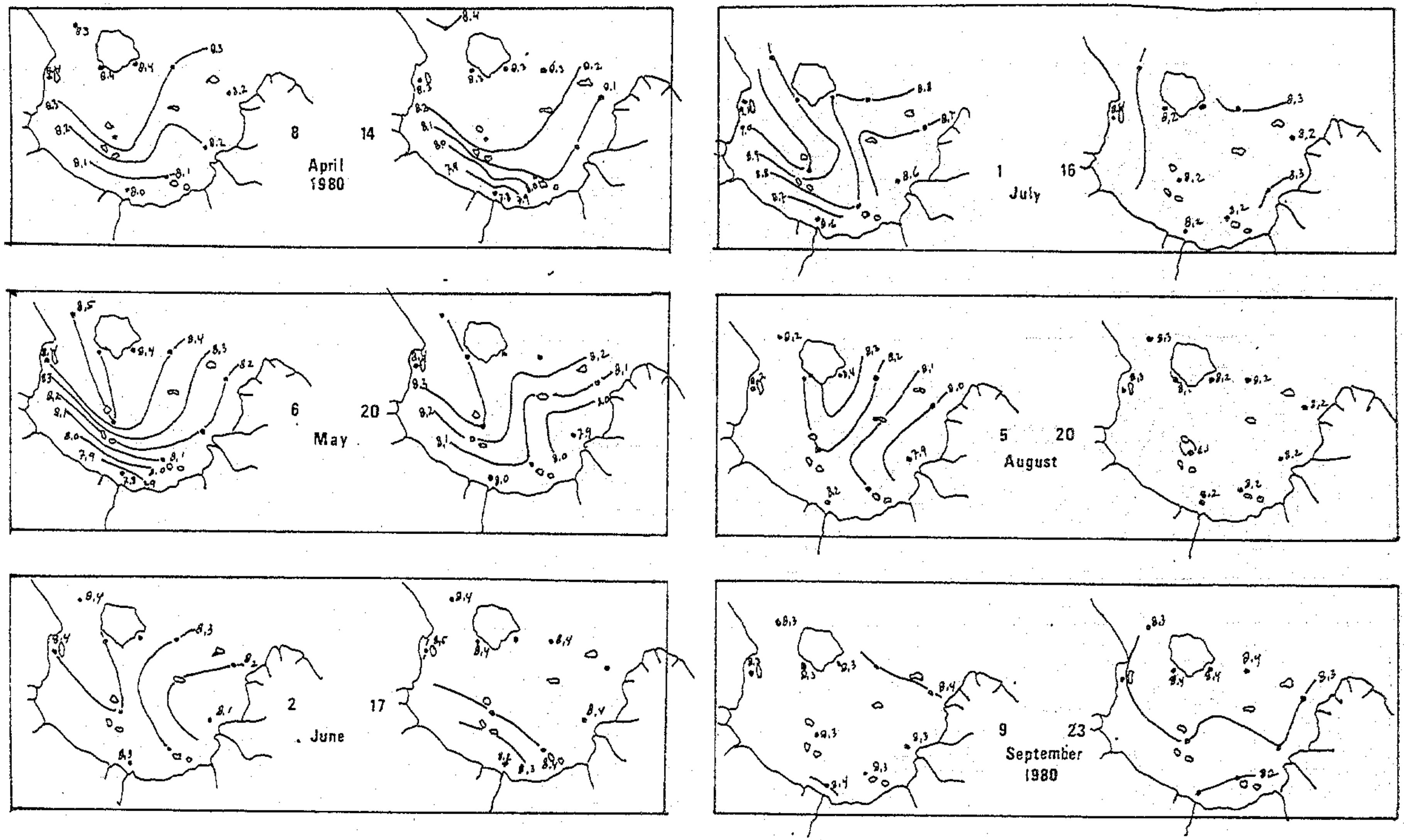


Figure 12. Horizontal distribution of pH in the surface layer in Banten Bay, October 1979 - March 1980



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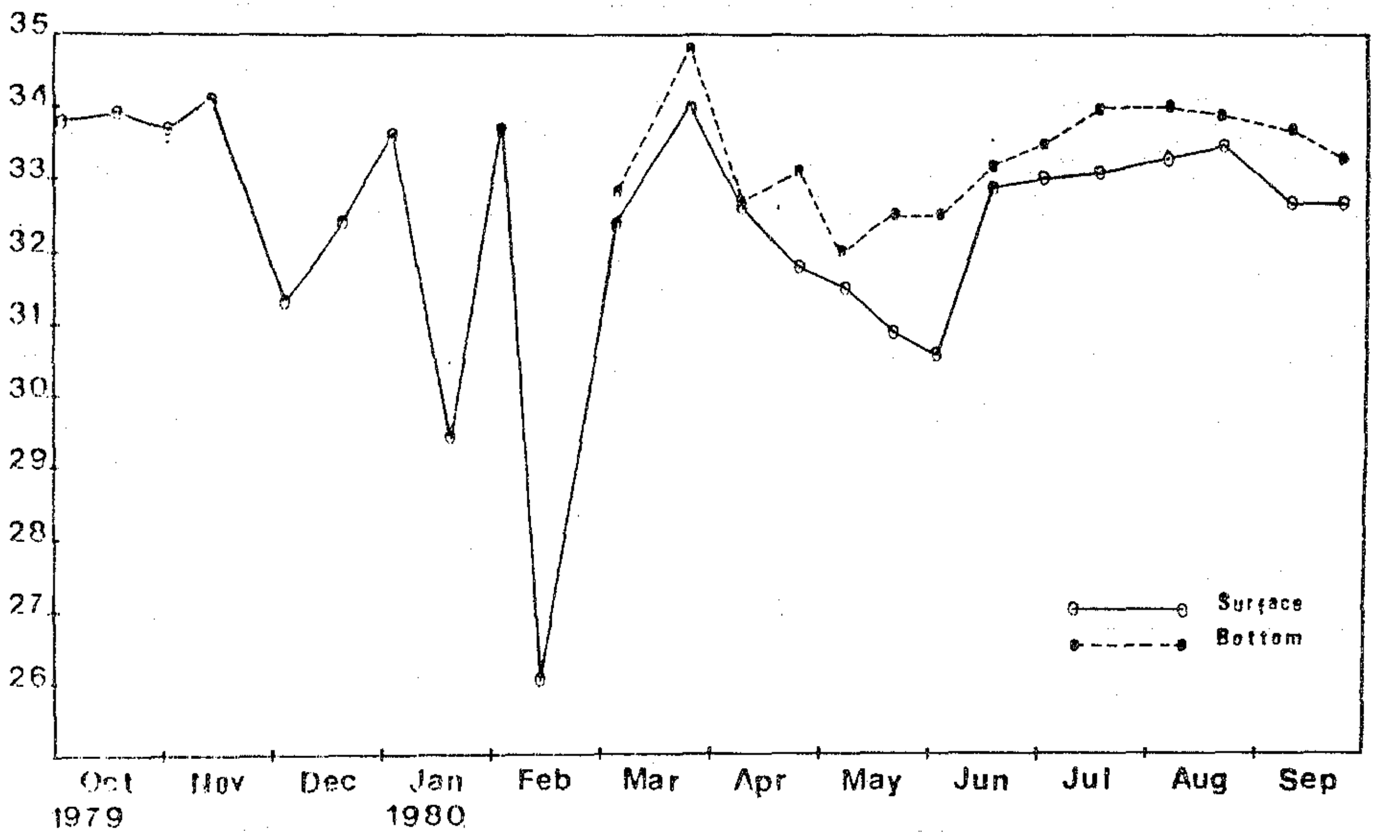

Figure 13. Seasonal change of salinity (‰) in Banten Bay, Oct. 1979 - Sep 1980

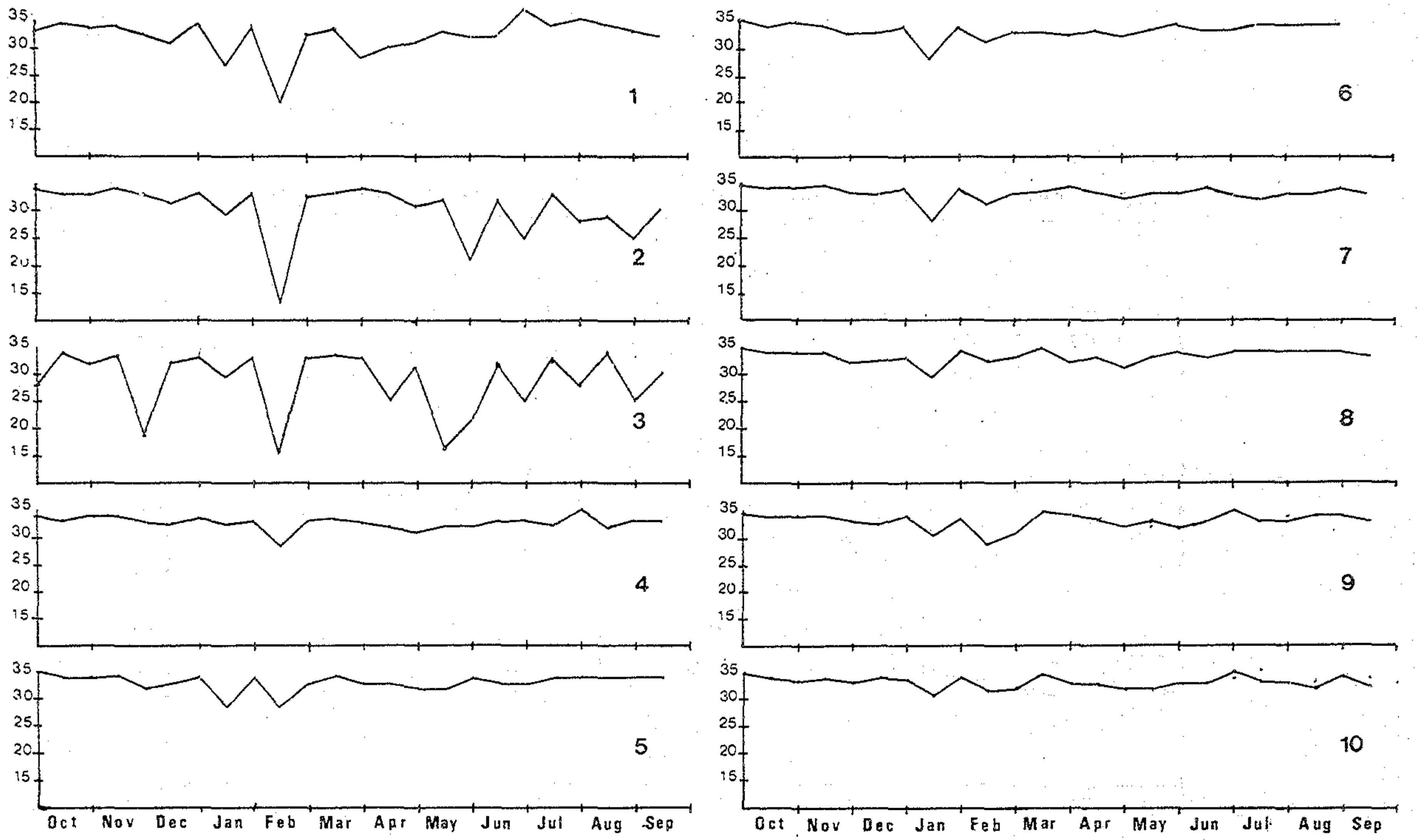

Figure 14. Seasonal change of salinity [‰] in each stasions in Banten Bay, October 1979 – September 1980

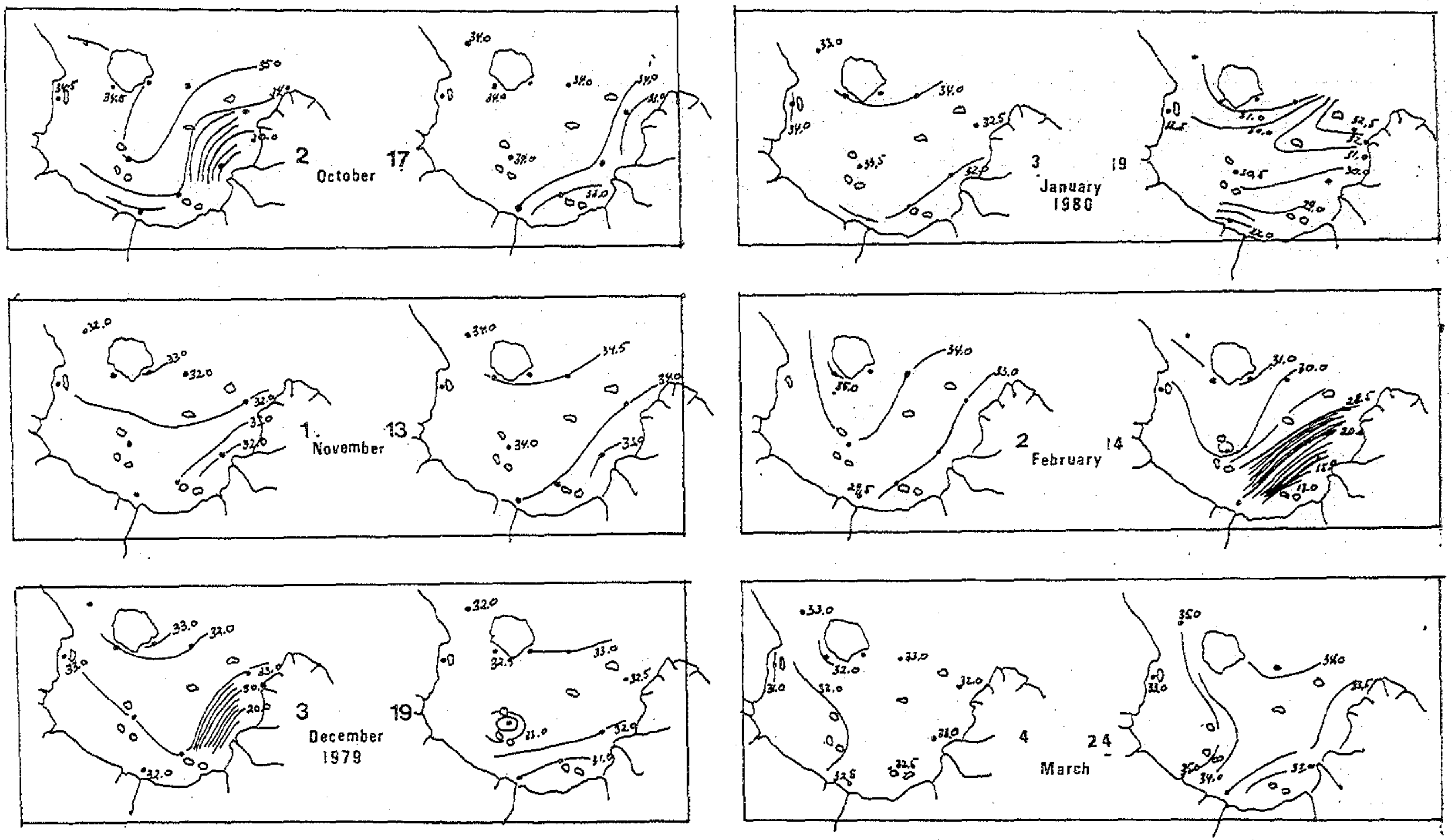

Figure 15. Horizontal distribution of salinity (‰) in surface layer in Banten Bay, October 1979—September 1980

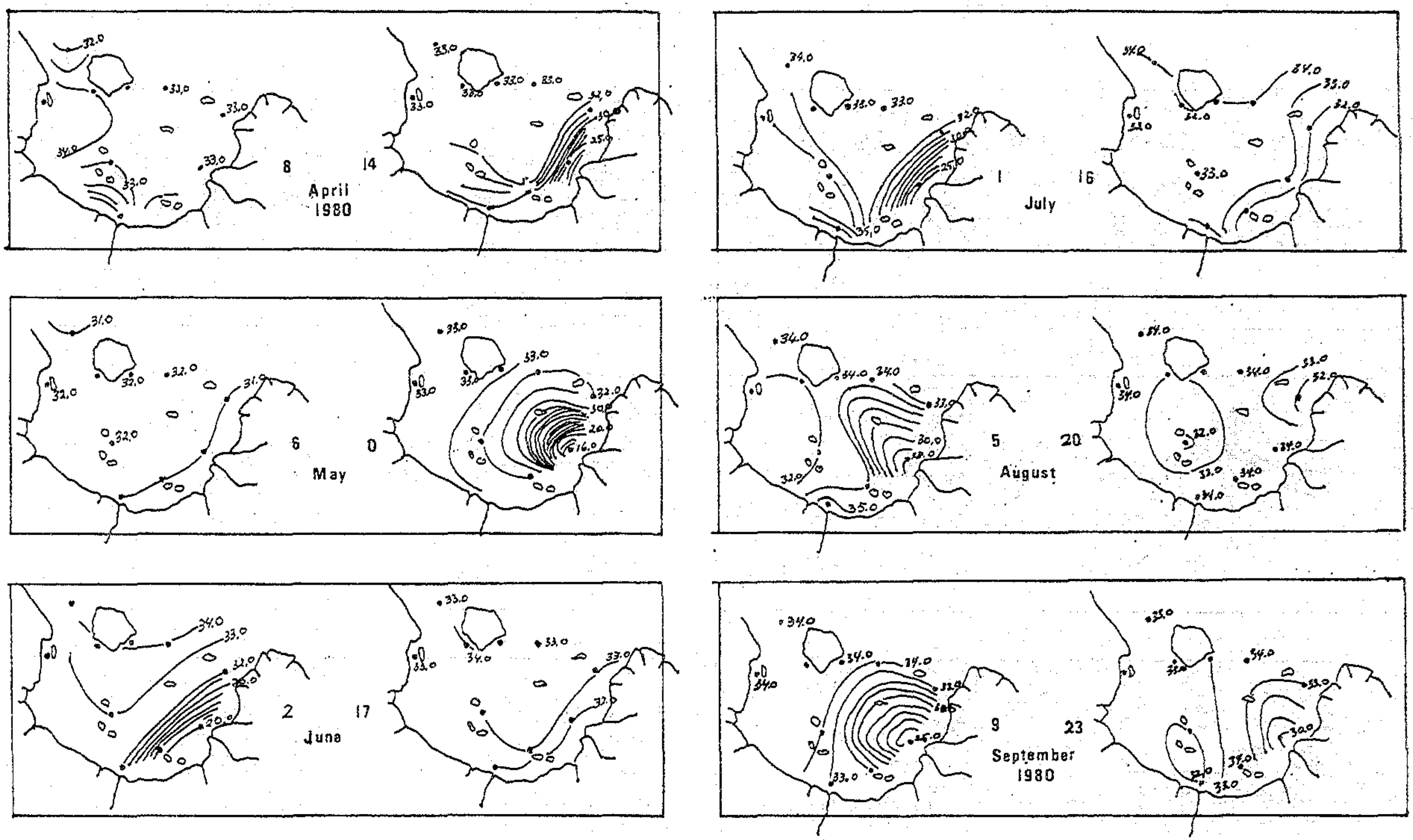

Figure 15. Continued

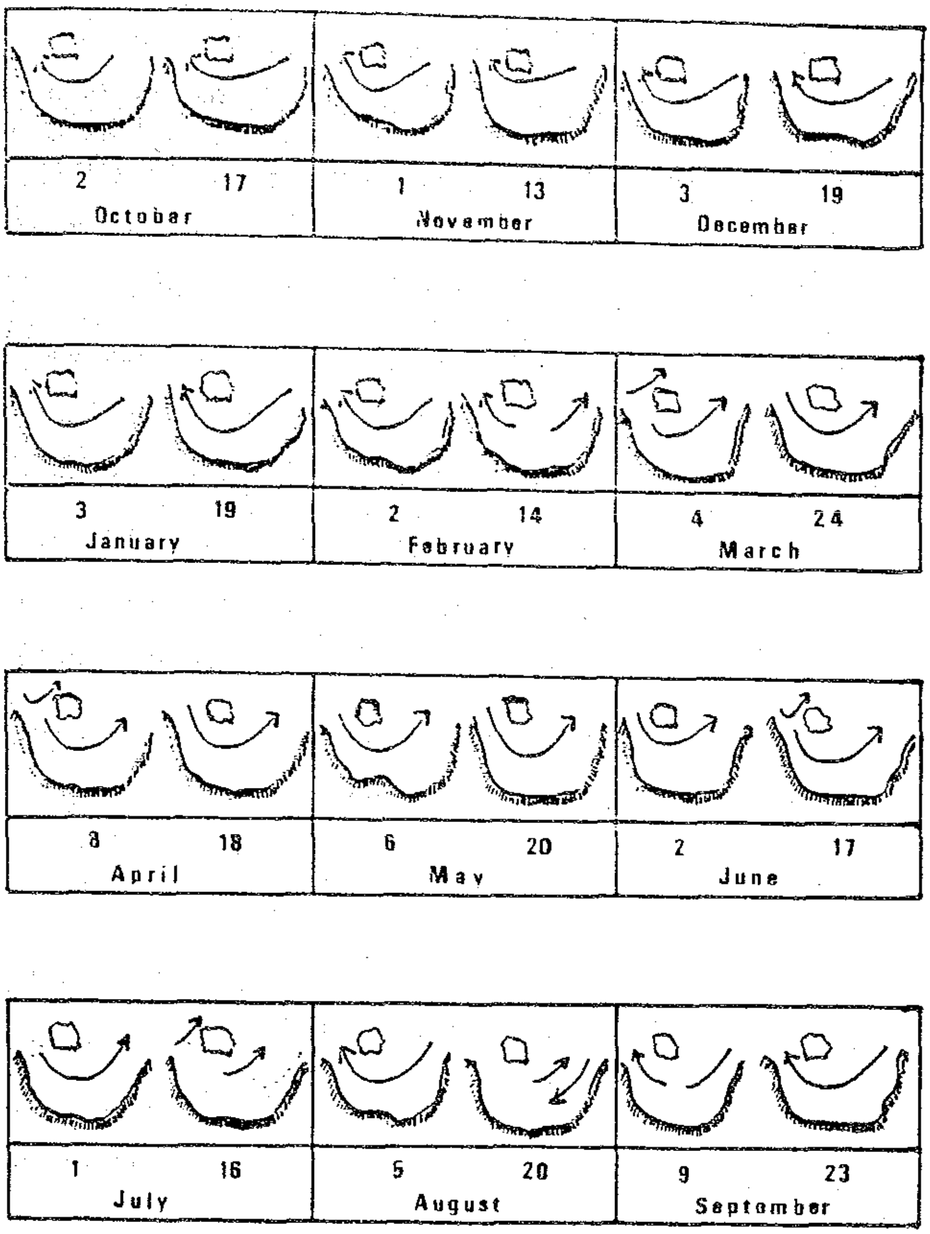

Fig 16. Current direction in Banten Bay, Oct.1979 – Sept.1980