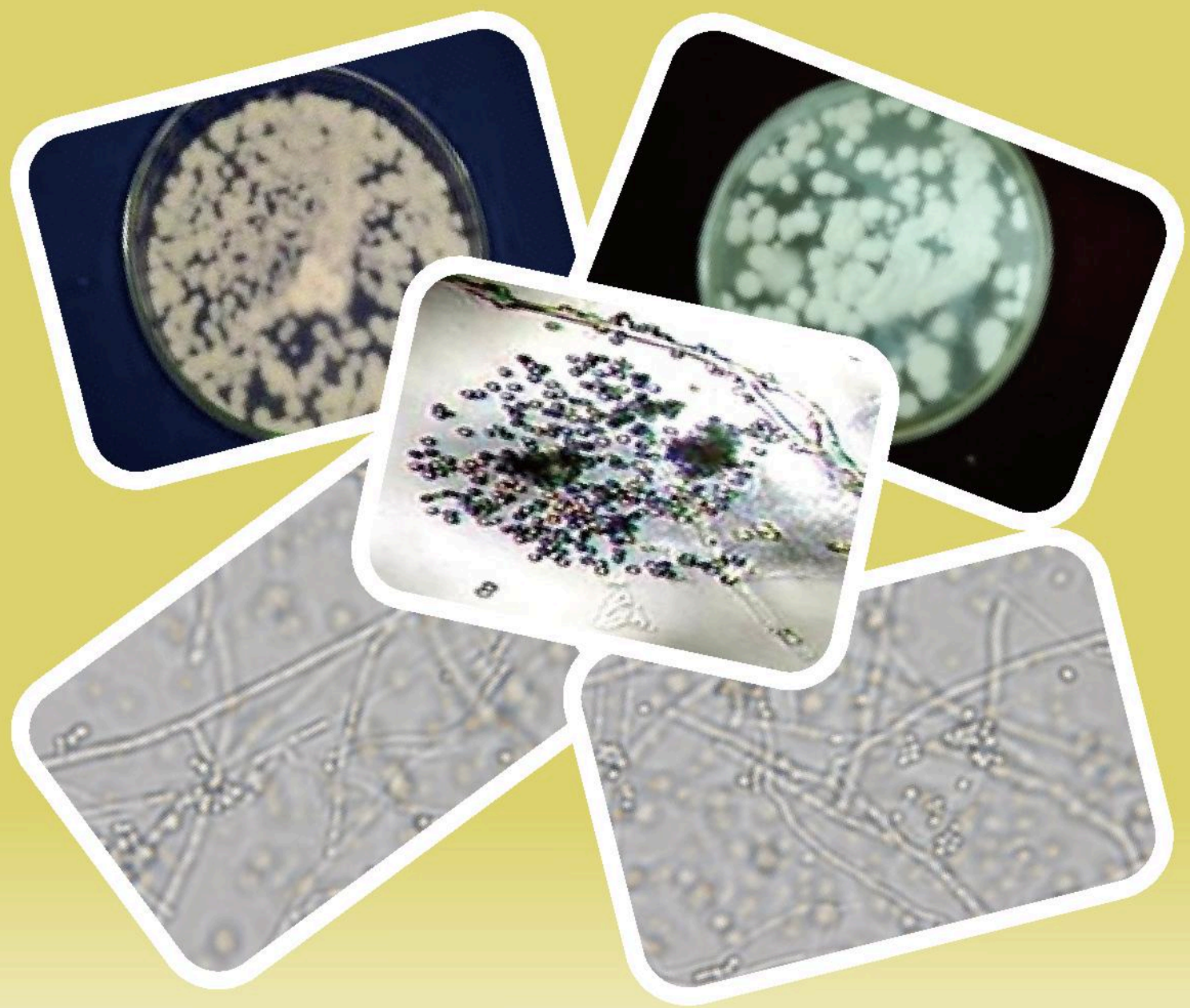
ISSN 0126-1754
636/AU3/P2MI-LIPI/07/2015
Volume 15 Nomor 2, Agustus 2016

LIPI

Berita Biologi

Jurnal Ilmu-ilmu Hayati



Berita Biologi	Vol. 15	No. 2	Hlm. 107-206	Bogor, Agustus 2016	ISSN 0126-1754

Pusat Penelitian Biologi - LIPI

BERITA BIOLOGI

Vol. 15 No. 2 Agustus 2016
Terakreditasi Berdasarkan Keputusan Kepala Lembaga Ilmu Pengetahuan Indonesia
No. 636/AU3/P2MI-LIPI/07/2015

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Keterangan foto cover depan: Morfologi jamur *Beauveria* spp. A dan B= koloni Beuveria pada agar media, Sesuai dengan makalah pada halaman 175.

ISSN 0126-1754
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Pusat Penelitian Biologi - LIPI

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OXYGEN CONSUMPTION OF ROCK BREAM *Oplegnathus fasciatus* IN DIFFERENT SALINITY LEVELS AND TEMPERATURE DEGREES [Konsumsi oksigen Ikan Rock Bream *Oplegnathus fasciatus* pada tingkat salinitas dan suhu yang berbeda]

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Revisi: 29 Juli 2016

ABSTRAK

Ikan rock bream *Oplegnathus fasciatus* merupakan salah satu spesies ikan laut yang memiliki nilai komersial tinggi di wilayah Asia Timur. Studi mengenai metabolisme terkait dengan faktor lingkungan untuk spesies ini masih sedikit dilakukan. Penelitian ini dilakukan untuk mengetahui efek salinitas dan suhu pada konsumsi oksigen ikan rock bream (Panjang total: 26.9 ± 0.6 cm, Bobot: 477.3 ± 61.9 gr) dengan menggunakan *respiratory chamber*. Penelitian dilakukan di Pukyong National University, Busan, Korea Selatan. Empat kelompok percobaan dilakukan untuk mengukur konsumsi oksigen berdasarkan salinitas (35, 25, 15, dan 35→5 psu) dan perubahan suhu (15→20→25°C). Hasil penelitian menunjukkan bahwa tingkat salinitas mempengaruhi penurunan konsumsi oksigen pada ikan rock bream (87.1, 78.3, 66.3, dan 58.5 mg O_2/kg/jam masing-masing pada 35, 25, 15, dan 5 psu). Sedangkan konsumsi oksigen ikan rock bream meningkat dengan adanya peningkatan suhu pemeliharaan (35 psu: 64.7, 104.0, dan 175.9 mg O_2/kg/jam masing-masing pada suhu 15, 20, dan 25°C; 25 psu: 45.8, 101.7, dan 185.9 mg O_2/kg/jam masing-masing pada suhu 15, 20, dan 25°C; 15 psu: 29.8, 103.3, dan 155.5 mg O_2/kg/jam masing-masing pada suhu 15, 20, dan 25°C).

Kata kunci : Rock bream, *Oplegnathus fasciatus*, Salinitas, Suhu, Konsumsi oksigen.

ABSTRACT

Rock bream *Oplegnathus fasciatus* is one of marine fish species with high commercial value in the region of East Asia. However, studies on the metabolism related to environmental factors for this species is still lacking. This study was therefore aimed to assess the effects of salinity and temperature on oxygen consumption (OC) of rock bream (TL: 26.9±0.6 cm, BW: 477.3±61.9 g) was observed by using respiratory chamber to understand the optimal salinity and temperature for culture of rock bream. Research was conducted in Pukyong National University, Busan, South Korea. Four experimental groups were conducted to measure oxygen consumption (OC) according to salinity (35, 25, 15, and 35→5 psu) and temperature changes (15→20→25°C). The results showed that low salinity exposures tend to decrease OC of rock bream (87.1, 78.3, 66.3, and 58.5 mg O_2/kg/h at 35, 25, 15, and 5 psu, respectively). Meanwhile, the oxygen consumption of rock bream increased with increasing water temperatures (35 psu: 64.7, 104.0, and 175.9 mg O_2/kg/h at 15, 20, and 25°C, respectively; 25 psu: 45.8, 101.7, and 185.9 mg O_2/kg/h at 15, 20, and 25°C, respectively; 15 psu: 29.8, 103.3, and 155.5 mg O_2/kg/h at 15, 20, and 25°C, respectively).

Key words : Rock bream, *Oplegnathus fasciatus*, Salinity, Temperature, Oxygen consumption.

INTRODUCTION

Rock bream *Oplegnathus fasciatus* is one of high-valued species for aquaculture in Korea. Its high commercial value makes it a promising aquaculture species in East Asian countries, such as Korea and Japan (Lipton and Kim, 2009; Biswas *et al.*, 2010). However, there is lack of information on the proper water temperature and salinity for the metabolism of rock bream and their related physiological factors such as oxygen uptake to support aquaculture development of this species.

Oxygen is one of most vital factor in aquaculture and oxygen consumption (OC) of aquatic organisms is related with their metabolism. According to that fact, many researches investigated the OC of fish related to temperature (Franklin *et al.*, 1994; Wares and Igram, 1979; Requena *et al.*, 1997; Das *et al.*, 2005), salinity (Marais, 1978; Tsuzuki *et al.*, 2008; Iwama *et al.*, 1997), photoperiod (Chang *et al.*, 2005), and stocking density (Bjornsson *et al.*, 2006; Miller *et al.*, 1995). The researches on OC were continuously developed for aquaculture study in various species (Kim *et al.*, 1995; Byun *et al.*, 2008; Jeong *et al.*, 2007).

As previous studies suggested, salinity and water temperature influence the oxygen consumption rates of several fish species. However, there are still limited data explaining about the effect of salinity and temperature related to OC in rock bream. The null hypothesis is that salinity and water temperature change will not affect the oxygen consumption of rock bream. The alternative hypothesis suggests that

Diterima: 2 Juni 2016 - Disetujui: 20 Juni 2016

salinity and water temperature change will affect the oxygen consumption of rock bream. It suggests that the treatment will give significant impact on the rate of respiration. The aims of this study were to evaluate the effects of different range of salinity and water temperature on OC of rock bream.

MATERIALS AND METHODS

Research was conducted in Pukyong National University, Busan, South Korea. The size of rock breams used in the experiments was 26.9±0.6 cm in total length and 477.3±61.9 g in body weight. The fish were fed twice a day at 2% of its body weight with commercial feed. In order to avoid the metabolic effect, no food was given to any experimental fish during 24 hours before experiment. A total of four different experiments were conducted to investigate the effects of salinity (15, 25, 35 psu, and gradual salinity changes from 35 to 5 psu) and water temperature (15°C, 20°C, and 25°C) on the OC of rock bream (Table 1).

A closed recirculating system with a respiratory chamber was used to measure OC (dimension of respiratory chamber: 20 × 30 × 20 cm). Fish were stocked in the respiratory chamber for 3 hours before running the experiment in order to stabilize the metabolic rate. The experimental fish were exposed with 12:12 hour light:dark cycle (07:00-19:00, 19:00-07:00). The methods for OC calculation and schematic diagram of OC measuring system was adopted from Chang *et al.* (2005). Dissolved oxygen content on the inlet water was maintained not lower than 7.0 mg/L in each experiment. Water temperature inside the respiratory chamber was increased gradually from 15°C to the target temperature at a rate of 1.0°C/h to minimize any thermal shock to the fish in OC experiment according to water temperature change. Meanwhile, water temperature was kept constant at 20°C in experiment to measure OC by gradual salinity changes from 35 to 5 psu. Salinity was changed to lower salinity on the next day after one day OC measurement of target salinity.

Breath frequency was counted using opercular cover movements (Wares and Igram, 1979). The opercular cover movements were counted for 1 minute interval and expressed as the average rate calculated from 10 records for each fish. In addition to measuring OC under different salinity, the behavior of the fish was observed during experiments, including their movements in the water and breathing frequency per minute. All data was tested to see the differences among the treatment given in this study using t-test and one-way ANOVA.

RESULTS

OC according to salinity and temperature

The OC of rock bream according to salinity and temperature showed linear increase and fluctuations (Figure 1). The fluctuations occured in 35, 25, and 15 psu during light and dark period. The pattern of OC was similar between each other. During the experiments, the OC of rock bream was slightly fluctuated. However, the highest fluctuation of OC can be found in 25 psu at 20°C during light period.

Another experiment in lowering salinity from 35 to 5 psu showed the OC decline by salinity changes. The rock bream consumed lower amount of OC in different salinity. The lowest amount can be found during 5 psu. Rock bream can survived and consumed low amount of oxygen in 4 days at 5 psu. After 4 days, rock bream finally died (Figure 2).

Table 2 illustrated the OC in each experiment with significant differences according to water temperature (P<0.05). The tendency of OC was de-

Table 1. Experimental conditions in OC measurement (*Kondisi perlakuan saat pengukuran konsumsi oksigen*)

Experiment (Perlakuan)	Water temp [Suhu air (°C)]	Salinity (Salinitas) (psu)	Number of fish (Jumlah ikan)
I	15, 20, 25	35	1
II	15, 20, 25	25	1
III	15, 20, 25	15	1
IV	20	35 → 25 → 15 → 5	1

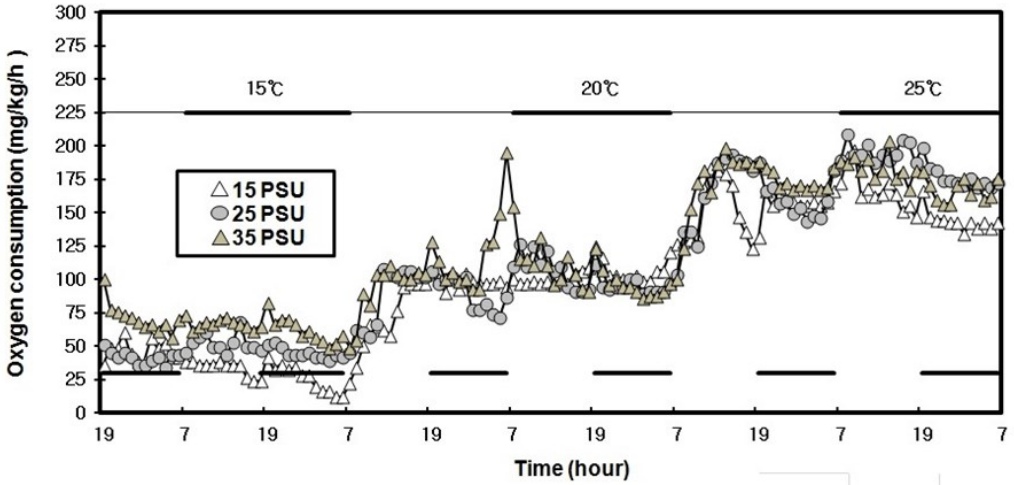

Figure 1. Oxygen consumption (OC) of rock bream *Oplegnathus fasciatus* according to different salinity and water temperature (*Konsumsi oksigen ikan rock bream Oplegnathus fasciatus berdasarkan perbedaan salinitas dan suhu air*).

creased linearly with the lowering salinity in each temperature, with the highest value of 185.9 mg O_2/kg/h at 25°C in 25 psu and the lowest value of 29.8 mg O_2/kg/h at 15°C in 15 psu. The highest slope of OC was found in 25 psu with the b value of 12.94, while the lowest was found in 35 psu with the b value of 10.87. Another experiment in gradual salinity changes from 35 to 5 psu showed the same tendency to decrease the OC with the highest value of 87.1 mg O_2/kg/h in 35 psu and the lowest value of 58.5 mg O_2/kg/h in 5 psu (Table 3).

The OC rate of rock bream showed higher value on light period rather than dark period at each temperature, except in 15 psu at 20°C (Table 4). The average value of OC during the light period was 107.6, 115.7, and 110.1% than dark period at 15, 20, and 25°C, respectively in 35 psu. Meanwhile, the average value of OC during light period was 116.2, 112.4, and 110.8% than dark period at 15, 20, and 25°C, respectively in 25 psu. However, the average of OC during the light period showed lower amount than dark period in 15 psu at 20°C, the value was 93.5% than dark period, while it was higher in light period than dark period showing the value of 131.1 and 116.4% at 15 and 25°C, respectively. Significant differences of OC between light and dark period were only found at 25°C in each experiment ($P<0.05$). Furthermore, the slope were higher in light period compared to dark period, which means the OC was increased faster in light period than dark period. On the other hand, gradual salinity changes from 35 to 5 psu showed the percentage of 118.4, 141.3, 124.4, and 115.1% in average value of OC compared between light and dark period at 35, 25, 15, and 5 psu, respectively with higher slope during light period (Table 5).

Fish breath frequency

The slope of linear regression of breath frequency according to different water temperature in rock bream at 35, 25, and 15 psu was 5.40, 4.42, and 3.49, respectively (Figure 3). Meanwhile, the slope of linear regression of breath frequency according to gradual salinity changes in rock bream from 35 to 5 psu was 0.81. These values indicated that the breath frequency increment was on the highest value at 35 psu.

DISCUSSION

Results from this study suggested that OC of rock bream was affected by temperature increase. Their breath frequency and OC per breath were also increased in line with temperature rise. These results were similar with that of Oh *et al.* (2006), that reported the same species at juvenile stage the OC was increased in line with the temperature rise. Gardner and King (1922) as well as Chang *et al.* (2005) also reported that OC of fish increased

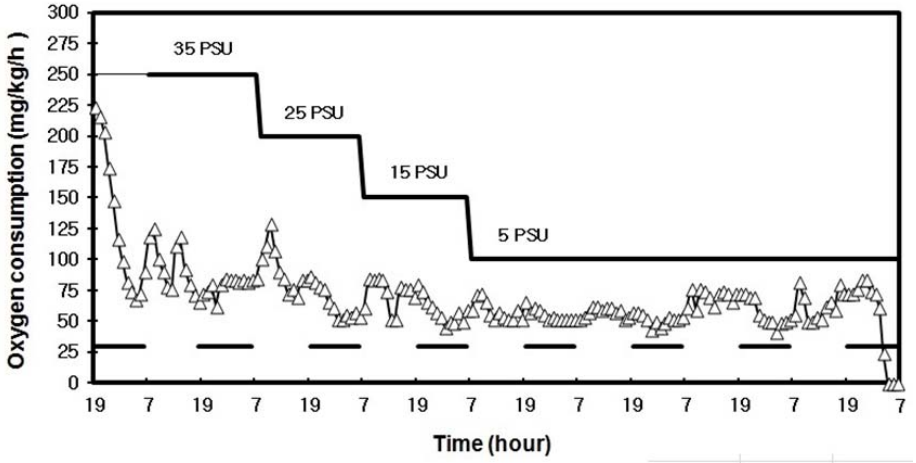

Figure 2. Oxygen consumption (OC) of rock bream *Oplegnathus fasciatus* in gradual lowering salinity changes at 20°C (*Konsumsi oksigen ikan rock bream Oplegnathus fasciatus pada perlakuan penurunan ke salinitas rendah secara gradual pada suhu 20°C*).

Table 2. Average OC (mg O_2/kg/h) of rock bream *Oplegnathus fasciatus* according to different salinity and water temperature (*Rata-rata konsumsi oksigen (mg O_2/kg/jam) dari ikan rock bream Oplegnathus fasciatus berdasarkan perbedaan salinitas dan suhu air*)

Experiments/ (Perlakuan)	Water temperature (Suhu air) (°C)			b	a	r^2
	15	20	25			
35	$64.7 \pm 7.5^{a***}$	$104.0 \pm 16.3^{b*}$	$175.9 \pm 12.2^{c**}$	10.87	-102.47	0.833
25	$45.8 \pm 6.7^{a**}$	$101.7 \pm 11.6^{b*}$	$185.9 \pm 12.4^{c**}$	12.94	-154.36	0.883
15	$29.8 \pm 9.0^{a*}$	$103.3 \pm 7.7^{b*}$	$155.5 \pm 16.7^{c*}$	11.97	-145.02	0.887

Description: Each values represent means ± SD (n = 24). Different superscript letters indicate significant differences among water temperatures in each salinity experiment, respectively. Asterisks indicate significant differences among salinities in each temperature experiments ($P<0.05$, one-way ANOVA) (*Masing-masing nilai menggambarkan nilai rata-rata ± standar deviasi (n=24). Perbedaan huruf yg dicetak atas mengindikasikan adanya pengaruh suhu air yang berbeda nyata pada masing-masing perlakuan salinitas. Tanda bintang mengindikasikan adanya pengaruh salinitas yang berbeda nyata pada masing-masing perlakuan suhu (P<0.05, ANOVA satu arah*).

directly as temperature rised. This study also showed that the highest OC was in 25 psu at 25°C, which means optimal condition for rock bream rearing was at that point.

According to OC data, rock bream consumed higher amount of oxygen during light period than dark period. Beamish and Mookherjii (1964) reported that OC of fish reflected the activity of fish itself. Associated with it, rock bream seems to be more active during day time than night time, which was similar with many fish species reported (Gibson, 1973; Muller, 1978). The OC values from this study also showed lower values than reported by Lim *et al.* (2004) and Oh *et al.* (2010). These lower results caused by different species, density, and body weight. Rock bream seems to have low metabolism rate compared with other fish species observed.

Salinity had impact on decreasing OC of rock bream from 35 psu to lower salinity. This phenomena was mostly associated with natural habitat of rock bream. It was also related to behavior and breath frequency of rock bream, as the results showed low activity at low salinity environment. Morgan and Iwama (1991) suggested that salinity was associated with the low metabolic rates. This results were similar to that of Jeong *et al.* (2007) when observing black porgy's OC and found that OC values in freshwater was lower than seawater. However, the

Table 3. Average OC (mg O_2/kg/h) of rock bream *Oplegnathus fasciatus* in gradual lowering salinity changes at 20°C (*Rata-rata konsumsi oksigen (mg O_2/kg/jam) dari ikan rock bream Oplegnathus fasciatus pada perlakuan penurunan ke salinitas rendah secara gradual pada suhu 20°C*)

Experiment (Perlakuan)	Salinity(Salinitas) (psu)				b	a	r^2
	35	25	15	5			
35→5	87.1 ± 16.6[b]	78.3 ± 20.4[a]	66.3 ± 13.3[a]	58.5 ± 14.8[a]	0.96	53.47	0.324

Notes: Different superscript letters indicate significant differences between salinity, respectively ($P<0.05$, one-way ANOVA) (*Perbedaan huruf yg dicetak atas mengindikasikan adanya pengaruh yang berbeda nyata pada masing-masing salinitas ($P<0.05$, ANOVA satu arah)*).

Table 4. Average OC (mg O_2/kg/h) of rock bream *Oplegnathus fasciatus* according to different salinity and water temperature during light (L) and dark period (D) (*Rata-rata konsumsi oksigen (mg O_2/kg/jam) dari ikan rock bream Oplegnathus fasciatus berdasarkan perbedaan salinitas dan suhu air saat periode terang (L) dan gelap (D)*)

Experiments (Perlakuan)	L : D	Water temperature (Suhu air)(°C)			b	a	r^2
		15	20	25			
35	L	67.1 ± 3.5[a]	111.9 ± 17.9[b]	184.4 ± 9.3[c**]	11.72	-113.54	0.931
	D	62.4 ± 9.6[a]	96.7 ± 10.5[b]	167.4 ± 8.4[c*]	10.50	-101.21	0.922
25	L	52.1 ± 6.9[a]	107.6 ± 12.9[b]	195.4 ± 7.1[c**]	14.33	-168.19	0.961
	D	44.9 ± 4.1[a]	95.7 ± 6.2[b]	176.3 ± 8.6[c*]	13.14	-157.24	0.970
15	L	33.8 ± 5.5[a]	99.8 ± 4.3[b]	167.3 ± 14.9[c**]	13.35	-166.63	0.972
	D	25.8 ± 10.2[a]	106.7 ± 8.9[b]	143.7 ± 7.9[c*]	11.79	-143.82	0.927

Notes: Each values represent means ± SD (n = 12). Different letters indicate significant difference between water temperature in each experiment, respectively ($P<0.05$, one-way ANOVA). Asterisk indicates significant difference between light and dark in each experiment, respectively (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, *t*-test). (*Tiap angka merupakan nilai rata-rata ± standar deviasi (n=12). Perbedaan huruf yg dicetak atas mengindikasikan adanya pengaruh yang berbeda nyata antar suhu air pada masing-masing perlakuan ($P<0.05$, ANOVA satu arah). Tanda bintang mengindikasikan adanya pengaruh yang berbeda nyata antara terang dan gelap pada masing-masing perlakuan (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, uji-t)*).

Table 5. Average OC (mg O_2/kg/h) of rock bream *Oplegnathus fasciatus* in gradual lowering salinity changes at 20°C during light and dark period (*Rata-rata konsumsi oksigen (mg O_2/kg/jam) dari ikan rock bream Oplegnathus fasciatus pada perlakuan penurunan ke salinitas rendah secara gradual pada suhu 20°C saat periode terang (L) dan gelap (D)*)

Experiment (Perlakuan)	L : D	Salinity (Salinitas) (psu)				b	a	r^2
		35	25	15	5			
35→5	L	94.5 ± 20.4[b]	91.7 ± 17.6[b]	73.5 ± 12.1[a]	62.6 ± 8.9[a]	1.16	57.06	0.509
	D	79.8 ± 6.5[b]	64.9 ± 12.9[a]	59.1 ± 10.6[a]	54.4 ± 18.2[a]	0.76	49.89	0.239

Notes: Each values represent means ± SD (n = 12). Different letters indicate significant difference between water temperature in each experiment, respectively ($P<0.05$, one-way ANOVA). Asterisk indicates significant difference between light and dark in each experiment, respectively (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, *t*-test). (*Tiap angka merupakan nilai rata-rata ± standar deviasi (n=12). Perbedaan huruf yg dicetak atas mengindikasikan adanya pengaruh yang berbeda nyata antar suhu air pada masing-masing perlakuan ($P<0.05$, ANOVA satu arah). Tanda bintang mengindikasikan adanya pengaruh yang berbeda nyata antara terang dan gelap pada masing-masing perlakuan (*: $P<0.05$, **: $P<0.01$, ***: $P<0.001$, uji-t)*).

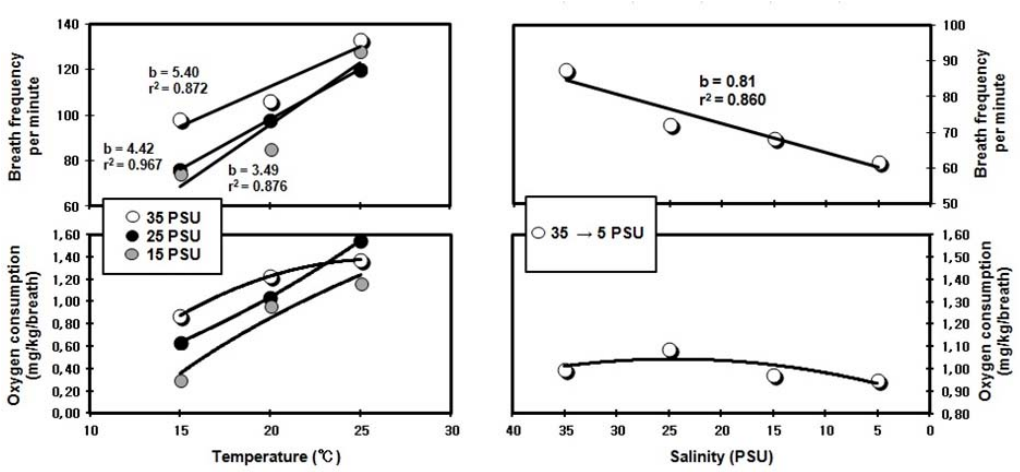

Figure. 3. Breath frequency per minute and OC per breath in rock bream *Oplegnathus fasciatus* in diferent salinity levels (35, 25, and 15 psu) and water temperature degrees (15, 20, and 25°C), and according to gradual salinity changes (35 to 5 psu) at 20°C (*Frekuensi bernapas per menit dan konsumsi oksigen per satu tarikan napas pada ikan rock bream pada tingkat salinitas (35, 25, and 15 psu) dan suhu (15, 20, and 25°C) yang berbeda, dan berdasarkan penurunan ke salinitas rendah secara gradual (35 ke 5 psu) pada suhu 20°C*).

results were different from Lim *et al.* (2004) whose observing on hybrid stripped bass and reported the opposite pattern of OC when comparing seawater and freshwater.

CONCLUSION

Salinity level and water temperature changes had significant impact to the oxygen consumption of rock bream *Oplegnathus fasciatus*. The oxygen consumption of rock bream decreased with lowering salinities. Meanwhile, the oxygen consumption of rock bream increased with increasing water temperatures.

ACKNOWLEDGEMENT

We thank the Korea International Cooperation Agency (KOICA) for funding this study. Our thank is also delivered to the Agency for Marine and Fisheries Research and Development, Ministry of Marine Affairs and Fisheries, Republic of Indonesia for support and encouragement to conduct this study.

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Pedoman Penulisan Naskah Berita Biologi

Berita Biologi adalah jurnal yang menerbitkan artikel kemajuan penelitian di bidang biologi dan ilmu-ilmu terkait di Indonesia. Berita Biologi memuat karya tulis ilmiah asli berupa makalah hasil penelitian, komunikasi pendek dan tinjauan kembali yang belum pernah diterbitkan atau tidak sedang dikirim ke media lain. Masalah yang diliput, diharuskan menampilkan aspek atau informasi baru.

Tipe naskah

1. **Makalah lengkap hasil penelitian (*original paper*)**
   Naskah merupakan hasil penelitian sendiri yang mengangkat topik yang *up-todate*. Tidak lebih dari 15 halaman termasuk tabel dan gambar. Pencantuman lampiran seperlunya, namun redaksi berhak mengurangi atau meniadakan lampiran.
2. **Komunikasi pendek (*short communication*)**
   Komuniasi pendek merupakan makalah hasil penelitian yang ingin dipublikasikan secara cepat karena hasil termuan yang menarik, spesifik dan baru, agar dapat segera diketahui oleh umum. Artikel yang ditulis tidak lebih dari 10 halaman. Hasil dan pembahasan boleh digabung.
3. **Tinjauan kembali (*review*)**
   Tinjauan kembali merupakan rangkuman tinjauan ilmiah yang sistematis-kritis secara ringkas namun mendalam terhadap topik penelitian tertentu. Hal yang ditinjau meliputi segala sesuatu yang relevan terhadap topik tinjauan yang memberikan gambaran '*state of the art*', meliputi temuan awal, kemajuan hingga issue terkini, termasuk perdebatan dan kesenjangan yang ada dalam topik yang dibahas. Tinjauan ulang ini harus merangkum minimal 30 artikel.

Struktur naskah

1. **Bahasa**
   Bahasa yang digunakan adalah bahasa Indonesia atau Inggris yang baik dan benar.
2. **Judul**
   Judul harus singkat, jelas dan mencerminkan isi naskah diikuti oleh nama dan alamat surat menyurat penulis. Nama penulis untuk korespondensi diberi tanda amplop cetak atas (*superscript*).
3. **Abstrak**
   Abstrak dibuat dalam dua bahasa, bahasa Indonesia dan Inggris. Abstrak memuat secara singkat tentang latar belakang, tujuan, metode, hasil yang signifikan, kesimpulan dan implikasi hasil penelitian. Abstrak berisi maksimum 200 kata, spasi tunggal. Di bawah abstrak dicantumkan kata kunci yang terdiri atas maksimum enam kata, dimana kata pertama adalah yang terpenting. Abstrak dalam bahasa Inggris merupakan terjemahan dari bahasa Indonesia. Editor berhak untuk mengedit abstrak demi alasan kejelasan isi abstrak.
4. **Pendahuluan**
   Pendahuluan berisi latar belakang, permasalahan dan tujuan penelitian. Sebutkan juga studi terdahulu yang pernah dilakukan.
5. **Bahan dan cara kerja**
   Pada bagian ini boleh dibuat sub-judul yang sesuai dengan tahapan penelitian. Metoda harus dipaparkan dengan jelas sesuai dengan standar topik penelitian dan dapat diulang oleh peneliti lain. Apabila metoda yang digunakan adalah metoda yang sudah baku cukup ditulis sitasi dan apabila ada modifikasi harus dituliskan dengan jelas bagian mana dan apa yang dimodifikasi.
6. **Hasil**
   Sebutkan hasil-hasil utama yang diperoleh berdasarkan metoda yang digunakan. Apabila ingin mengacu pada tabel/grafik/diagram atau gambar uraikan hasil yang terpenting dan jangan menggunakan kalimat 'Lihat Tabel 1'. Apabila menggunakan nilai rata-rata harus menyebutkan standar deviasi.
7. **Pembahasan**
   Jangan mengulang isi hasil. Pembahasan mengungkap alasan didapatkannya hasil dan apa arti atau makna dari hasil yang didapat tersebut. Bila memungkinkan, bandingkan hasil penelitian ini dengan membuat perbandingan dengan studi terdahulu (bila ada).
8. **Kesimpulan**
   Menyimpulkan hasil penelitian, sesuai dengan tujuan penelitian, dan penelitian berikut yang bisa dilakukan.
9. **Ucapan terima kasih**
10. **Daftar pustaka**
    Tidak diperkenankan untuk mensitasi artikel yang tidak melalui proses peer review. Apabila harus menyitir dari "Laporan" atau "komunikasi personal" dituliskan *'unpublished'* dan tidak perlu ditampilkan di daftar pustaka. Daftar pustaka harus berisi informasi yang *up to date* yang sebagian besar berasal dari *original papers*. Penulisan terbitan berkala ilmiah (nama jurnal) tidak disingkat.

Format naskah

1. Naskah diketik dengan menggunakan program Word Processor, huruf New Times Roman ukuran 12, spasi ganda kecuali Abstrak. Batas kiri -kanan atas-bawah masing-masing 2,5 cm. Maksimum isi naskah 15 halaman termasuk ilustrasi dan tabel.
2. Penulisan bilangan pecahan dengan koma mengikuti bahasa yang ditulis menggunakan dua angka desimal di belakang koma. Apabila menggunakan bahasa Indonesia, angka desimal menggunakan koma (,) dan titik (.) bila menggunakan bahasa Inggris. Contoh: Panjang buku adalah 2,5cm. Lenght of the book is 2.5 cm. Penulisan angka 1-9 ditulis dalam kata kecuali bila bilangan satuan ukur, sedangkan angka 10 dan seterusnya ditulis dengan angka. Contoh lima orang siswa, panjang buku 5 cm.
3. Penulisan satuan mengikuti aturan *international system of units*.
4. Nama takson dan kategori taksonomi merujuk kepada aturan standar termasuk yang diakui. Untuk tumbuhan *International Code of Botanical Nomenclature* (ICBN), untuk hewan *International Code of Zoological Nomenclature* (ICZN), untuk jamur *International Code of Nomenclature for Algae, Fungi and Plant* (ICFAFP), *International Code of Nomenclature of Bacteria* (ICNB), dan untuk organisme yang lain merujuk pada kesepakatan Internasional. Penulisan nama takson lengkap dengan nama author hanya dilakukan pada bagian deskripsi takson, misalnya pada naskah taksonomi. Sedangkan penulisan nama takson untuk bidang lainnya tidak perlu menggunakan nama author.
5. Tata nama di bidang genetika dan kimia merujuk kepada aturan baku terbaru yang berlaku.
6. Ilustrasi dapat berupa foto (hitam putih atau berwarna) atau gambar tangan (*line drawing*).
7. Tabel
   Tabel diberi judul yang singkat dan jelas, spasi tunggal dalam bahasa Indonesia dan Inggris, sehingga Tabel dapat berdiri sendiri. Tabel diberi nomor urut sesuai dengan keterangan dalam teks. Keterangan Tabel diletakkan di bawah Tabel. Tabel tidak dibuat tertutup dengan garis vertikal, hanya menggunakan garis horisontal yang memisahkan judul dan batas bawah. Paragraf pada isi tabel dibuat satu spasi.
8. Gambar
   Gambar bisa berupa foto, grafik, diagram dan peta. Judul ditulis secara singkat dan jelas, spasi tunggal. Keterangan yang menyertai gambar harus dapat berdiri sendiri, ditulis dalam bahasa Indonesia dan Inggris. Gambar dikirim dalam bentuk .jpeg dengan resolusi minimal 300 dpi.
9. Daftar Pustaka
   Sitasi dalam naskah adalah nama penulis dan tahun. Bila penulis lebih dari satu menggunakan kata 'dan' atau *et al.* Contoh: (Kramer, 1983), (Hamzah dan Yusuf, 1995), (Premachandra *et al.,* 1992). Bila naskah ditulis dalam bahasa Inggris yang menggunakan sitasi 2 orang penulis

maka digunakan kata 'and'. Contoh: (Hamzah and Yusuf, 1995).

a. Jurnal
   Nama jurnal ditulis lengkap.
   Premachandra GS, H Saneko, K Fujita and S Ogata. 1992. Leaf Water Relations, Osmotic Adjustment, Cell Membrane Stability, Epi-cutilar Wax Load and Growth as Affected by Increasing Water Deficits in Sorghum. *Journal of Experimental Botany* **43,** 1559-1576.
b. Buku
   Kramer PJ. 1983. *Plant Water Relationship*, 76. Edisi ke-(bila ada). Academic, New York.
c. Prosiding atau hasil Simposium/Seminar/Lokakarya.
   Hamzah MS dan SA Yusuf. 1995. Pengamatan Beberapa Aspek Biologi Sotong Buluh *(Sepioteuthis lessoniana)* di Sekitar Perairan Pantai Wokam Bagian Barat, Kepulauan Aru, Maluku Tenggara. *Prosiding Seminar Nasional Biologi XI,* Ujung Pandang 20-21 Juli 1993. M Hasan, A Mattimu, JG Nelwan dan M Litaay (Penyunting), 769-777. Perhimpunan Biologi Indonesia.
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   Leegood RC and DA Walker. 1993. Chloroplast and Protoplast. In: *Photosynthesis and Production in a Changing Environment.* DO Hall, JMO Scurlock, HR Bohlar Nordenkampf, RC Leegood and SP Long (Eds), 268-282. Champman and Hall. London.
e. Thesis dan skripsi.
   Keim AP. 2011. Monograph of the genus *Orania* Zipp. (Arecaceae; Oraniinae). University of Reading, Reading. [PhD. Thesis].
f. Artikel online.
   Artikel yang diunduh secara online mengikuti format yang berlaku misalnya untuk jurnal, buku atau thesis, serta dituliskan alamat situs sumber dan waktu mengunduh. Tidak diperkenankan untuk mensitasi artikel yang tidak melalui proses *peer review* atau artikel dari laman web yang tidak bisa dipertangung jawabkan kebenarannya seperti wikipedia.
   Forest Watch Indonesia[FWI]. 2009. Potret keadaan hutan Indonesia periode 2000-2009. *http://www.fwi.or.id*. (Diunduh 7 Desember 2012).

Formulir persetujuan hak alih terbit dan keaslian naskah

Setiap penulis yang mengajukan naskahnya ke redaksi Berita Biologi akan diminta untuk menandatangani lembar persetujuan yang berisi hak alih terbit naskah termasuk hak untuk memperbanyak artikel dalam berbagai bentuk kepada penerbit Berita Biologi. Sedangkan penulis tetap berhak untuk menyebarkan edisi cetak dan elektronik untuk kepentingan penelitian dan pendidikan. Formulir itu juga berisi pernyataan keaslian naskah, yang menyebutkan bahwa naskah adalah hasil penelitian asli, belum pernah dan sedang diterbitkan di tempat lain.

Penelitian yang melibatkan hewan

Untuk setiap penelitian yang melibatkan hewan sebagai obyek penelitian, maka setiap naskah yang diajukan wajib disertai dengan '*ethical clearance approval*' terkait *animal welfare* yang dikeluarkan oleh badan atau pihak berwenang.

Lembar ilustrasi sampul

Gambar ilustrasi yang terdapat di sampul jurnal Berita Biologi berasal dari salah satu naskah. Oleh karena itu setiap naskah yang ada ilustrasi harap mengirimkan ilustrasi dengan kualitas gambar yang baik disertai keterangan singkat ilustrasi dan nama pembuat ilustrasi.

Proofs

Naskah *proofs* akan dikirim ke author dan diwajibkan membaca dan memeriksa kembali isi naskah dengan teliti. Naskah proofs harus dikirim kembali ke redaksi dalam waktu tiga hari kerja.

Naskah cetak

Setiap penulis yang naskahnya diterbitkan akan diberikan 1 eksemplar majalah Berita Biologi dan reprint. Majalah tersebut akan dikirimkan kepada *corresponding author*.

Pengiriman naskah

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BERITA BIOLOGI

Vol. 15(2) **Isi (Content)** Agustus 2016

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