Fisheries Science (2019) 85:821–828
https://doi.org/10.1007/s12562-019-01330-2

, (. 1 ; 1). ,

C. hongkongensis *C. sikamea* (1 ; . 2004). , - - (. 200 ; . 2012, 201). , · *C. hongkongensis* *C. angulate* (. 201), *C. hongkongensis* *C. sikamea* (. 201) *C. hongkongensis* *C. ariakensis* (. 201). , *C. hongkongensis* *C. gigas* (. 201), .

C. sikamea , (. 201), - *C. sikamea* *C. gigas* (. 1 ; . 2012).

C. sikamea (. 201). , ; - (. 2004). , , - (. 1 4; . 200 ; . 2012). - *C. gigas* *C. sikamea*

. *C. sikamea*, , . , *C. gigas*, , . (2011), .

. , *C. sikamea* *C. gigas* - . , - - *C. gigas* *C. sikamea* , - , -

Material and methods

Brood stocks and rearing conditions

C. sikamea , , . - - *C. gigas* (200) - , , . 201 , - - . (2011). - , *C. gigas* 1 . 1 , , *C. sikamea* 1000- 2 .2 0. 2 0 .

Fertilization and embryo hatching

C. sikamea 201 , . , - . , - . , % . 0 - ; *C. gigas* ( ) *C. sikamea* ( ) (1). , 0 0 , . (201). · *C. gigas* ♀ *C. gigas* ♂( ), *C. gigas* ♀ *C. sikamea* ♂( ), *C. sikamea* ♀ *C. gigas* ♂( ), *C. sikamea* ♀ *C. sikamea* ♂( ). . - , 0- - 0 40 1 .

Table 1 *C. gigas* *C. sikamea*

	1♀	1♀	2♀	2♀	♀	♀
1♂	1	1				
1♂	1	1				
2♂			2	2		
2♂			2	2		
♂						
♂						

C. gigas ♀, *C. gigas* ♂, *C. sikamea* ♀, *C. sikamea* ♂, *C. gigas* ♀, *C. sikamea* ♂, *C. sikamea* ♀, *C. gigas* ♂ . 1, 2, 4 ;

2 0 0 .

Rearing, nursery and grow-out

24 , - 4 - (0-). - 1 . , . (2012). , *Isochrysis galbana* , *Platymonas* . . 100% . 2 0 2 0 . 0% , . 10 , 1 . , 0- - , , - , ; - 1. 2 .

Genetic con□rmation

( ) ( ) (200) ( ). , 120 - (4 0) . , - 100. - ( ), 1 (1) (200). 1 ′- (2) ′- (.). 1 (2+), 0.2 , 1 , 0.2 *Taq* ( ) 1 0 . , 1 , 1 , 2 1 , 2 . -1 *Hin* - . *C. gigas* (4 4) *Hin* 1 2 1 , *Hin* - *C. sikamea* (, 2). 1. 10 . - 1. % .

Sample collection

. , 2- , ( ) . - - ( ), - , - (2). , - - , - - , - , ,

Table 2 , *C. gigas* ( ), *C. sikamea* ( ), ( ), (*H*) - (*I*)

					(%)				
					12	21	120	210	20
	( )	(%)	(%)	- (%)					
1	0.	4.1	2.	1.1	2 .	.	4.	2. 1	1.02
2	0.	2.	. 1	.1	24	11.	.1	.	1.
	1.1	0	.	.2	1	.	.	.2	0.
4	1. 2	.1	.	1.	1	4.	.1	.02	0. 1
	1.1 0. 2	. 1 4.0	. 2 .12	.12 .41	21.1	.2 .4	4. 2.2	. 1.	1.04 0.41
1		4.2	0.	.	1.		. 2	4.0	2
2		1		.	2	10	.4	.	2.
		0	.14	. 1	0	.	.0	.4	2.0
4		.	.	. 4		.	.	.1	1.0
		.1 . 2	1.2 .	1.22 12.	0. .	. 1.	.2 1.	4.4 0. 2	1. 0.
1		1. 2	0.						
2		0.2							
		0.0							
4		0.4	0.0 2						
1	4 .		1.			.	.	.	1.
2	4 .4	. 1	.	2.22	20	.	. 2	4.1	0.
	44.02	1. 4	.4	. 1	1	4.	2.1	1.24	0.41
4	4	4.44	.	2. 4	40	12	.	. 4	1. 4
	4 . 4 0.4	2.12 .11	.0 .	0. 14.4	2 . 11.	.0	4. 2 2. 2	.1 1. 2	1.0 0.
H (%)		4.24	4.	.	2 .	.	2 . 2	2 .1	
I (%)		.	. 4	11.	11.	.1	0.	40.4	.2

, *n* 120 (4 0); , , *n* 4 ( ) - . , (*p* 0.0)

0 - .0 . - , - (*H*) 0 (1).

0.01 -

$$H_t(\%) = (2SG - GG - SS)/(GG + SS) \times 100,$$

.

Statistical analysis

, .

C. sikamea, (*I*) .

- , , .

$$I_{SG}(\%) = (X_{F1} - X_{Ai}) \times 100/X_{Ai},$$

- ( ). X_{-1} , X *C. sikamea*.

- . -

-

,

- .

1 .0 , p 0.0 .

Results

Fertilization

C. gigas *C.* *sikamea* , 1.1 *C. gigas* 4 . 4 *C. sikamea* (2)! , , . - 0. 1%, - . 1%, .1 % 2.12% , , (2);

Survival

- , . , (2). . 2% , 1.2 % , .0 % (2). - , - 1.1 % , 0. % , 0.1 % (2). , ( ). , (2). _ , 12 21, - 2 . % . %, . -

Table 3 -

	.	_	*F*		.	_	*F*	
_	2	0.004	.00	0.002**				
		0.00	11. 0	0.001***				
		0.00	.1	0.001***				
	2	0.00	10. 2	0.001***				
		0.00	20.	0.001***				
		0.00	2 .0	0.001***				
	2	0.14	1 . 11	0.001***	2	0.20	1 .1 0	0.001***
		0.0	.0 0	0.001***		0.00	0.	0.
		0.10	111. 1	0.001***		0.00	0.40	0.
12	2	0.0 4	124.	0.001***	2	0.	.	0.001***
		0.0 0	120.0 1	0.001***		0.00	0.	0. 21
		0.041	1.	0.001***		0.00	1.0	0.
21	2	0.0	4 . 1	0.001***	2	0. 4	.	0.001***
		0.122	. 0	0.001***		0.00	0.	0.40
		0.0	44. 4	0.001***		0.00	0.	0.
120	2	0.0 2	.401	0.002**	2	2.	14 .4 2	0.001***
		0.1	20.221	0.001***		0.0	4. 4	0.004**
		0.0	. 1	0.001***		0.1	.02	0.001***
210	2	0.10	4. 0	0.02 *	2	2.14	10 . 2	0.001***
		0.1 0	.	0.001***		0.0	2. 1	0.04 *
		0.0	2. 02	0.0 *		0.0	2.	0.00 **
20	2	0.41	4.240	0.02 *	2	0.2	4.1	0.001***
		0.0	0.	0.4 1		0.00	0.	0.4
		0.212	2.1	0.0 4		0.01	2.004	0.0 4

_ , , *n* (12); , *n* 00 (0 12)

*p 0.0 ; **p 0.01; ***p 0.001

, ; (4),
I 0. % 120 40.4 % *I* 2 . 2% 120 24.4 %
210. , 210. (
(*p* 0.0) (2); -)
- (*p* 0.001) ( ).
( ).

Growth

Genetic con rmation

1 *C. gigas* *C.*
sikamea , 0 (. 1),
4.
. , *Hin* -
(*p* 0.0 ; , 4). - 1 *C. gigas*
, (200 00),
(*p* 0.0). *C. sikamea*,
, _1 (. 1).

Table 4 *C. gigas* ( ), *C. sikamea* ( ), ( ) , (*H*) - -
(*I*)

	( )	12 ( )	21 ( )	120 ( )	210 ( )	20 ( )
1	122.40	141.	2 1. 1	12.	14.4	1.1
2	1 .42	1 .2	2 .	12.	1 . 4	2.01
	121.1	142.	2 . 4	14.44	1 .22	2.
4	12 .	140.2	2 .2	14.2	1 .0	2.
_	12 .1 2 .4	1 . .	2 0. 4 .2	1 . 0.	1 .02 0.41	2.1 . 2
1	102.	11 .	21 .	.	11.01	0.20
2	.0	11 . 0	21 .	10. 2	.	2 .01
	102. 2	11 .	21 .2	. 1	10. 1	2 .14
4	.2	11 .	210.	. 4	10.42	2 .
_	100. 1 .	11 . 4 2 .	214.1 42. 4	. 2 1.	10. 0.4	2 . 2 1.1
1	10 . 1	12 . 1	2 . 0	.2	. 4	2 .1
2	104.	11 . 0	2 4.4	. 2	.4	2 .2
	104.	112. 4	2 2. 4	. 2	.2	2 . 2
4	. 0	11 .41	2 .	.	. 2	24. 4
_	100. 2 .	11 .1 0.	2 . . 1	.0 0.	. 1 1.	2 .2 4.
H (%)	11.	.2	21. 4	1 .	10.00	2.2
I (%)	0.2	1.14	1 .	2 . 2	24.4	.

_ , *n* 120 . (*p* 0.0).
- ,

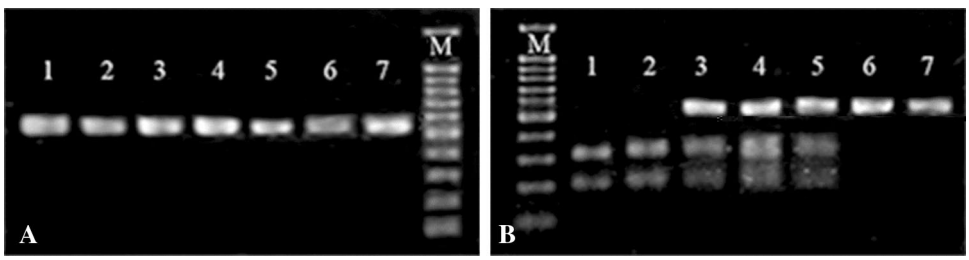

Fig. 1 *C. gigas*, *C. sikamea* . 1 . 1 *Hin* . _ , -
(100); 1 2, *C. gigas* ; , *C. sikamea* | *C. gigas* ; , *C. sikamea*

Discussion

, *C. sikamea* *C. gigas*.

. .

C. sikamea *C. gigas* ,

C. gigas *C.*

sikamea . ,

;

C. gigas

C. sikamea -

(. 2012).

(. 201). ,

.1 %,

. - ,

. , -

-

Crassostrea (

. 1 ; . 200 ;

201).

(. 200 ; . 200). -

,

, ,

(. 1 4; . 200 ;

. 200). ,

,

-

C. gigas *C. sikamea* .

, *C. gigas*

C. sikamea ,

(

200 ; . 2011). ,

-

(. 201),

-

.

-

Crassostrea (.

1 ; 1 ; . 2002).

, ,

,

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. ,

(

. 2010; 2012).

C. hongkongensis *C.*

angulate (. 201) *C. hongkongensis* *C.* -1

sikamea (. 201),

.

,

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C. ariakensis *C. sikamea*, *C. virginica* *C.*

gigas *C. gigas* *C. angulata* (. 1 ; -

. 2002; . 200).

_1 -

, (

. 201). , (*C.*

sikamea)

, 2 . 2%

120 24.4 % 210.

. . (201) -

, , (1)
Crassostrea virginica ( ) *C. rivularis* ( ) *C. gigas* ( ). 11 ·2 2
, , , (1 4)
, *Crassostrea gigas* *C. sikamea*. 121·12 1
, , (2001) -
. 10· 2
, , , , , (200)
Crassostrea ariakensis *Crassostrea virginica*· 2 · 00
, , , , , ,
(200) *Crassostrea sikamea* -
,
. 2 · 1 22
, (1)
(*Argopecten circularis*, , 1)
. 212· 110
, , , , , ,
, (200) , ,
, , -
- (*Crassostrea gigas*).
24 ·21 22
, , (2010) -
(*Crassostrea gigas*). .
. -
2 ·21 2
(200)
. ,
, , , (201)
Crassostrea sikamea
, . · 11
(1) .
. 14·22
, (200)
Crassostrea gigas. 2 2·1 2
, , , (1) -
Crassostrea sikamea , .
1 ·
, , (2012)
Crassostrea sikamea
. ·2 2
, , , (201) , ,
Crassostrea hongkongensis ♀ *Crassostrea ariakensis* ♂
. 2·
, - (2011) -
Haliotis·
. · 4
, , , , , ,
(201)
(*Panopea zelandica*).
. :// . /10.101 / 002 1 41 001
, , , (2011) -
Crassostrea
gigas. · 4 4
, (200) *Cras-*
sostrea gigas. 42 ·21 220
, (2012)
(*Crassostrea virginica*)
, · 1
, , (200) -
Mytilus edulis *M. trossulus*.
14 · 1 2
(1) -
. 1 ·1 1
, , (200)
. 214·
, , , , , ,
, (2002) ,
Crassostrea gigas, *C. angulata*
. 1 ·24 2 0
, , , , , , , ,
, (201)
- ,
.
12· 01 2 1
, (200) *Crassostrea ariakensis*
- .
2 ·4 1 4
, (200)
. 2 ·4 4
, , , (2004)
Crassostrea rivularis (, 1 1) ,
. 242·1 1
, , , (2012)
(*Crassostrea gigas*).
11·41 41
, , , (201)
Crassostrea sikamea (1 2) .
2·4 44
, , , , , , , (201) -
, ,
. 4 ·2 0 2
, , , (2011) -
Crassostrea sikamea, -
Crassostrea.
0· 4
, , , , , (200) -
Crassostrea ariakensis *C.* .
2 ·4 4
, , , , (201) -
Haliotis discus
hannai *H. fulgens*. 44 ·24 24
, (201)
1 ·1 11
, , , , , , , , (2012)
.
. 1· 1 2
, , , , , (201)
-
Crassostrea hongkongensis (& , 200)
. 4 ·1 11
, , , , , (201)
Crassostrea hongkongensis ♀ *C. angulata* ♂
. 4 · 40
, , , , , , , (201)
Crassostrea hongkongensis *C. gigas*
. 4 0· 101
, , , , , (201) -
-
, *Crassostrea hongkongensi* *Crassostrea sikamea*
. 4 · 10 1

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