

Sex Ratio of the Japanese Crayfish *Cambaroides japonicus* (de Haan, 1841) (Crustacea, Decapoda, Astacoidea) in a Stream and a Small Lake in Hokkaido*¹

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The sex ratio of the Japanese crayfish *Cambaroides japonicus* (de Haan, 1841) was studied in a stream and a small lake in Hokkaido. In both areas, the sex ratios were 1:1 in juveniles and adults for each month.

The Japanese crayfish *Cambaroides japonicus* (de Haan, 1841) lives in streams and lakes in the northern part of Japan: Hokkaido, Aomori, Akita, and Iwate Prefectures. This species generally grows to 5-6cm in body length¹⁾. Ecological information on the crayfish is scarce though it is protected as a natural monument of locality because of its rarity value²⁾. Thus, for comparison we studied its sex ratio relating to reproduction in a stream and a small lake in Hokkaido.

Material and Methods

The study areas were a stream in Atsuta and a small lake in Shikaoi, Hokkaido. The stream has no tributaries over the 1km-drift, 1m in maximum width and 5cm in maximum depth. The lake is circular in form, 0.8 km in circumference, 5m in maximum depth and has no inflow or outflow stream. The Japanese crayfish were collected from 25m² in the stream and from 40m² along the shore of the lake by hand with a 1 × 1m quadrat. These samplings were carried out once a month from 1990 to 1992.

In the lake, samplings at three different depths, 0-2m, 2-4m, and 4-5m, were also conducted using a hand net with a 1 × 1m quadrat using SCUBA on Oct. 24 and 27 in 1990. Total swept area was 20m² at each depth range.

Carapace lengths (CLs) of specimens collected were measured from the posterior portion of the eye socket to the posterior margin of the carapace. The smallest sexually mature individuals were 18mm in CL for both males and females in these habitats³⁾, therefore, we defined individuals larger than 18mm as "adult" and smaller ones as "juvenile". According to Holdich and Reeve⁴⁾, sex was determined by the morphology of the 1st and 2nd pleopods and the position of the gonopores. All individuals were released back to the place where they were captured immediately after examination.

Results and Discussion

The stream studied was surrounded by trees and a large quantity of fallen leaves covered the stony bottom of the stream in autumn.

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Japanese crayfish was observed under the fallen leaves without a personal burrow. In the lake, a salamander *Hynobius retardatus* and the larvae of aquatic insect were also found. Crayfishes hid themselves under stone or fallen leaves all the year round and had no burrows. There

hid themselves under stone or fallen leaves all the year round and had no burrows. There were no fish and aquatic predators on *C.japonicus* in both the stream and the lake.

During this study, 532 males and 551 females were collected in the stream, and we

Table 1. Sex ratio of *Cambaroides japonicus* in a stream in Hokkaido

Date	Sex ratio (No. males/No. females)		
	Juvenile (a)	Adult (b)	Population (a+b)
Apr. 29, 1991	2.00(4/ 2)	1.00(3/ 3)	1.40(7/ 5)
May 11,	0.67(4/ 6)	1.33(4/ 3)	0.89(8/ 9)
June 29,	0.72(42/ 58)	1.20(18/ 15)	0.82(60/ 73)
July 7,	1.17(28/ 24)	0.75(27/ 36)	0.92(55/ 60)
Aug. 25,	1.13(36/ 32)	0.70(19/ 27)	0.93(55/ 59)
Sep. 22,	1.31(21/ 16)	0.80(12/ 15)	1.06(33/ 31)
Oct. 6,	2.50(10/ 4)	0.67(8/ 12)	1.13(18/ 16)
Nov. 23,	2.50(10/ 4)	1.33(12/ 9)	1.69(22/ 13)
Apr. 20, 1992	3.00(3/ 1)	0.40(2/ 5)	0.83(5/ 6)
May 17,	1.64(18/ 11)	0.79(11/ 14)	1.16(29/ 25)
June 21,	0.92(22/ 24)	1.00(14/ 14)	0.95(36/ 38)
July 7,	0.64(7/ 11)	0.70(7/ 10)	0.67(14/ 21)
Aug. 5,	0.94(29/ 31)	1.27(19/ 15)	1.04(48/ 46)
Sep. 8,	0.91(29/ 32)	1.29(18/ 14)	1.02(47/ 46)
Oct. 10,	1.37(26/ 19)	1.40(35/ 25)	1.39(61/ 44)
Nov. 4,	0.60(21/ 35)	0.58(14/ 24)	0.59(35/ 59)
Total	1.00(310/310)	0.93(223/241)	0.97(533/551)

* Juvenile, ≤ 18 mm CL (Carapace Length); Adult, > 18 mm CL; following Kawai *et al.*³¹.

Table 2. Sex ratio of *Cambaroides japonicus* in a small lake in Hokkaido

Date	Sex ratio (No. males/No. females)		
	Juvenile (a)	Adult (b)	Population (a+b)
May 25, 1991	0.00(1/ 0)	6.00(6/ 1)	7.00(7/ 1)
June 29,	1.11(10/ 9)	1.42(17/ 12)	1.29(27/ 21)
July 28,	0.00(0/ 0)	1.88(15/ 8)	1.88(15/ 8)
Aug. 10,	0.75(24/ 32)	0.76(16/ 21)	0.75(40/ 53)
Sep. 16,	1.29(9/ 7)	1.34(51/ 38)	1.33(60/ 45)
Oct. 31,	0.63(5/ 8)	0.80(4/ 5)	0.69(9/ 13)
Nov. 3,	0.67(2/ 3)	0.71(5/ 7)	0.70(7/ 10)
May 24, 1992	0.00(0/ 0)	0.67(4/ 6)	0.67(4/ 6)
June 27,	1.06(19/ 18)	1.73(26/ 15)	1.36(45/ 33)
July 25,	1.23(16/ 13)	0.74(17/ 23)	0.92(33/ 36)
Aug. 30,	0.29(2/ 7)	0.84(37/ 44)	0.76(39/ 51)
Sep. 20,	0.50(2/ 4)	0.63(15/ 24)	0.61(17/ 28)
Oct. 3,	0.43(3/ 7)	0.65(22/ 34)	0.61(25/ 41)
Nov. 6,	0.00(0/ 3)	0.83(5/ 6)	0.56(5/ 9)
Total	0.84(93/111)	0.98(240/244)	0.94(333/355)

* Juvenile, ≤ 18 mm CL (Carapace Length); Adult, > 18 mm CL; following Kawai *et al.*³¹.

sampled 333 males and 355 females in the lake. There were no significant difference between numbers of males and females at both study sites (Binomial tests, $P_s > 0.05$) (Tables 1 and 2). In both the stream and the lake, numbers of males and females were not significantly different for each month for juveniles and adults (Binomial tests, $P_s > 0.05$), except for samples of Nov. 4, 1992 (Tables 1 and 2). In the lake,

Table 3. Sex ratio of *Cambaroides japonicus* at each depth range in the small lake in Hokkaido

Depth	Sex ratio (No. males/No. females)		
	Juvenile (a)	Adult (b)	Population (a+b)
0-2m	1.00 (5/ 5)	1.04 (27/26)	1.03 (32/31)
2-4m	3.00 (6/ 2)	1.25 (30/24)	1.38 (36/26)
4-5m	0.57 (4/ 7)	0.64 (9/14)	0.62 (13/21)
Total	1.07 (15/14)	1.03 (66/64)	1.04 (81/78)

* Juvenile, ≤ 18 mm CL (Carapace Length); Adult, > 18 mm CL; following Kawai *et al.*³⁾

there were also no statistical differences between numbers of males and females in the different three depth ranges in October, 1990 (Binomial tests, $P_s > 0.05$) (Table 3). Since *P. clarkii* adult females are confined to their burrows during the breeding season, the number of females may be underestimation at this time⁵⁾. The noble crayfish *Astacus astacus* female in a lake were also confined under their shelters with a low activity during the reproductive season, therefore, during the breeding season males more than females were sampled⁶⁾. For *C. japonicus* collected here, however, no burrows

were found, thus, all females were available for sampling by hand in each quadrat. Hence, we conclude that the sex ratio in both habitats is 1:1 year-round and no underestimation of female numbers.

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北海道の小川および小湖におけるザリガニ *Cambaroides japonicus* の性比

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北海道の小川と小湖におけるザリガニ性比を調査した結果、両調査地とも、未成体及び成体の各月の性比はそれぞれ1:1であった。