

Notes on protandry in the creediid fishes *Limnichthys fasciatus* and *L. nitidus* (Teleostei: Creediidae)

著者	Toshiaki Shitamitsu, 須之部 友基
journal or publication title	Ichthyological Research
volume	64
number	3
page range	365-367
year	2017-07
科学研究費研究課題	魚類における配偶システムの系統進化と脳内神経葉ホルモン遺伝子に関する研究
研究課題番号	16K07507
URL	http://id.nii.ac.jp/1342/00001580/

doi: 10.1007/s10228-016-0566-z



1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28

Notes on protandry in the creediid fishes *Limnichthys fasciatus* and *L. nitidus*
(Teleostei: Creediidae)

Toshiaki Shitamitsu • Tomoki Sunobe

T. Shitamitsu • T. Sunobe

Laboratory of Fish Behavioral Ecology, Tateyama Station, Field Science Center,
Tokyo University of Marine Science and Technology, 670 Banda, Tateyama
294–0308, Japan

Present Address:

T. Shitamitsu (✉)

Marine Fisheries Research and Development Center, Japan Fisheries Research
and Education Agency, 15F Queen’s Tower B, 2–3–3 Minatomirai, Nishi-ku,
Yokohama-city, Kanagawa 220–6115, Japan

E-mail: shitamitsu@affrc.go.jp

Running title: Protandry in *Limnichthys*

News and Comments

Six pages

Two figures

29 Fishes of the family Creediidae occur mainly on sandy bottom of tropical and
30 temperate shallow waters in Indo–West Pacific Ocean. Eight genera and 18 valid
31 species are known (Fricke and Golani 2012; Nelson et al. 2016). For ecological
32 information, Leis (1982) and Reader et al. (2000) describe egg and larval
33 development of *L. fasciatus* and *L. nitidus*, respectively. Cozzi and Clark (1995)
34 reports darting behavior, exhibited by *L. nitidus* as quick movements out and
35 back in the sand, suggesting that it was an escape behavior when they were
36 disturbed.

37 Biological information on reproduction of Creediidae has been very limited.
38 Langston (2004) histologically studies sexuality of 10 species of creediids and
39 shows that *Crystallodytes cookei* and *Limnichthys nitidus*, identified as *L.*
40 *donaldsoni* in the original paper, which is a junior synonym of *L. nitidus*
41 (Yoshino et al. 1999; Shimada 2013), are regarded as protandry (sex change
42 from male to female) by histological observation of gonads and size
43 distributions of both sexes (female>male). In addition to these two species,
44 *Chalixodytes tauensis*, *Crystallodytes pauciradiatus* and *L. fasciatus* have
45 gonads comprised of ovarian and testicular parts divided by connective tissue in
46 functional males, whereas those of females consist of only ovarian part.

47 Sadovy de Mitcheson and Liu (2008) indicates that functional
48 hermaphroditism is confirmed in 27 families of teleost fishes in their review on
49 hermaphrodite fishes. However, Creediidae is not included among these families.
50 Namely, hermaphroditism of Creediidae has been overlooked for a long time. In
51 order to provide evidential data of functional hermaphroditism, we made
52 histological observations on gonads of the two creediid fishes *L. fasciatus* and *L.*
53 *nitidus*.

54 Forty–two specimens of *L. fasciatus* were collected by hand net using SCUBA
55 at Banda Beach, Tateyama, Chiba, Japan (34 58' N, 139 46' E) on 13 April (n =
56 1), 14–15 May (n = 7), 17 June (n = 9), 18–16 July (n = 13) and 18–21 August (n

57 = 12), 2013. The fish were brought to the laboratory, anesthetized in 100 ppm
58 MS-222, measured for standard length (SL) to the nearest 0.1 mm with a digital
59 caliper, fixed in Bouin's solution for 24 hours, and then preserved in 70 %
60 ethanol. The abdominal parts of the specimens were embedded in paraffin,
61 sectioned to 5 μ m, and stained with haematoxylin and eosin.

62 We also examined gonads of seven *L. nitidus* specimens deposited at the
63 National Science Museum, Tokyo: NSMT-P 71438 (n = 4, 16.0–20.5 mm SL,
64 collected at Ambon Isl., Indonesia on 5 December 1998) and NSMT-P 77532 (n
65 = 3, 14.9–26.8 mm SL, Okinoshima Isl., Kochi, Japan on 24 July 2007). We
66 dissected and extracted the abdominal organs containing the gonads and
67 prepared the tissues following the methods outlined above.

68 The gonads of 21 specimens of *L. fasciatus* were comprised of both testis and
69 ovary (Fig. 1a), which were apparently divided by connective tissue. The
70 oocytes of all 21 hermaphroditic specimens were immature, while the testicular
71 parts of seven specimens collected in July and August were developed and
72 sperm and spermatids were detected. Therefore, those individuals were regarded
73 as functional male. The gonads of other 21 specimens were comprised of only
74 vitellogenic oocytes (Fig. 1b). These individuals were identified as functional
75 female. The females (mean \pm SD = 39.8 \pm 7.0 mm SL, range = 25.4–47.5 mm SL)
76 were significantly larger than the males (31.3 \pm 5.1 mm SL, 24.3–39.1 mm SL)
77 (*t*-test, *t* = -4.4, *df* = 40, *P* < 0.01) (Fig. 2). These results strongly suggest that *L.*
78 *fasciatus* is protandrous.

79 The gonadal structure of *L. nitidus* also indicated bisexuality (Fig. 1c, d), as
80 in *L. fasciatus*. The gonads of the three individuals (14.9, 16.4 and 17.8 mm SL)
81 were comprised of both testicular ovarian parts. However, only ovarian tissue
82 was detected in the other four specimens (16.0, 20.5, 23.5 and 26.8 mm SL). The
83 former and latter samples were regarded as males and females, respectively.
84 Although we did not have enough data on sizes for a statistical analysis, there

85 was a tendency that the females were larger than the males. These results
86 suggest that *L. nitidus* is also protandrous.

87 The gonadal structure of *L. fasciatus* and *L. nitidus* are well corresponded
88 with the previous study by Langston (2004), being divided into testicular and
89 ovarian parts by the connective tissue in functional male and comprised of only
90 ovarian part in functional female. In some protandrous species, the structure of
91 ovotestis is divided by connective tissue (Sadovy and Shapiro 1987). This type
92 of gonad structure is similar to those of the other protandrous species like
93 *Thysanophrys celebica* (Platycephalidae) (Sunobe et al. 2015), genus
94 *Amphiprion* (Pomacentridae) (Moyer and Nakazono 1978) and *Acanthopagrus*
95 *schlegelii* (Sparidae) (Chang and Yueh 1990).

96 Protandry has been known in Centropomidae, Gonostomidae, Latidae,
97 Muraenidae, Platycephalidae, Pomacentridae and Sparidae (Sadovy de
98 Mitcheson and Liu 2008). Creediidae is the eighth family, which protandry is
99 confirmed.

100

101 **Acknowledgements** We are deeply indebted to E. Katayama and G. Shinohara
102 (NSMT) for giving us the opportunity to examine *L. nitidus* specimens and for
103 providing important basic knowledge. This study is supported by JSPS
104 KAKENHI Grant to T.Sunobe (no. 19570016 and 24370006) from Japan Society
105 for Promotion of Science.

106

107 **References**

108

- 109 Chang CF, Yueh WS (1990) Annual cycle of gonadal histology and steroid
110 profiles in the juvenile males and adult females of the protandrous black
111 porgy, *Acanthopagrus schlegelii*. *Aquaculture* 91:179–196
112 Cozzi J, Clark E (1995) Darting behavior sandburrer fish, *Limnichthys*

113 *nitidus* (Creediidae), in the Red Sea. *Env Biol Fish* 44:327–336

114 Fricke R, Golani E (2012) *Limnichthys marisrubri*, a new species of sand diver
115 (Teleostei: Creediidae) from the Red Sea. *Stuttgater Beiträge zur Naturkunde*
116 A, Neue Serie 5: 287–292

117 Langston RC (2004) Gonad morphology and sex change in sandburrowers
118 (Teleostei: Creediidae). Doctoral dissertation, UNIVERSITY OF HAWAI'I

119 Leis JM (1982) Hawaiian creediid fishes (*Crystallodytes cookei* and *Limnichthys*
120 *donaldsoni*): Development of eggs and larvae and use of pelagic eggs to trace
121 coastal water movement. *Bul Mar Sci* 32:166–180

122 Moyer JT and Nakazono (1978) Protandrous hermaphroditism in six species of
123 the anemonefish genus *Amphiprion* in Japan. *Japan J Ichthyol* 25: 101–106

124 Nelson JS, TC Grande, MVH Wilson (2016) *Fishes of the world*, 5th edition.
125 John Wiley & Sons, Inco., New Jersey

126 Reader SE, JM Leis, DS Rennis (2000) Creediidae: In Leis JM, Carson–Ewart
127 BM (eds) *The larvae of Indo–Pacific coastal fishes: An identification guide to*
128 *marine fish larvae*. BRILL, Netherlands, pp 575–578

129 Sadovy Y, Shapiro DY (1987) Criteria for the diagnosis of hermaphroditism in
130 fishes. *Copeia* 1987:136–156

131 Sadovy de Mitcheson Y, Liu M (2008) Functional hermaphroditism in teleosts.
132 *Fish and Fisheries* 9: 1–43

133 Shimada K (2013) Creediidae. In: Nakabo T (ed) *Fishes of Japan with pictorial*
134 *keys to the species*, 3rd edition. Tokai Univ Press, Tokyo, pp 1270–1271,
135 2093–2094

136 Sunobe T, Sakaida S, Kuwamura T (2015) Random mating and protandrous sex
137 change of the platycephalid fish *Thysanophrys celebica* (Platycephalidae). *J*
138 *Ethol* 34: 15–21

139 Yoshino T, Kon T, Okabe S (1999) Review of the genus *Limnichthys*
140 (Perciformes: Creediidae) from Japan with description of a new species.

141 Ichthyol Res 46:73–83

142

Figure legends

143

144

145 **Fig. 1** Gonad structure of *Limnichthys fasciatus* (male: **a**, female: **b**) and *L.*
146 *nitidus* (**c**, **d**). *O*–ovarian tissue; *T*–testicular tissue. *Scale bars* 100 μm (**a**) and
147 300 μm (**b**, **c**, **d**)

148

149 **Fig. 2** Size frequencies of male and female *Limnichthys fasciatus*

Fig. 1

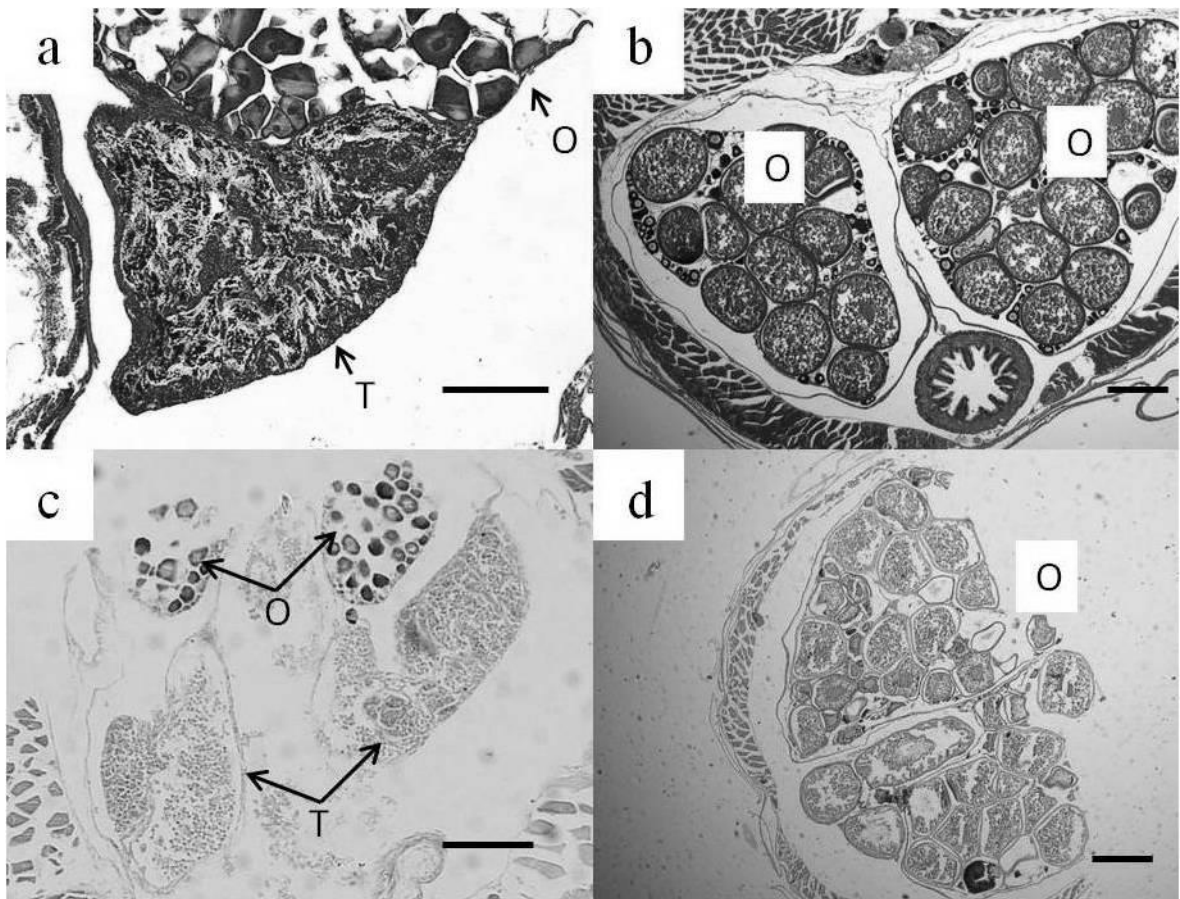


Fig. 2

