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Study of the Parasites on the Gill of Cultured Eel in Taiwan

臺灣養殖鰻魚鰓部寄生蟲之研究

I. Classification of Dactylogyrid

I. 鰓指環蟲之分類

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Abstract

7143 dactylogyrids were collected from gills of 308 cultured eels (*Anguilla japonica*) in Taiwan, during the period of Jul. 1982-Jan. 1984. There were only three species found from these collection; *Pseudodactylogyrus bini* is the dominant species (45.3%) in comparison with *P. anguillae* (17.3%), the other species is *Gyrodactylus nipponensis* 37.4%).

From the measurement of 366 worms, it revealed that the testis of an organism in *P. anguillae* may be larger, equal or smaller than its ovary, and the variation is changed continuously. For this reason, the authors suggest that *P. microrrchis* established 1976 should be regarded as a synonym of *P. anguillae.*

Body and haptor dimension of the dactylogyrids found in the present study were greater than that of the corresponding species found in Japan and mainland China, but both the cirrus appendage and anchor were about the same size.

Ecological niche of these dactylogyrids on the gills was noticed, that *P. anguillae* harbours only on the region close to gill arch, while *P. bini* and *G. nipponensis* are both stick on the marginal area of the gill, there exist a clear competitive exclusion between the two species.

Introduction

Monogenea trematodes is one of the most common fish parasites, it is world-wide distributed and occured in almost every kind of fishes, especially in intensive cultured

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conditions. Large numbers of monogenea parasitized on gill of cultured eel were reported, not infrequently gill filaments of one eel was harboured by hundreds or even thousands of monogenea[5]. It could not be overestimated the effects of the parasites in evoke of other secondary gill infection.

The present work is concerned with a systematic study of gill monogenea in cultured eel in Taiwan.

Materials and Methods

All specimen of monogenea were collected from gill of japanese eel (Anguilla japonica) cultured in Lu-kang and Pingtung area, once per month during the period of 1982 July to 1984 Janurary. Two definite eel pounds in each area were selected for eel sampling, five eels were randomly catched from school of eel, when they were gathering for feeding in the pond.

The parasites were picked out from gill filaments under stereoscope of appropriate maginification, and pressed to extend by a cover glass on a slide. The specimen then fixed with formalin acetic alcohol (FAA) and followed by staining with either Heidenhaines iron haematoxylin or Gower's carmine, finally mounted in Canada balsam for preparation of a permanent preservation.

In observation of the morphorlogy and detailed structures, both fresh and mounted specimen were used, but only mounted specimens were used for measuring. Measurement of the body size and haptor were under 100×, magnification, while measurement of the other parts were under 400× or 1000×. Twenty two items of measurement were taken in the specimen of genus *Pseudodactylogyrus*. Method of measuring the anchor and marginal hooks were shown in Fig. 1.

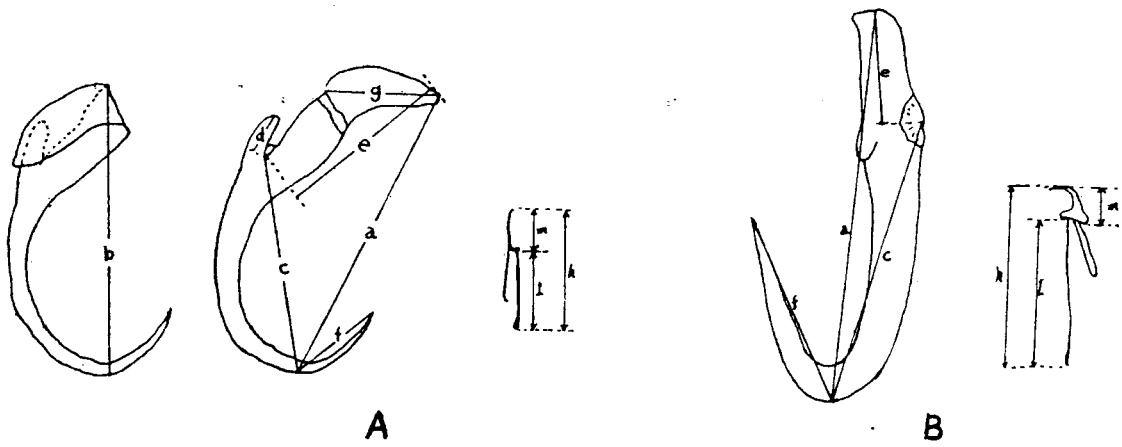

Fig. 1. Methods of measuring the anchor and marginal hooks. A. *Pssudodactylogyrus* B. *Gyrodactylus* (a: overall length of the anchor. b: the anchor length without the reflexed part of the internal process. c: base length of the anchor. d: external process length. e: internal process length. f: point length. f: point length. g: length of the reflexed part of the internal process. h: marginal hook length. l: handle length. m: sickle length.)

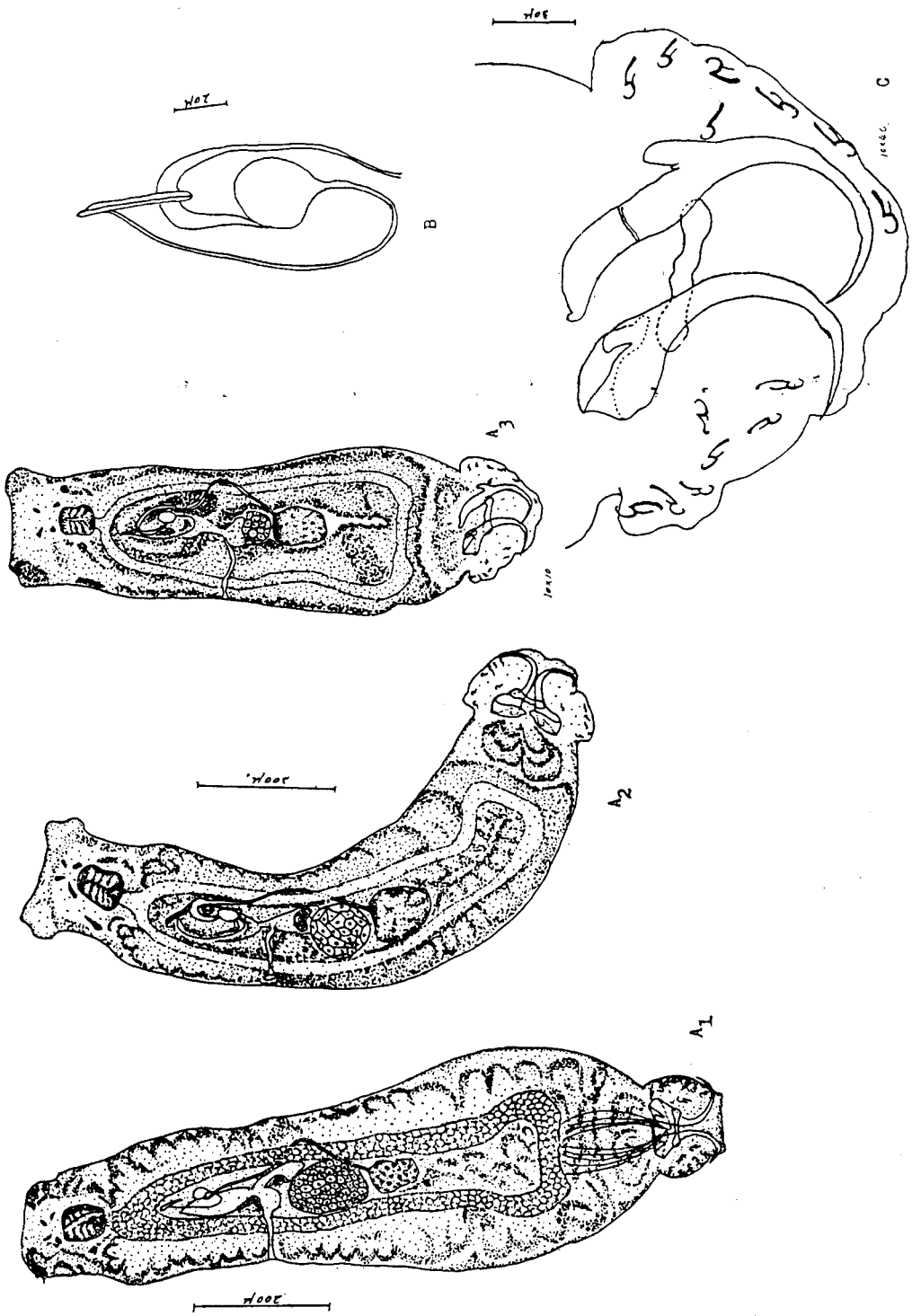

Fig. 2. Pseudodactylogyrus anguillae. A. entire worm (A_1: testis <ovary, A_2: testis=ovary, A_3: testis> ovary). B. Copulatory organ. C. anchors and marginal hooks.

Results

A number of 7143 monogenea in total were collected in this study. Two species of *Pseudodactylogyrus* and one species of *Gyrodactylus* were found. *Gyrodactylus* was relatively smaller than *Pseudodactylogyrus* in size and it is easily recognized by the embryo in the middle of body proper. *Pseudodactylogyrus*[1] is differentiated from *Dactylogyrus* by the following three characters: 1. the haptor is situiated ventrally instead of dorsally as in the case of *Dactylogyrus*. 2. one prostatic reservoir. 3. larval type of marginal hooks[3].

The following is a datailed morphological and structural character of the three species of dactylogyrids found in this study.

***Pseudodactylogyrus anguillae* (Yin and Sproston 1948)** (Fig. 2)

The body is elongated and the head is as wide as the other part of the body. Two pairs of eyespots located anterodorsally to the pharynx, three pairs of head organs could be clearly observed in fresh specimen but unable to notice in a fixed and stained specimen, the organs opening at the anterior edge. The mouth leads into a muscular ellipsoidal pharynx and followed by a short esophagus. The intestinal caeca extend posteriorly and confluent before the cement glands, which exist at the posterior end of the body proper. The cement glands open into the ventral side of the haptor.

Table 1. Measurencent of data in *Pseudodactylogyrus*

			P. anguillae		*P. bini*	
			Range	Mean	Range	Mean
Body	length		595–1659	1114	700–1960	1322
	width		162– 364	259	175– 336	256
Heptor	length		93– 203	141	75– 114	97
	width		110– 280	184	85– 196	157
Pharynx	length		44– 98	74	44– 112	82
	width		42– 88	64	37– 121	73
Cirrus accessory 1.			24– 46	38	21– 61	51
Prostatic reservoir (di)			19– 44	28	12– 44	34
Ovary	length		44– 179	110	26– 145	82
	width		46– 130	91	35– 130	82
Testis	length		26– 126	86	70– 308	183
	width		23– 140	67	61– 224	126
Anchor	length	a.	94– 141	116	61– 79	70
		b.	82– 114	97	49– 61	55
		c.	66– 88	79	36– 46	43
		d.	5– 16	9.0	7– 11	8.8
		e.	54– 72	66	35– 44	39
		f.	28– 34	31	22– 30	25
Bar	length		43– 70	56	35– 53	43
	width		5– 13	8.7	5– 11	8.2
Marginal hooklet		o. l.	12– 18	16	14– 18	17
		p. l.	5– 9	6.3	5– 9	8.5

Round shaped ovary situiates in the midplane and in front of the oval from-testis. The size of both overy and testis fluctuate greatly (Table 1). Testis may be larger, equal or smaller than the ovary. The seminal receptacle swelling at the right margin. Genital pore opening on the ventral side behind the intestinal bifurcation and pass to the short uterus. Vitellarian gland profused and run along the whole intestine. Vas deferens starts at the upper edge of the testis and go forwards along the left caecum, it then turns backward to

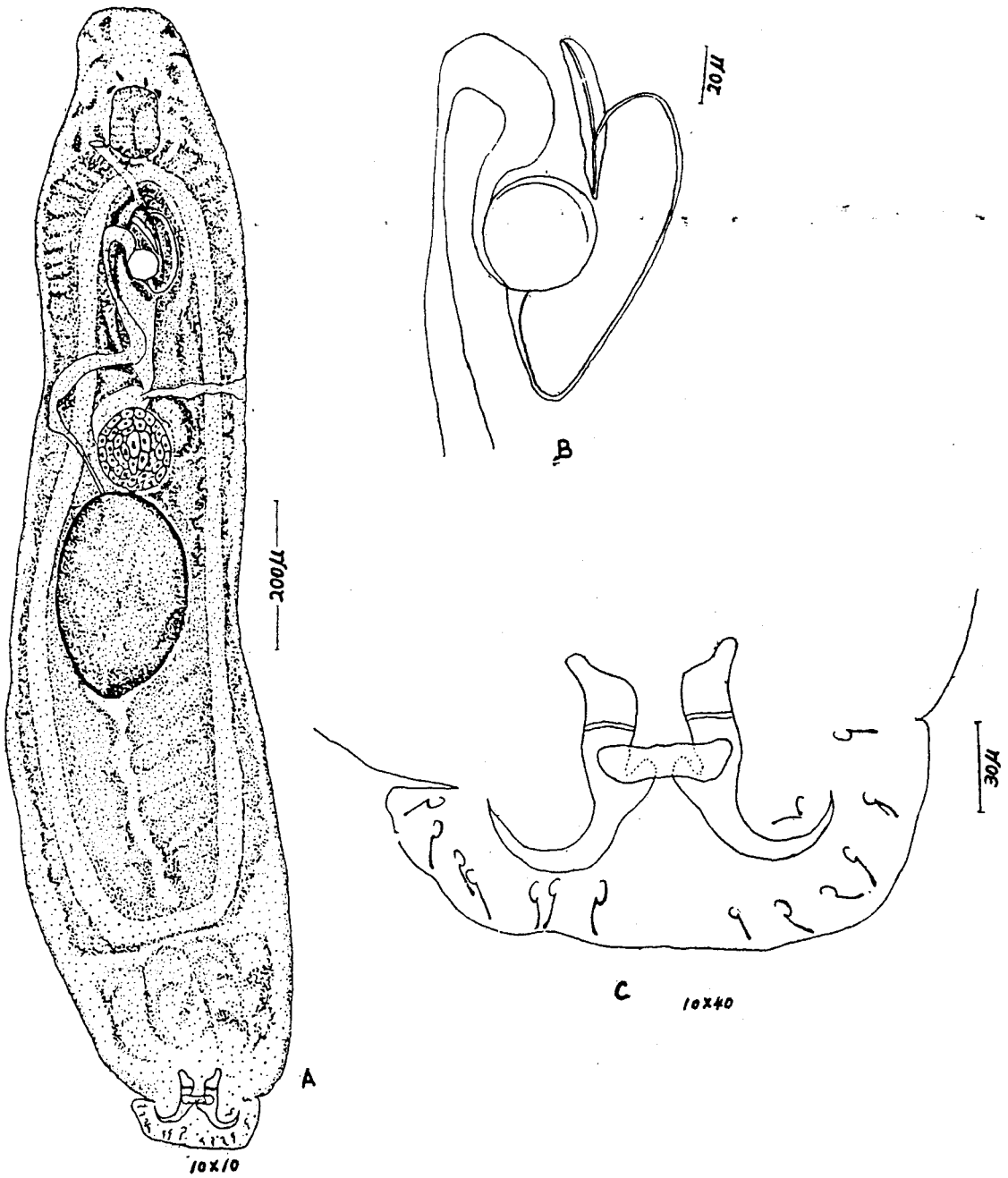

Fig. 3. *Pseudodactylogyrus bini*. A. entire worm. B. copulatory organ. C. anchors and marginal hooks.

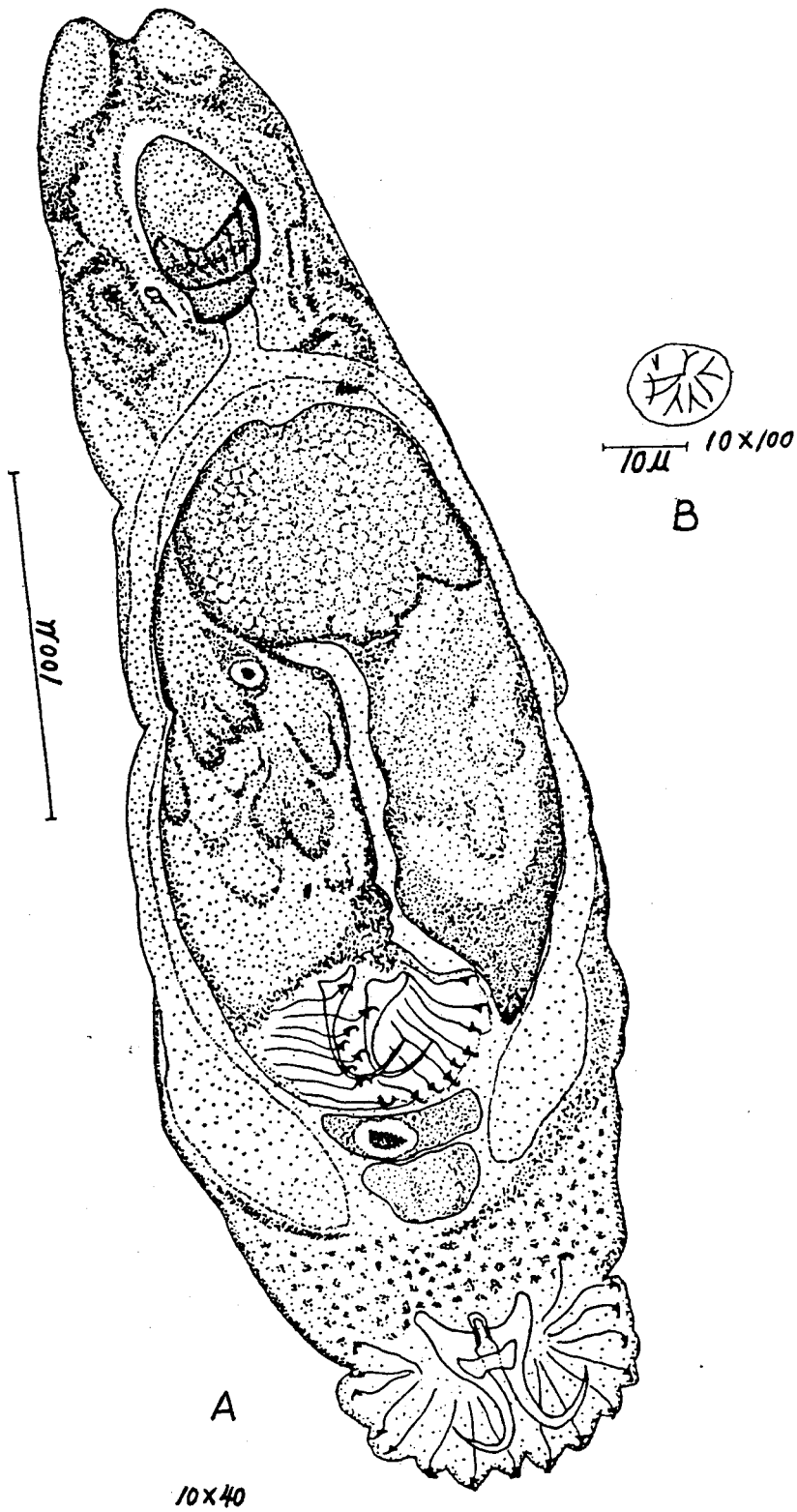

Fig. 4. *Gyrodactylus nipponensis*. A. entire worm. B. copulatory organ.

form the seminal vesicle and leads to prostatic resorvoir. The slender curved cirrus with simple rod form accessory in the terminal end, it originate from the prostatic reservoir (Fig. 2B).

The haptor in the posterior end of the body proper is not clearly depart from it. Two large anchors (hooks) located on ventral side of the haptor and connect by a bar on the ventral side (Fig. 2C), seven pairs of larval type marginal hooks. The shape and size of the hooks is the main characteristics differentiate this species from the others. All measurements are shown in Table 1.

***Pseudodactylogyrus bini* (Kikuchi 1909)**

This species is differentiate from the *P. anguillae* by having a larger body size with an apparently smaller haptor and anchors, the haptor not well marked off from the body. The ovaries located before the testis is always smaller than the testis (Table 1) and also smaller than that of *P. anguillae*. All other characteristics are similar to that of *P. anguillae*. The measurements of *P. bini* are listed in Table 1.

Gyrodactylus nipponensis

Body elongate and small, 245-546×61-121 μ (347×91), two head organs markedly prominent, pharynx 53×33 μ. Genus characteristics are same as that described by S. Yamagutt[8]. Measurements of the chitinous parts are as following: anchor ℓ. 35-42 μ (mean 39.6); point ℓ. 18-20 μ (mean 19.3); root ℓ. 10-15 μ (mean 12.7); base ℓ. 30-35 μ (mean 32.5); dorsal bar ℓ. 19 μ; ventral bar ℓ. 9 μ; marginal hooks total ℓ. 31.5 μ; sickle ℓ. 3.5 μ; distal part of sickle 3 μ; proximal part of sickle 3 μ. Based on the body size; relative long root; ratio of basal ℓ. to root ℓ. of the anchor (32.5/12.7=2.6); and the same size of proximal part and distal part of the sickle of marginal hook, the species is differentiate from *G. anguillae* by K. Ogawa and S. Egusa[6], and is assigned as *G. nipponensis*.

Discussion

Among the monogenea parasitized on fish gill, *Gyrodactylus* is found to have a broad spectra of host species, include cyprinacea, ayu (smelt fish) and eel, *Dactylogyrus* is mainly parasitized on cyprinaceae[5,6] while the *Pseudodactylogyrus* is only found on eels. The *Pseudodactylogyrus* was thought to be a native parasite of european eel and was introduced to japanese eel in Japan since since 1969. In the present study, all gill monogenea collected from the cultured japanese eel are belong to *Pseudodactylogyrus* and *Gyradactylus*, except that only in one case among the seven thousand collections, one *Dactylogyrus extensus* was noticed on an eel. Because some cyprinacean fish are also stock in the eel pond, it is thought that ,he *Dactylogyrus* found was contaminated to the eel from cyprinacean fish by chance. The *Dactylogyrus sp.* found on eel, reported by Wang and Yu[10] is supposed to be a misidentification of *Pseudodactylogyrus* species.

In close examined the distribution of the parasites on the gills, *P. anguillae* is found to occupy the base portion of the gill filment close to the gill arch, while both *P. bini* and *Gyrodactylogyrus nipponensis* harboured on the marginal area of the gill filments. Therefore competition for habitat between *G. nipponensis* and *P. bini* is supposed to occur. This lead

Table 2. Comparison of mesurements of two species of Pseudodactylogyrus found in Taiwan, Mainland China, Japan and Australia

		P. anguillae			*P. bini*			
		Taiwan	Japan**	China***	Taiwan	Japan***	China***	Australia***
Body	length	595–1659 (1114)*	582–1168 (768)	482–854 (658)	700–1960 (1322)	1100–1400	563–1210 (797)	1400
	width	162–364 (259)	150–241 (203)	167–213 (182)	175–336 (256)	200	135–207 (175)	260
Haptor	length	92–203 (141)	112–148 (127)	112–136 (122)	75–114 (97)	70–80	68–90 (78.5)	80
	width	110–280 (184)	132–174 (153)	117–131 (127)	85–196 (157)	140	104–130 (114)	150
Carrus accessory 1.		24–46 (38)	32–42 (37)	35.5–36.0 (35.9)	21–61 (51)	30–46	36–39 (36.5)	—
Anchor	length a.	94–141 (116)	103–121 (113)	104–120 (110.2)	61–79 (70)	—	39.6–63.0 (53.8)	35
	b.	82–114 (97)	91–105 (99)	—	49–61 (55)	44–53	—	75–81
Bar	length	43–70 (56)	48–64 (54)	50.5–58.3 (54.6)	35–53 (43)	32–40	37.4–42.5 (40.1)	41–47
Marginal hook 1.		12–18 (16)	14–16 (15)	10	14–18 (17)	10–14	25	16–18

* mean

** not include that of "*P. microrchis*"[3]

***Data from K. Ogawa and S. Egusa[3]

to the exclusion effect. A similar relationship was noticed among many species in monogenea[3,9]. But other ecological factors still may be involved in the distributions of these species.

Ogawa and Egusa suggested the establishment of the new species *P. microrchis* according to the smaller testis in comparison with ovary[4]. The present study find that in comparison of ratio of testis to ovary in *P. anguillae* it could not clearly distinguished to two groups. In many worms, the size of testis is very close to that of the ovary. The same condition was also noticed by Ogawa and other researchers in Japan in many recent studies[2,7]. Because the ratio values is a continuously changing characteristics, it is unpractible to establish the species of *P. microrchis*. The authors would like to suggest that *P. microrchis* is a synonym of *P. anguillae*. A more detailed statistical data to support this viewpoint is editing by Dr. K. Ogawa and the present authors.

The mean size of the three monogenea species in the present study are larger than that found in Japan and mainland China (Table 2). Except the size of body and haptor dimensions, no other characteristics were different among the coordinated species from the three regions[4].

Seasonal fluctuation of the occurence of infection and ecological distribution was apparently occured in the present study, and is discussed in other edition.

中 文 摘 要

1982 年 7 月～1984 年 1 月，由 308 尾養殖日本鰻魚 (*Anguilla japonica*) 的鰓上採集到 7143 尾單生吸蟲類，共發現二屬三種，其中 *Pseudodactylogyrus bini* 佔 45.3%，*P. anguillae* 17.3%而 *Gyrodactylus nipponensis* 37.4%。

詳細測定其中 366 隻蟲體的結果發現 *P. anguillae* 的精巢及卵巢的大小比值爲漸進性的，即精巢大於、等於及小於卵巢的情形均有，無法以此比值作爲分類依據，故著者礙難同意 Ogawa 及 Egusa 將精巢小於卵巢之蟲體由 *P. anguilla* 之種中分開命名爲 *P. microrchis* 之新種之建議 (1976)；亦即 *P. microrchis* 應視爲 *P. anguillae* 之同義語。

由本研究之數據測定可看出屬 *Pseudodactylogyrus* 之體長、寬及吸盤之大小均較日本及中國大陸之同種蟲體之測值爲大，但作爲分類依據之交接器附屬器 (Cirrus accessory) 及錨鉤長則非常接近，故應屬同種。

P. bini 及 *G. nipponensis* 在鰻鰓上共同佔據鰓之邊緣地帶，有顯著之互相排斥現象，而 *P. anguillae* 則着生於靠近鰓弓之部份。

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