動物分類学

2018/05/17

理工学部　遠藤広光

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FULL PAPER

A new species of anglerfish (Lophiidae: *Lophiodes*) from the western Pacific

Hsuan-Ching Ho · Kwang-Tsao Shao

Lophiodes endoi Ho and Shao, 2008

エンドウヒメアンコウ（アンコウ目アンコウ科）

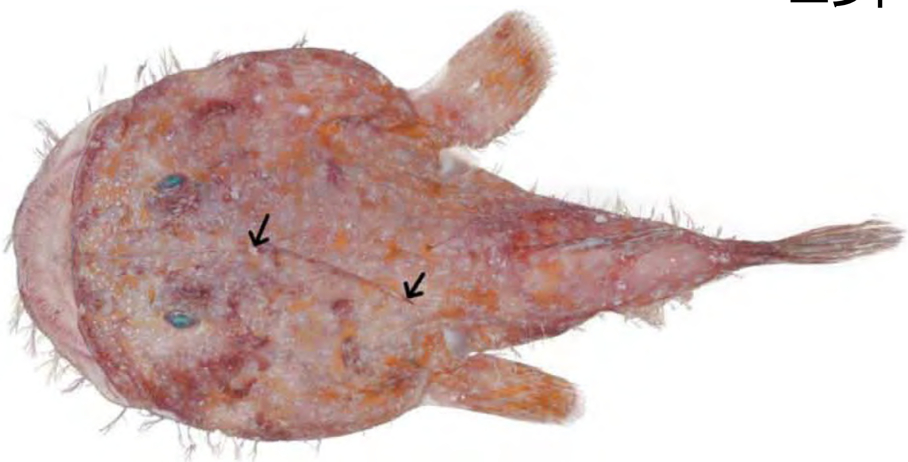

Fig. 1 *Lophiodes endoi* sp. nov., holotype, ASIZP 63175, male, 192 mm SL. Photo by H.-C. Ho. *Left arrow* indicates the esca and *right arrow* indicates the tendrils on the third dorsal spine

New lophiid from the western Pacific

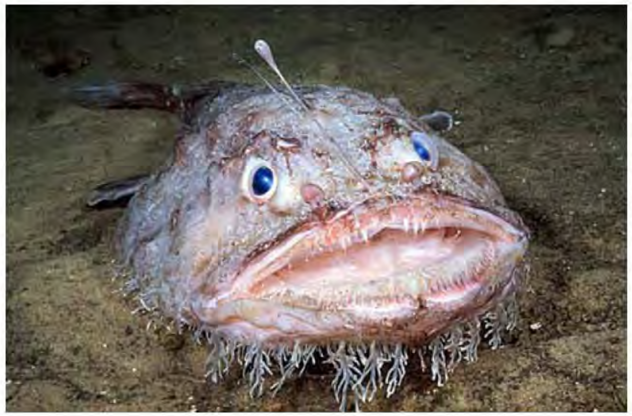

Fig. 2 Underwater photograph of *Lophiodes endoi* sp. nov., male, ca. 260 mm TL. Specimen not obtained. Photo by K. Aitken from an underwater vehicle at Greenwell Point, New South Wales, Australia, at depth about 160 fathoms (used with authority)

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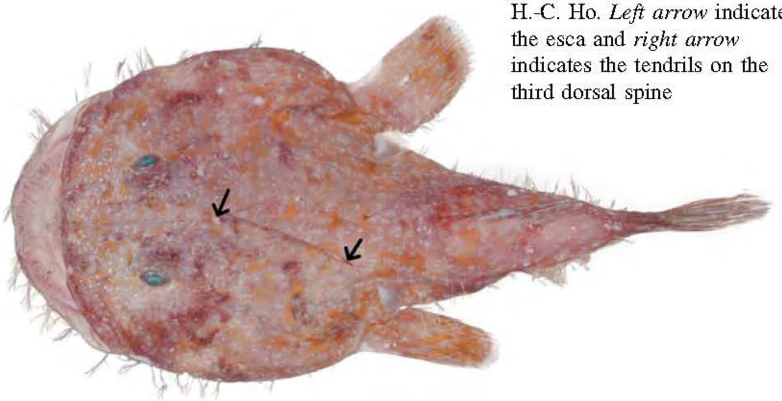

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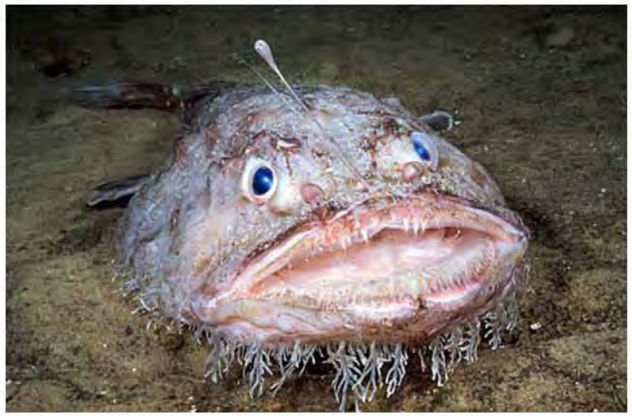
***Lophiodes endoi* sp. nov.** (New English name: Endo's Anglerfish) (New Japanese name: Endou-himeankou) (Figs. 1, 2, 3a, 4a, 5a, 6a)

Lophiodes sp.: Okamura 1984:267, 376 (one specimen, BSKU 32471, is included as paratype); Ho and Shao 2007:28 (all specimens used are included in type series).

Holotype. ASIZP 63175, male, 192 mm, 24°53′N, 122°13′E, Nan-fang-ao, Su-ao, northeastern Taiwan, northwestern Pacific, 280–310 m, 9 May 2004.

Paratypes. 54–380 mm SL, 40 specimens. Taiwan (near type locality): AMS I.43853-001, 2 specimens, 240–270 mm; ASIZP 63170, 245 mm, 9 May 2004; ASIZP



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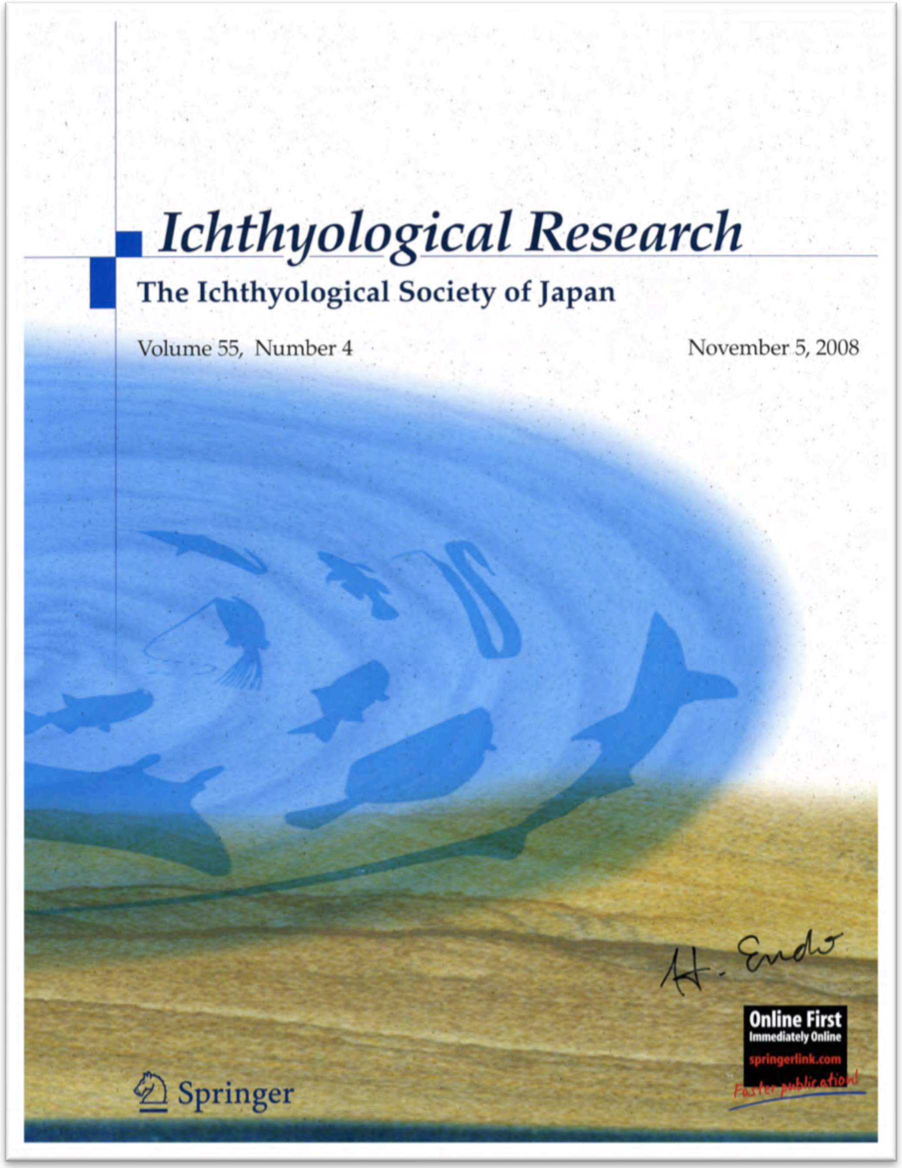
日本魚類学会の英文誌と和文誌

＊新種記載の論文が発表されるのは英文誌



種の違いは形態の違いで認識される

trawlers; otherwise collecting methods are described in the material examined. Symbolic codes for institutions are those provided by Leviton et al. (1985) with exception of the Biodiversity Research Center, Academia Sinica, Taipei, Taiwan (ASIZP). Data of congeners used for comparison were presented in Caruso (1981) and Ho and Shao (2007). Specimens used here for comparison are listed in the last section.

***Lophiodes endoi* sp. nov.** (New English name: Endo's Anglerfish) (New Japanese name: Endou-himeankou) (Figs. 1, 2, 3a, 4a, 5a, 6a)

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Paratypes. 54–380 mm SL, 40 specimens. Taiwan (near type locality): AMS I.43853-001, 2 specimens, 240–270 mm; ASIZP 63170, 245 mm, 9 May 2004; ASIZP 63171, 218 mm, 9 May 2004; ASIZP 63176, 200 mm, 9 May 2004; ASIZP 65418, 275 mm, 22 May 2004; ASIZP 65419, 273 mm, 22 May 2004; ASIZP 65423, 249 mm, 30 June 2004; ASIZP 66348, 295 mm, 16 March 2005. Taiwan (Ta-shi, northeastern Taiwan, ca. 300 m): ASIZP 63214, 288 mm, 24 April 2004; ASIZP 63215, 330 mm, 24 April 2004; ASIZP 63275, 165 mm, 27 March 2004; ASIZP 64572, 3, 203–295 mm, 7 July 2004; ASIZP 65424, 350 mm, 13 June 2004; ASIZP 65425, 343 mm, 13 June 2004; ASIZP 65426, 380 mm, 13 June 2004; ASIZP 65427, 320 mm, 30 June 2004; ASIZP 65428, 368 mm, 30 June 2004; ASIZP 65429, 285 mm, 30 June 2004; CAS 223996, 2, 210–235 mm, 7 July 2004. Japan: BSKU 32314, 148 mm, 28°06.42′N, 134°39.56′E, Kyushu–Palau Ridge, bottom trawl, 19 December 1979; BSKU 32319, 126 mm, same data as BSKU 32314; BSKU 32471, 260 mm, 25°48′N, 124°25.50′E, Okinawa Trough, bottom trawl, 19 December 1979; BSKU 44481, 243 mm, central Tosa Bay, R/V *Kotaka-maru*, bottom trawl, 300 m, 1 December 1987; BSKU 55304, 136 mm, Mimase fish market, Tosa Bay, 18 January 2001; BSKU 80110, 132 mm, Mimase fish market, Tosa Bay, 5 March 1992; BSKU 86095, 146 mm, 33°14′N, 133°38.30′E, R/V *Kotaka-maru*, 261–273 m, 5 March 1999; HUMZ 75231, 149 mm, 26°14.10′N, 135°46.70′E, Kyushu–Palau Ridge, 360 m, 23 January 1978; HUMZ 75232, 143 mm, 28°05′N, 134°38.50′E, Kyushu–Palau Ridge, 535 m, 25 January 1978. Australia: AMS I.43862-001, 213 mm, FRV *Kapala*, 37°13′S, 150°22′E; Gabo Island, New South Wales, 369–404 m, 25 July 1996; AMS I.19375-002, 135 mm, 35°30′S, 150°44′E, eastern Ulladulla, New South Wales, 329 m, 10 November 1976; AMS I.22817-034, 2, 54–131 mm, 18°06′S, 117°45′E, northwest Shelf, 240 km north of Port Hedland, engel trawl, 492–520 m, 7 April 1982; NMV A 8815, 130 mm, 37°41.10′S, 150°13.90′E, 25 km southeast of Gabo Island, Bass Strait, Victoria, otter trawl, 466 m, 3 August 1985; NMV A 22075, 153 mm, 33°38′S, 162°21′E, Lord Howe Rise, Tasman Sea, demersal trawl, 300–750 m, 2 April 2001; NMV A 22076, 320 mm, data as NMV A 22075; NMV A 20454, 149 mm, 35°05.20′S, 151°04.20′E, off Wollongong, New South Wales, bottom trawl, 426–459 m, 2 December 1998; NMV A 21947, 255 mm, 33°20′S, 162°30′E, Lord Howe Rise, Tasman Sea, bottom trawl, 423–750 m.

Diagnosis. A species of the *Lophiodes mutilus* group differing from congeners by the following characters: a rounded esca with paler tip (Fig. 3a); third dorsal spine bearing a pair of black tendrils located at two-thirds of illicial length (Fig. 4a); 18–22 (mainly 20–21) pectoral fin rays; a relatively short head (33.4–39.6% SL, $\bar{x} = 35.7\%$ SL); a relatively short illicium (16.5–26.7% SL, $\bar{x} = 21.7\%$

Fig. 1 *Lophiodes endoi* sp. nov., holotype, ASIZP 63175, male, 192 mm SL. Photo by H.-C. Ho. *Left arrow* indicates the esca and *right arrow* indicates the tendrils on the third dorsal spine

Fig. 2 Underwater photograph of *Lophiodes endoi* sp. nov., male, ca. 260 mm TL. Specimen not obtained. Photo by K. Aitken from an underwater vehicle at Greenwell Point, New South Wales, Australia, at depth about 160 fathoms (used with authority)

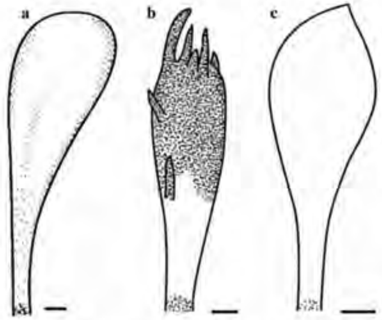


Fig. 3 Escae of three *Lophiodes* species. **a** *L. endoi* sp. nov., from the holotype; **b** *L. bruchius*, BSKU 32034, 310 mm SL; **c** *L. monodi*, from the holotype. *Bar* 1 mm

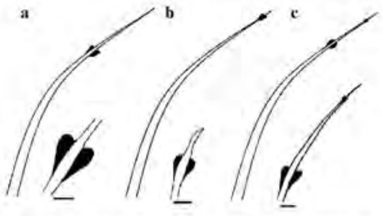


Fig. 4 Tendrils (*right side*) and their positions on third dorsal spines (*left side*) of three *Lophiodes* species. **a** *L. endoi* sp. nov., from the type; **b** *L. bruchius*, BSKU 30618, 125 mm SL; **c** *L. monodi*, from USNM 215002, 144 mm SL. *Bar* 2 mm (for tendrils only)

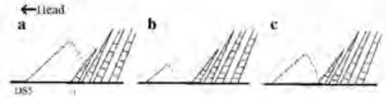


Fig. 5 Comparisons of the fifth dorsal spine lengths of three *Lophiodes* species. **a** *L. endoi* sp. nov., from the holotype; **b** *L. bruchius*, from BSKU 30618, 125 mm; **c** *L. monodi*, from the holotype. *DS5* fifth dorsal spine, *i* first dorsal fin ray

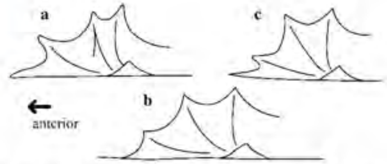


Fig. 6 Frontal spines of three *Lophiodes* species. **a** *L. endoi* sp. nov., from the holotype; **b** *L. bruchius*, BSKU 30714, 194 mm SL; **c** *L. monodi*, from the holotype

SL); a relatively short third dorsal spine (30.0–42.3% SL, $\bar{x} = 36.5\%$ SL); fifth dorsal spine relatively long, when folded back reaching base of third dorsal fin ray (Fig. 5a), and anterior frontal spine enlarged (Fig. 6a).

Description. Proportional measurements, expressed in percent of SL and HL, and meristics of the specimens of the type series are given in Table 1.

Head and body moderately depressed; head relatively short (33.4–39.6% SL, $\bar{x} = 35.7\%$ SL); tail cylindrical, somewhat depressed, tapering posteriorly; eye large; gill openings extending in front of pectoral fins; both maxilla and frontal ridge smooth, without knobs; frontal divided into three spines, anterior one enlarged, directed forward (Fig. 6a), sometimes divided into two sub-spines; sphenotic with two spines, inner spine well developed, straight and directed upward; inner frontal spine present in specimens smaller than 300 mm and reduced in specimens larger than 300 mm; single interopercular spine; parietal spine present at either side of third dorsal spine base, reduced in larger specimens; hyomandibula with two spines, anterior spine smaller, becoming blunt with three knobs in larger specimens; humeral spine well developed with three to four spines.

All dorsal fin spines, except for the third, devoid of tendrils; second to sixth dorsal spines bearing a tiny dark bulb at tip in most specimens; illicium lightly pigmented, relatively short (16.5–26.7% SL, $\bar{x} = 21.7\%$ SL), when folded back reaching third dorsal spine base, reaching sphenotic spines in larger specimens; esca a rounded bulb, slightly darker than illicium, tip pale (Fig. 3a); second dorsal spine slightly longer than illicium, when folded back

形，計数・計測形質と分布の違い

Table 1 Morphometric data, expressed in percent SL and HL, and meristics of the type series of *Lophiodes endoi* sp. nov.

		ASIZP 63175			
		Holotype	Holotype + paratypes		
Standard length		192 mm	54–380 mm (n = 41)		
Proportion as % SL			Range	Average	SD
Head length		39.6	33.4–39.6	35.7	1.6
Illicial length		23.2	16.5–26.7	21.7	2.3
Second dorsal spine length		30.0	22.7–30.2	26.9	2.2
Third dorsal spine length		38.5	30.0–42.3	36.5	2.9
Tail length		25.4	20.2–28.4	25.4	1.8
Proportion as % HL					
Head width		49.8	49.8–61.0	56.6	2.7
Head depth		60.1	60.1–72.4	65.7	3.0
Distance between inner sphenotic spines		39.2	39.2–47.9	44.3	2.1
Distance between posterior frontal spines		33.9	33.9–44.0	40.1	2.6
Snout width		16.6	16.6–22.3	19.1	1.5
Snout length		43.1	40.9–58.0	49.2	5.3
Distance between pterotic and sphenotic spines		15.5	14.9–19.3	17.4	1.1
Distance between quadrate and anterior palatine spines		67.7	48.3–87.2	75.7	7.6
Distance between opercular and subopercular spines		36.5	36.5–50.1	43.0	3.4
Meristics	n	Holotype	Range	Frequency	
Dorsal fin rays	41	8	7–8	7(5), 8(36)	
Anal fin rays	41	6	5–6	5(2), 6(39)	
Pectoral fin rays	41	20	18–22	18(1), 19(1), 20(16), 21(21), 22(2)	
Vertebrae	12	19	19	19(12)	

reaching between third dorsal spine base and end of neurocranium; third dorsal spine relatively short (30.0–42.3% SL, $\bar{x}$ = 36.5% SL), bearing one pair of darkly pigmented tendrils at about two-thirds its length (Fig. 4a), when folded back reaches third dorsal fin ray base, reaching origin of soft dorsal fin in larger specimens; fourth dorsal spine absent; fifth dorsal spine relatively long, when folded back reaching base of third dorsal fin ray, reaching origin of soft dorsal fin in larger specimens (Fig. 5a); sixth dorsal spine very short, when folded back not reaching origin of dorsal fin, embedded under skin in larger specimens. Anal fin extending beyond caudal fin base in smaller specimens, reaching caudal fin base in larger specimens.

Coloration when fresh (Fig. 1). Based on the holotype and paratypes collected from Taiwan: reddish-brown background with diffuse orange yellowish patches on dorsal surface, those patches disappearing with time; ventral surface pale gray; illicium paler than surface; esca darker than dorsal surface, tip pale; pectoral fin tip pale, dorsal surface of fin as body color; some darker patches associated with spines, fin bases, and caudal peduncle; peritoneum black.

Coloration in life (Fig. 2). Based on a series of underwater photographs of a male specimen taken from Greenwell Point, New South Wales, Australia: dorsal surface pale brown with numerous medium-sized, diffuse light blue or gray patches; illicium paler; esca darker at base and paler at tip; some darker patches associated with head spines and upper jaw; pectoral fin margin pale, dorsal surface with some diffuse pale blue spots.

Coloration in preservative. Uniform gray to dark on dorsal surface, pale gray on ventral surface with some darker patches associated with spines, fin bases, and caudal peduncle; a pair of dark tendrils on the third dorsal spine; peritoneum black.

Size. Up to 380 mm SL (paratype, ASIZP 65426).

Distribution. *Lophiodes endoi* is widely distributed in the western Pacific (Fig. 7), from off Japan, Taiwan and Australia, at depths of 261–750 m. Specimens were collected from southeastern Japan (Okinawa trough, Tosa Bay, and Kyushu–Palau Ridge) at depth range 261–600 m. In Taiwanese waters this species is usually captured together with *Lophiodes mutilus* at depths of about 280–310 m, and some may range deeper. Specimens were collected

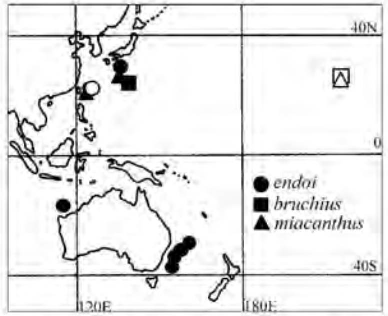


Fig. 7 Distribution map of three *Lophiodes* species from the western Pacific and central Pacific. *Open dots* mean the type localities. One symbol may represent more than one capture

from the Tasman Sea of southeastern Australia at depths of 300–750 m, and a series of photographs were taken of a specimen at a depth of 288 m at Greenwell Point, New South Wales, Australia, by an underwater vehicle (K. Aitken, personal communication, 20 March 2005). Two specimens were collected from the northwest shelf off Australia at depths of 492–520 m.

Etymology. *Lophiodes endoi* is named in honor of Dr. Hiromitsu Endo, Associate Professor of Faculty of Science, Kochi University, in recognition of his excellent work in ichthyology, his friendship, and for supplying specimens for this study.

Comparisons. *Lophiodes endoi* can be easily distinguished from *L. miacanthus* by having a pale illicium and a rounded esca (vs. a black illicium and a cirrus at tip of esca).

It is most similar to *L. bruchius* from the western and central Pacific in having a pair of dark tendrils on the third dorsal spine, but differs in having a shorter illicium (16.5–26.7% SL vs. 25.0–45.0% SL; Fig. 8), third dorsal spine relative short (30.0–42.3% SL vs. 27.8–62.6% SL; Fig. 9), a rounded esca with a paler tip (vs. darker tip with cirri; Fig. 3b), dark tendrils located at two-thirds of illicial length (vs. four-fifths to near the tip; Fig. 4b), and a longer fifth dorsal spine that reaches the base of first to third dorsal fin ray (vs. short and not reaching base of soft dorsal fin; Fig. 5b). In addition, the length of the third dorsal spine shows slightly negative allometric growth, but the slope is not steeper than that of *L. bruchius* (Fig. 9).

It is similar to *L. mutilus* of the Indo-West Pacific in having the inner frontal spine, but differs in having a shorter the third dorsal spine (30.0–42.3% SL vs. 50.0–55.7% SL in Ho and Shao 2007), a pair of dark tendrils on third dorsal fin spine (vs. more than 5 pairs) and a larger esca (>2 mm vs. <2 mm in diameter).

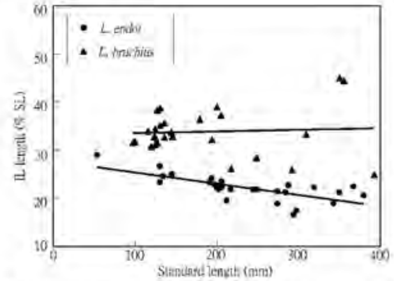


Fig. 8 Proportions of illicial length versus standard length for *L. bruchius* and *L. endoi* sp. nov

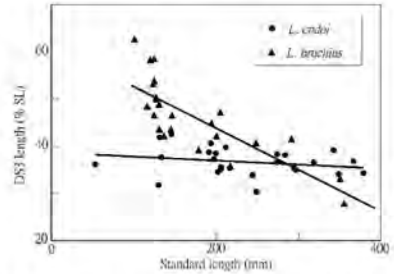


Fig. 9 Proportions of third dorsal spine length versus standard length for *L. bruchius* and *L. endoi* sp. nov

It is also similar to a fourth species, *Lophiodes monodi* Le Danios 1971, in the northwestern Atlantic in having a rounded esca, but differs in having a relatively short illicium (16.5–26.7% vs. 26.0–35.9% SL in Caruso 1981), a single pair of dark tendrils on the third dorsal spine (vs. two pairs; Fig. 4c), and anterior frontal spines enlarged (vs. relatively small; Fig. 6c).

Comments on *Lophiodes bruchius*. We examined 27 specimens (98–392 mm SL, listed below) collected from the Kyushu–Palau Ridge, southern Japan. *Lophiodes miacanthus* reported by Yamakawa (1982) and Nakabo (1984) is identified as *L. bruchius* by us. All characters and morphometrics of this species agreed well with the data provided by Caruso (1981) and the type specimens examined by the first author, except for the morphology of the esca and length of illicium.

Most specimens of *L. bruchius* examined by us have a rounded or elongated and cylindrical esca, instead of a leaf-like structure, usually bearing some cirri on its tip

Barcording of Life

DNA バーコードプロジェクト

- DNAの短い塩基配列データで全生物を分類しようという試み
- 動物に関しては COI遺伝子を用いる

チトクロームCオキシダーゼ・サブユニットI（*COI*）

- DNA解析の証拠標本(voucher)を必ず保管

バウチャー

Japanese Barcode of Life Initiative

日本バーコードオブライフ・イニシアティブ（JBOLI）

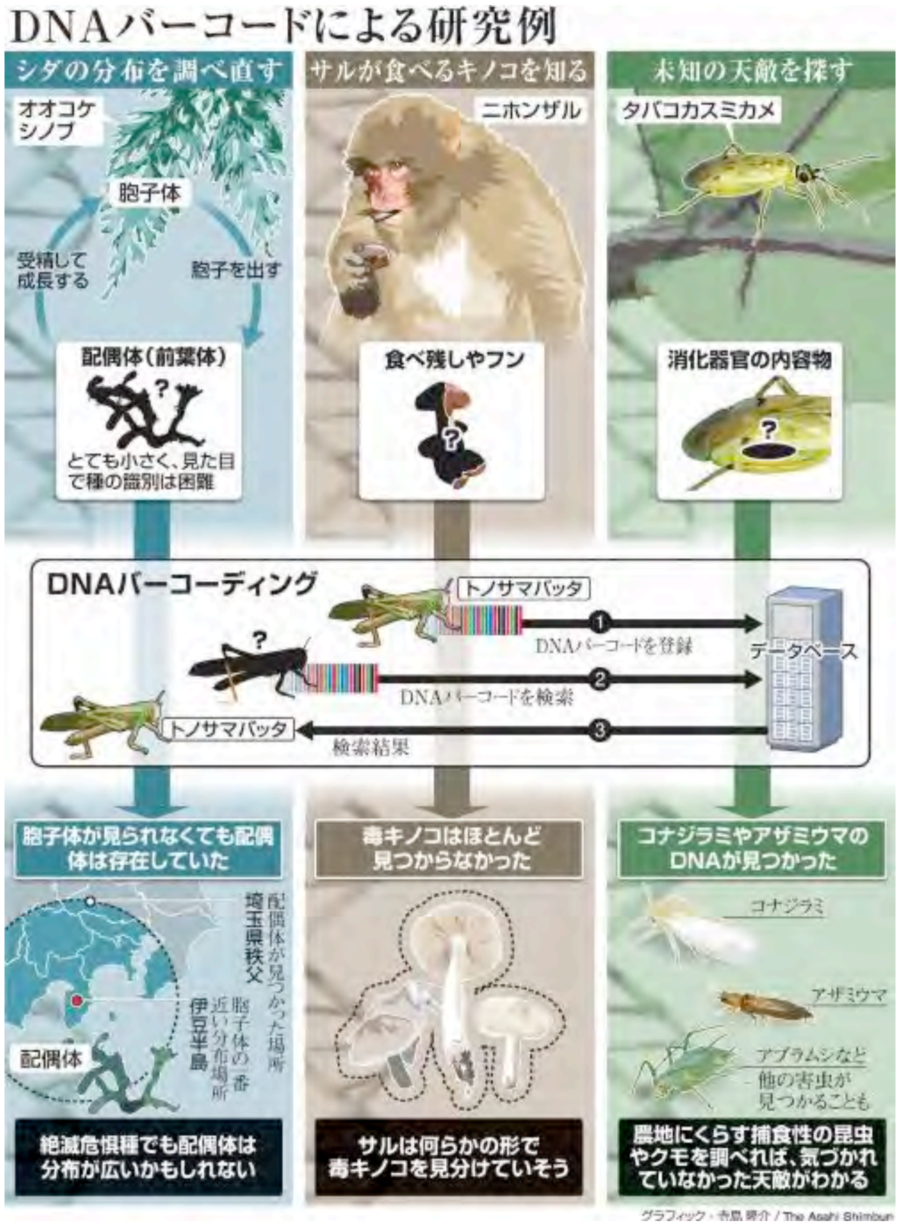
日本におけるDNAバーコーディングの普及や関連プロジェクトの支援を目的として2007年に設立された組織

目的 DNAバーコーディングに関する啓蒙・普及活動に取り組むと共に、国内におけるDNAバーコーディング関連の活動拠点として、JBOLIは以下の役割を果たすこと

- 国内におけるDNAバーコーディングに関する活動の入り口
- Consortium for the Barcode of Life (CBOL), DNA Data Bank of Japan (DDBJ), 証拠標本保管機関などとの調整
- 非公開データの保存および解析ツールの提供
- 国内向け同定支援システムの構築

JBOLI ホームページより

[朝日新聞aサロン　科学面にようこそ　種名判別DNAで簡単に]



2010年４月23日

分類学の３学派

1) 進化分類･伝統的分類 *

evolutionally taxonomy,

orthodox classification

2) 表形学，表形分類　*類似度で分類

phenetics, phenetic classification

数量分類 numerical taxonomy

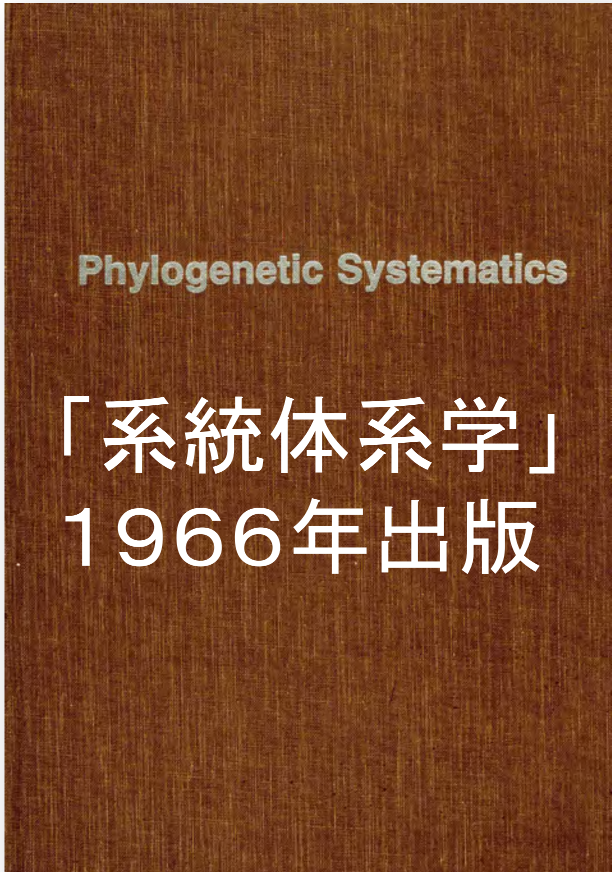
3) 分岐学，分岐分類

cladistics, cladistic classification

Willi Hennig (1913–1976)

ヴィリ・ヘニック
（ヘンニッヒまたはヘニッヒ）

ドイツの昆虫分類学者



分岐学の特徴

- 派生形質（新形質）の共有関係に基づいて系統類縁関係を推定する
- 生物の分岐進化 cladogenesis のみを仮定し，向上進化 anagenesisは考慮しない
- 単系統群のみをタクソンとして認め，分類のランクを与える
- 外群比較法をもちいる　外群と内群
- 最節約的に分岐仮説を選ぶ

分岐学ではホモプラシーが最小となる樹形を選ぶ

ホモロジー

ホモプラシー（非相同）

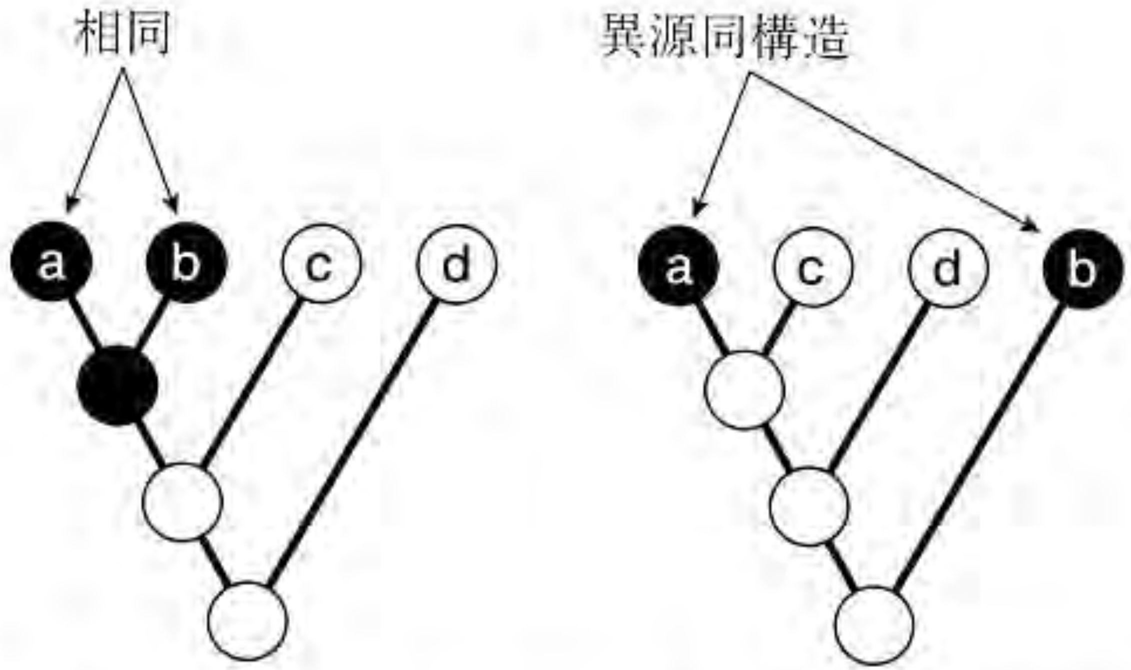


図 27.4　相同と異源同構造（Page and Holmes, 1998）

最大節約法　maximum parsimony

馬渡（2006）より

相同 (homology)

- 異なる生物間で，類似の構造と機能をもつ器官が系統進化的に共通の祖先に由来する時，これらの器官を相同であるという．相似（analogy）に対する用語．哺乳類の前肢と鳥類の翼などが例としてあげられる．相同器官をもつ生物は類縁関係をもつことが期待され，生物間の類縁性を調べる手がかりとなる．

石川統ほか編．2010．生物学事典（東京化学同人）より

ホモプラジー（homoplasy）

- 系統樹上の別々の枝で独立に進化した派生形質状態を意味する．共通の仮想祖先に由来する派生形質状態は最節約法（→分岐学）による系統推定において役立つ．しかし，ホモプラジーは逆に系統推定を誤らせる可能性がある．最節約法による系統推定ではホモプラジーはデータと系統樹の矛盾を説明するその場しのぎ（ad hoc）の仮定とみなされ，その回数は最小化される．ホモプラジーが生じる原因は，収れん進化，平行進化，形質の逆転である．

石川統ほか編．2010．生物学事典（東京化学同人）より

ホモロジーとホモプラシーの問題

実はかなりややこしい…

図 27.5 異源同構造の種類（Page and Holmes, 1998）
A. 平行進化：共通祖先形質状態から独立に同じ形質が進化. B. 収斂進化：異なる祖先形質状態から独立に同じ形質が進化. C. 先祖返り：一度失われた祖先形質状態が復活.

＊先祖返り atavisim

馬渡（2006）動物分類学30講より

平行現象と収斂の違いは？

1）平行現象 (parallelism), 平行進化

異なる祖先の同じ形質から生じ，相同のように見えるが相同ではない

例）魚類や昆虫の眼の退化

2) 収斂 (convergence)，収斂進化

異なる起源の異なる形質から相同と区別のつきにくい形質が生じる

例）鳥とコウモリの翼，魚とクジラの鰭，

有袋類のフクロモモンガと真獣類のムササビ

単系統，側系統，多系統
monophyly　paraphyly　polyphyly

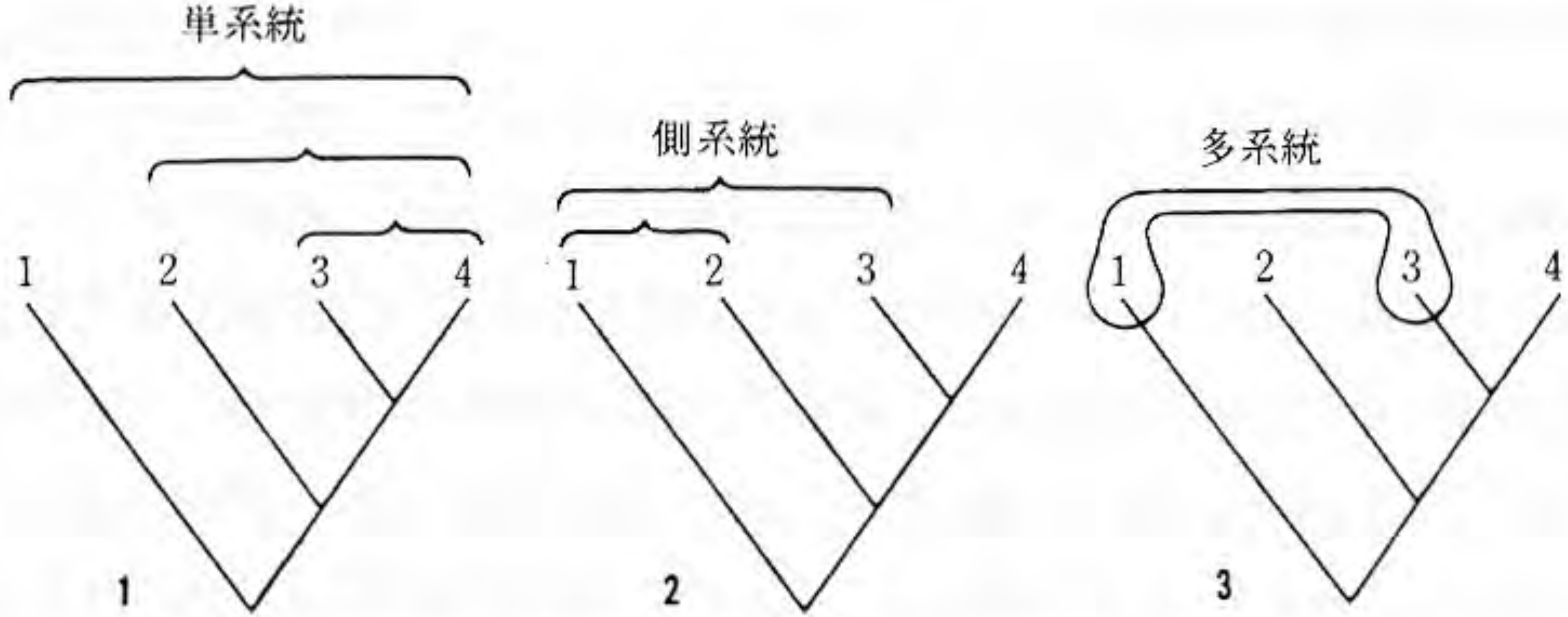


図 31　単系統，側系統，多系統の違い（Ridley, 1986 より）

馬渡（1994）より

単系統群(=クレード or クレイド)とは

monophyletic group=clade

- ある祖先とその子孫すべてを含む種の集合体

＊あるいは偽系統

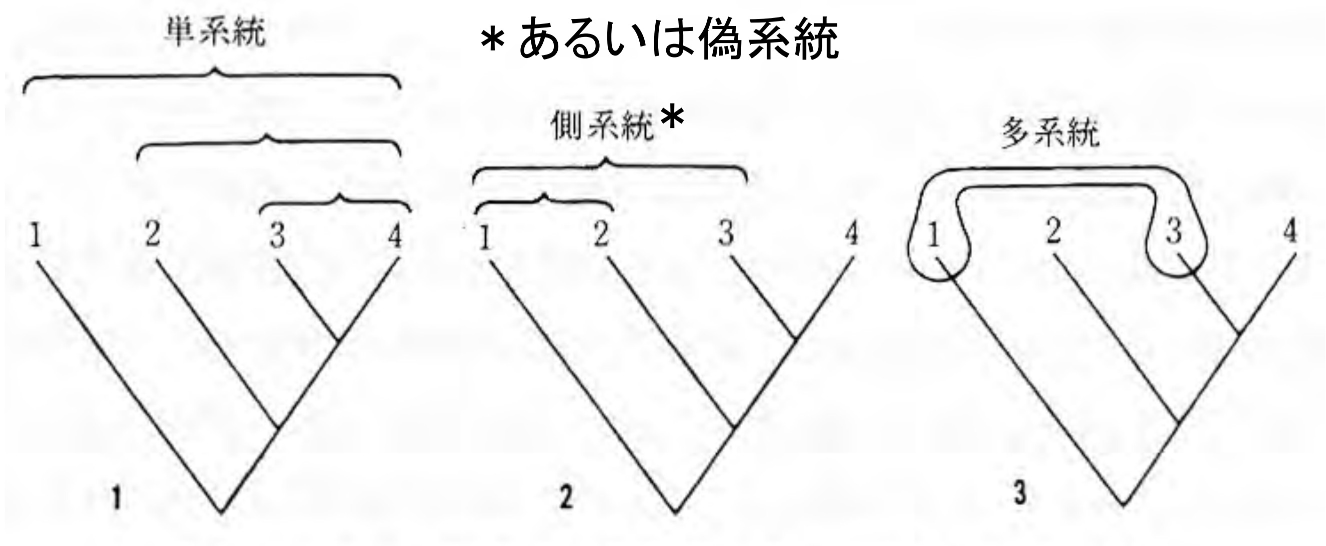
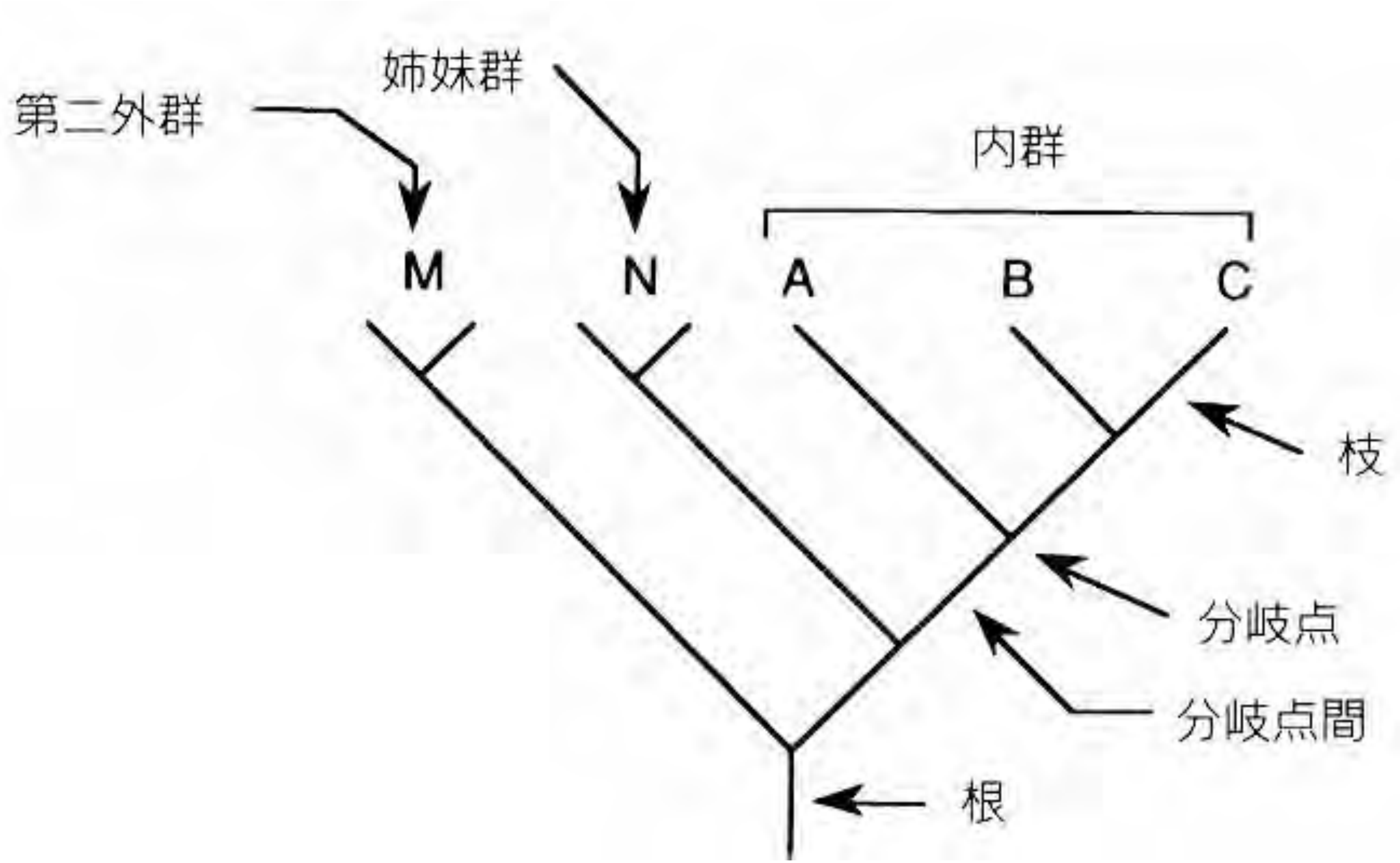


図 31　単系統，側系統，多系統の違い（Ridley, 1986 より）

内群，外群，姉妹群



宮　正樹（1992）「系統分類学入門」より

有根樹と無根樹

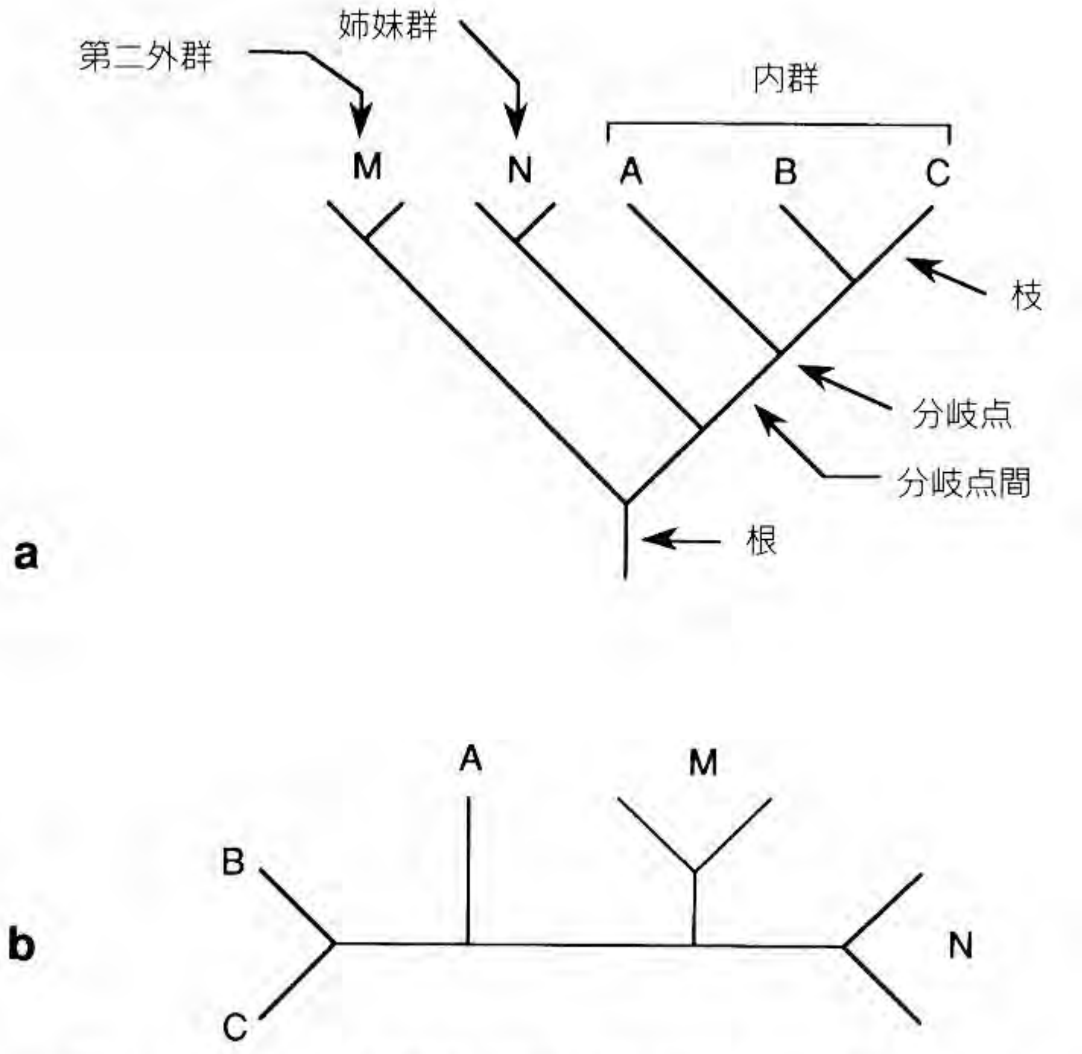
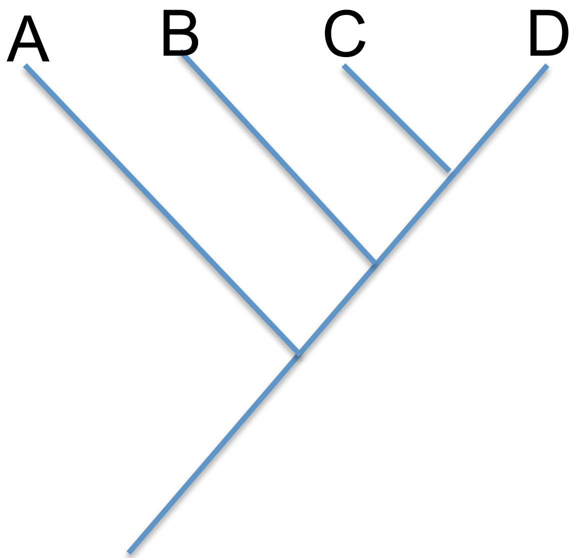
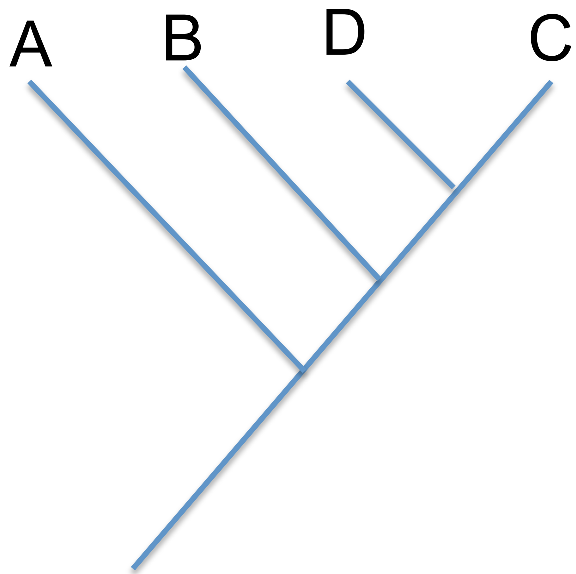


図 1.2. グループ ABC ならびにその外群 N（姉妹群）と M の
a. 有根系統樹と b. 無根系統樹.

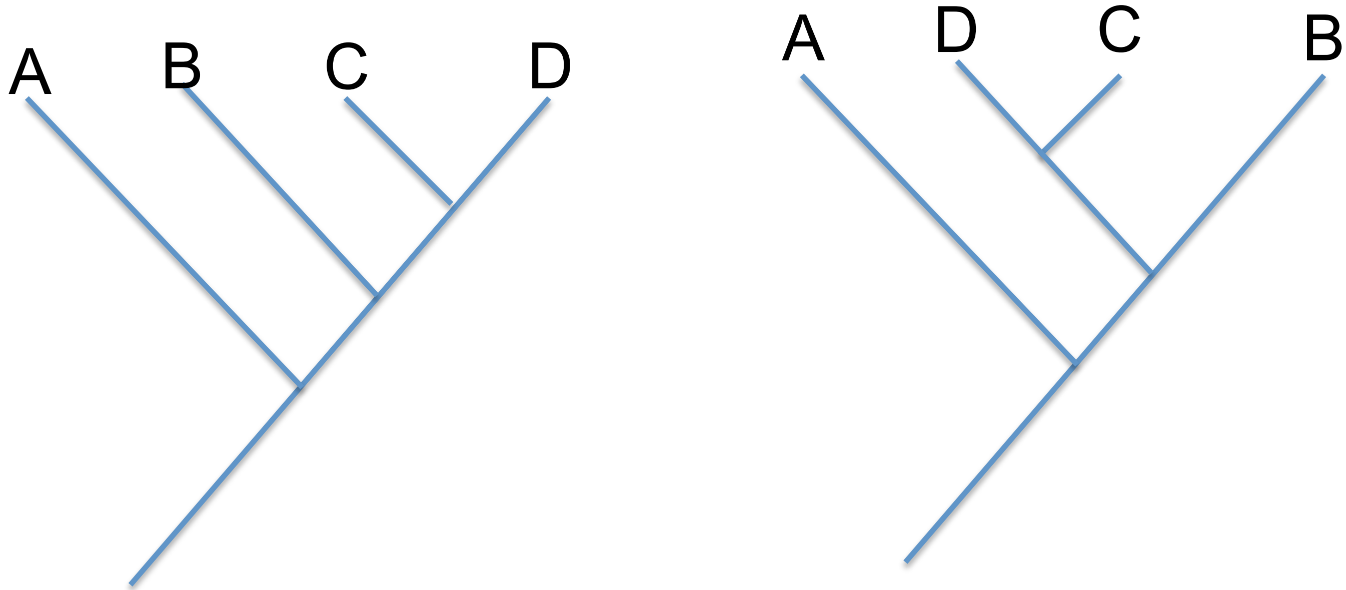
宮　正樹（1992）「系統分類学入門」より

同じ分岐関係？

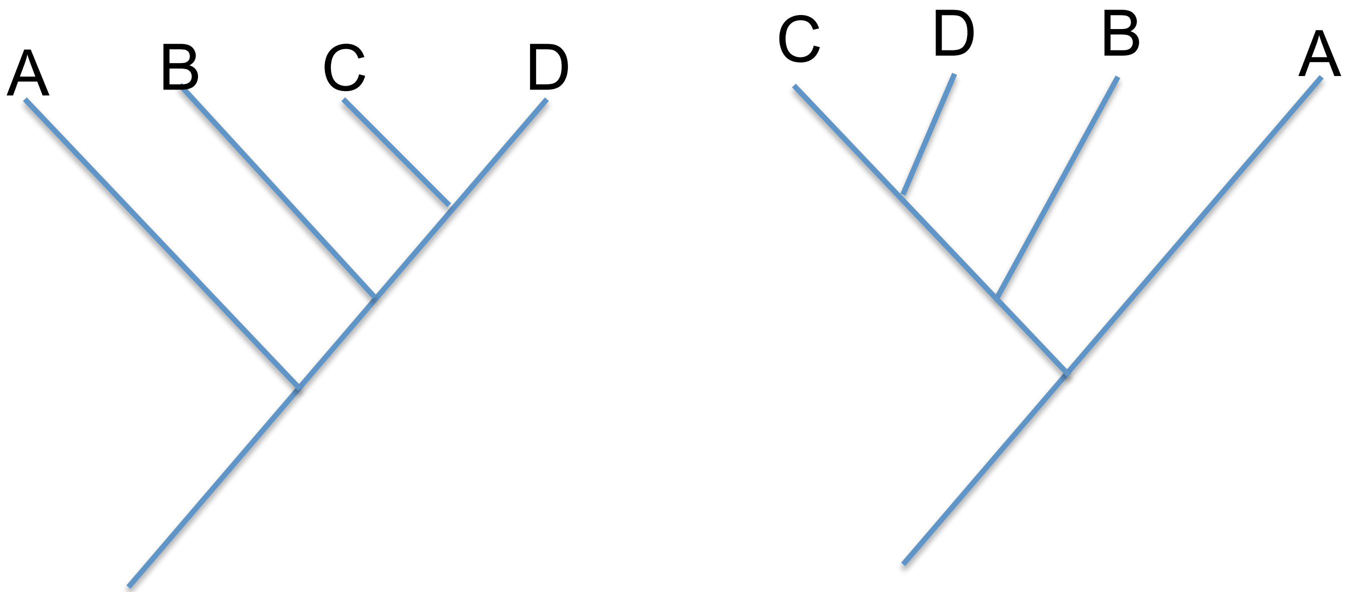




同じ分岐関係？



同じ分岐関係？



分岐図（cladogram）は，分岐の順番のみを示す

派生形質と祖先形質の共有関係

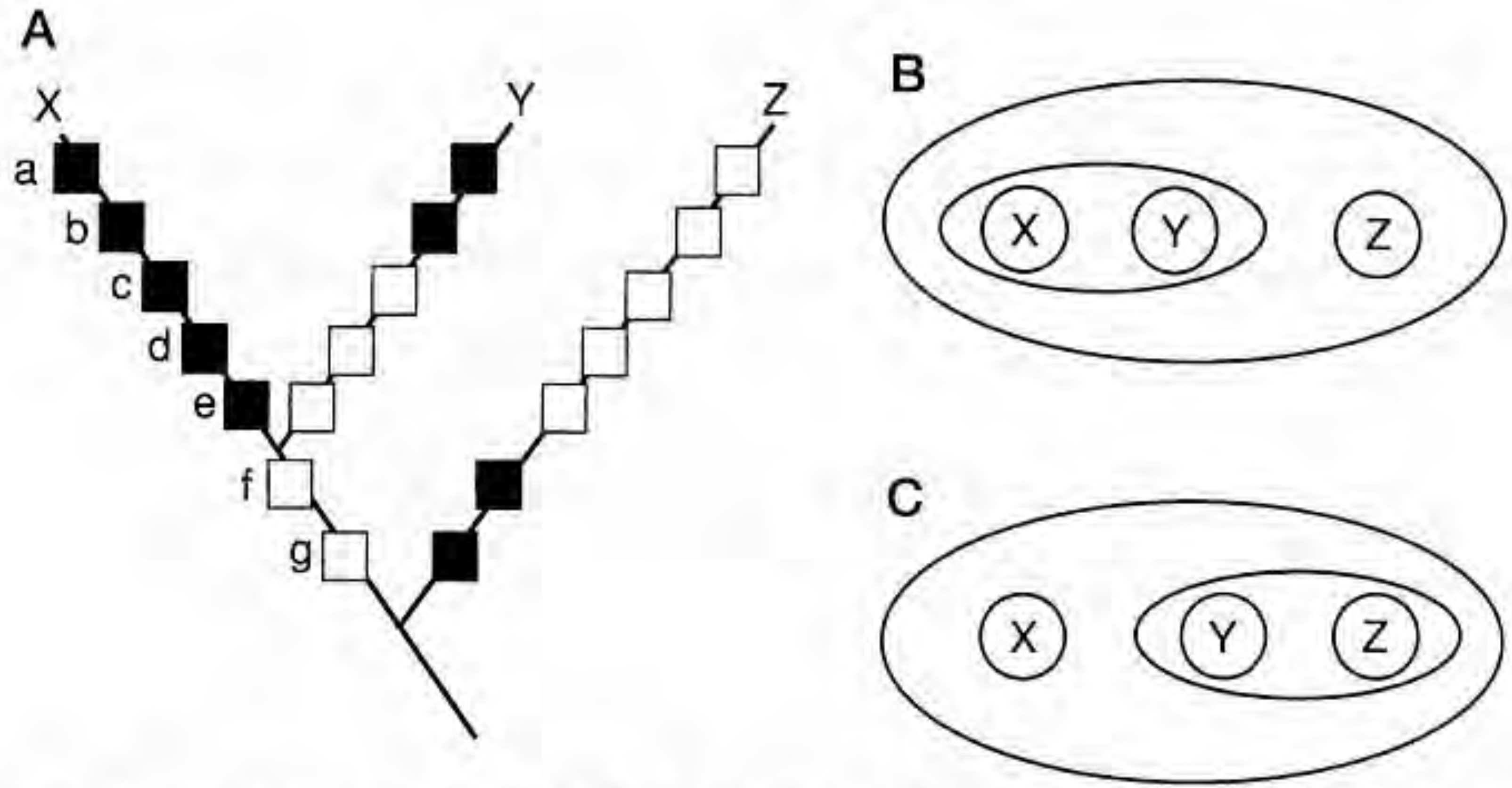


図 3-1　種 X，Y，Z の関係を示す樹状図．形質 a-g の黒は派生的状態，白は祖先的状態を示す．派生的形質の共有（形質 a と b）にもとづくと，種 X と Y が近縁となり，B のような入れ子状集合が得られ，祖先的形質の共有（形質 c，d，e）にもとづくと種 Y と Z が近縁となり，C のような入れ子状集合が得られる．

松浦 (2009) 動物分類学より