南米コロンビア産草本性タケ類とササ属植物との間にみられる形態的類似性

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Mikio KOBAYASHI*and Nobuo SATOMI**:

Herbaceous Bambusoid Grasses around the Peneya River, Colombia, South America, with Special Reference to Affinity with Japanese Woody Bamboos of Genus *Sasa*

小林幹夫*・里見信生**：南米コロンビア産草本性タケ類とササ属植物との間にみられる形態的類似性

Abstract

Herbaceous bambusoid grasses of the neotropical rain forest around the Peneya River, Colombia, were investigated for the gross morphology of their external vegetative structure and compared phylogenetically with the genus *Sasa* plants, the Japanese woody bamboos. These herbaceous bambusoid grasses were identified as *Olyra latifolia* L., *O. micrantha* H. B. K., *Cryptochloa unispiculata* SOD., *Piresia goelidii* SWA., *P. linearifolia* SOD., *Pariana setosa* SWA., *P. interrupta* T., and two other *Pariana* species. These species shared several characters common to genus *Sasa* plants: oblong-lanceolate broad leaf-blades, transverse veinlets of abaxial leaf suface, oral setae, truncate or high adaxial ligule, persistent culm-sheath, prominent node, cespitose clump, and amphipodial rhizome system. Two different types of *Olyra latifolia* L. were observed: the herbaceous and the lignified type. The former had some variations in spikelet characters such that it had a hermaphrodite spikelet and was colored the various anthecium shades of whitish, olivaceous, and reddish brown.

Key Words: Amphipodial rhizome—Colombia—Herbaceous bambusoid—Neotropical rain forest—*Sasa*

Bambusoideae, one of the subfamilies of the grass family, are composed of two major groups: the woody bamboos and the herbaceous bambusoid grasses (herbaceous bamboos). They are distinguished from other grasses by their perennial nature, pseudopetiolated leaves, special type of leaf anatomy and epidermis, flowers with three lodicules, often six stamens and three stigams, and distinctive seedlings (CALDERÓN and SODERSTROM, 1980).

During the second Amazonian expedition conducted by the Japan Monkey Center from October 1973 to March 1974, SATOMI collected many bamboo plants from the neotropical rain forest around the Peneya River, underlying the western Amazonia. Most of the plants were herbaceous bambusoid grasses whose gross morphology except the flower structure was very similar to that of the Japanese woody bamboos of the genus *Sasa*. In the present study, we compared the external gross morphology of the two plants and considered their phylogenetic significance.

Locality

Plants were collected from the lowland tropical rain forest in an area about 20km², located at approximately 0°latitude, 75°W longitude, altitude about 200 m, on the right side of the Peneya River, a branch of the Caqueta River, in Colombia.

Identification

The specimens were identified by JUDZIDWICZ, the contractor of the project for Biodiversity of the Guianas, Department of Botany, Smithsonian Institution, Washington, D. C., as in Table 1.

Except for genus *Arthrostylidium*, the plants were all herbaceous bambusoid grasses belong to the tribe Olyreae (*Olyra, Cryptochloa, Piresia*) or Parianeae (*Pariana*) (CALDERÓN and SODERSTROM, 1980). These plants are monoecious with one-flowered spikelets arranged in mixed panicles or on separate male and female inflorescences

* Faculty of General Education, Utsunomiya University, 350 Mine-machi, Utsunomiya 321, Japan. 宇都宮大学教養部

** 4-359, Hisayasu, Kanazawa 921, Japan. 〒921 金沢市久安4-359

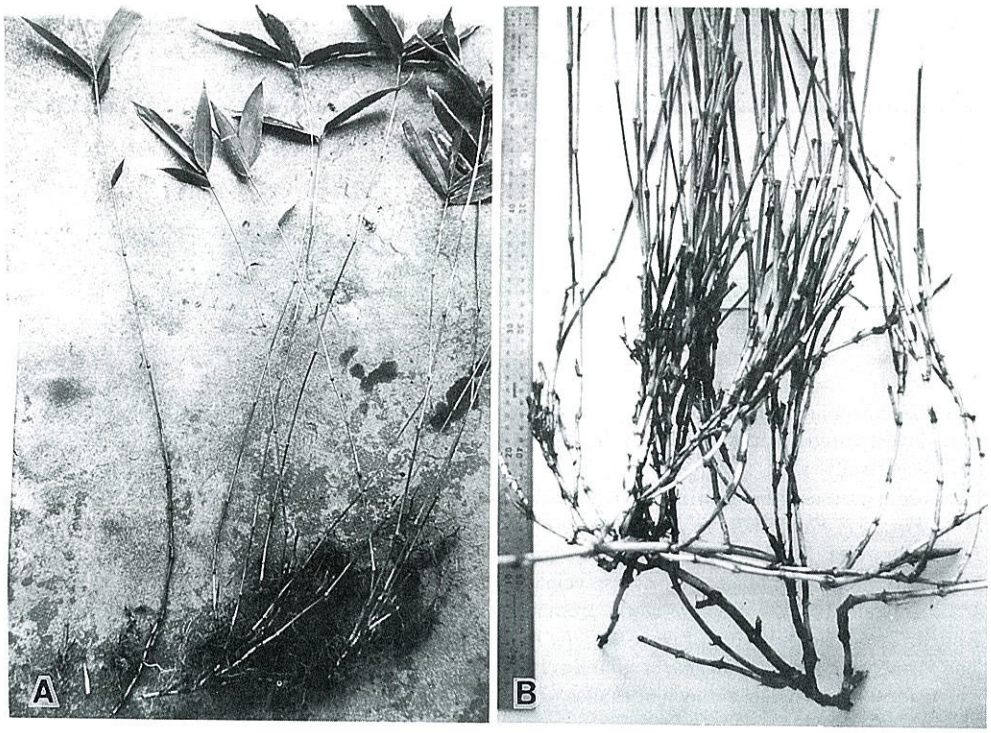

Fig. 1　*Sasa nipponica* from Senjogahara, Tochigi Prefecture. (A) Cespitose clump profile with newly developed culms. 6 August 1986. (B) Amphipodial rhizome system. Roots are removed and old culms are snapped. 11 November 1986.

Table 1.　List of specimen identified.

SATOMI Collect. No.	Date of Collectdon	US Herbarium Accession No.	Botanic Name
199	Nov. 30, 1973	3149504	*Olyra latifolia* L.
200	Dec. 12, 1973	3149503	*Olyra latifolia* L.
167	Dec. 1, 1973	3149507	*Olyra micrantha* HUMBOLDT, BONPLAND et KUNTH vel. aff.
193	Nov, 7, 1973	3149506	*Piresia goeldii* SWALLEN
191	Nov. 7, 1973	3149505	*Piresia linearifolia* SODERSTROM indet.
177	Nov. 9, 1973	3149511	*Cryptochloa unispiculata* SODERSTROM
173	Jan. 8, 1974	3149508	*Parina setosa* SWALLEN ad int.
196	Dec. 28, 1973	3149502	*Pariana interrupta* TUTIN ad int.
201	Nov. 12, 1973		*Pariana* sp.
179	Dec. 1, 1973		*Pariana* sp.
176	Nov. 28, 1973	3149510	*Arthrostylidium* sp.
162	Feb. 3, 1974	3149509	*Arthrostylidium* sp.

within the same plants (CALDERÓN and SODERSTROM, 1980).

Summary and some examples of vegetative morphological character and peduncle types of *Sasa*

Rhizome long, creeping under the ground, usually sympodial, rarely monopodial. Clump habit spreading. Culms ascendent, simple or ramose with one branch to a node, fistulous. Nodes prominent. Culm-sheaths persistent, closely encircled, usually shorter than internodes. Leaves palmately or pinnato-palmately arranged towards the top of culms or branches, 4-9 in

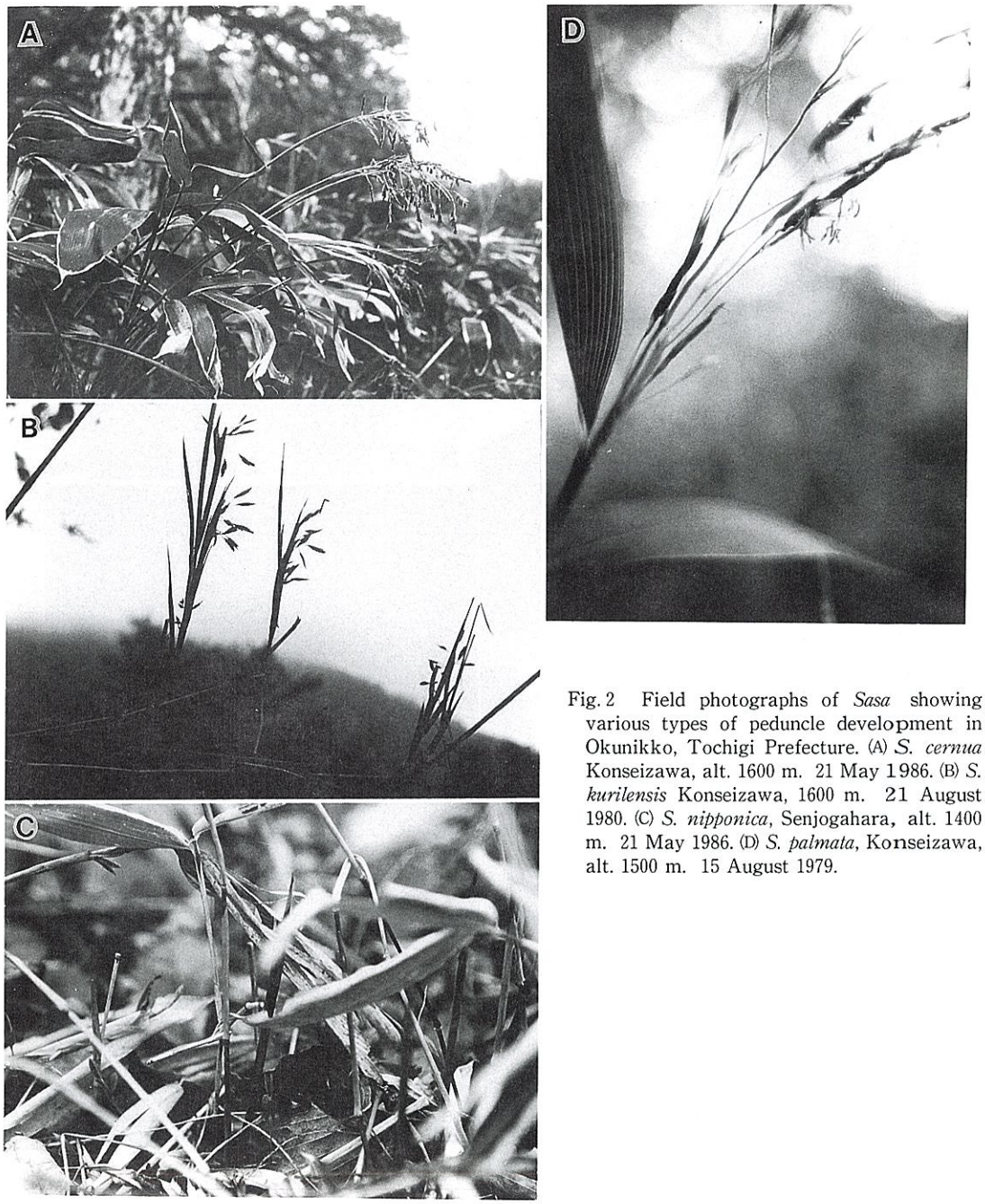

Fig. 2 Field photographs of *Sasa* showing various types of peduncle development in Okunikko, Tochigi Prefecture. (A) *S. cernua* Konseizawa, alt. 1600 m. 21 May 1986. (B) *S. kurilensis* Konseizawa, 1600 m. 21 August 1980. (C) *S. nipponica*, Senjogahara, alt. 1400 m. 21 May 1986. (D) *S. palmata*, Konseizawa, alt. 1500 m. 15 August 1979.

number, chartaceous to coriaceous, from narrowly lanceolate to ovate, acuminate; oral setae setiform, radiate, deciduous, sometimes lacking, scabrous over the entire length; adaxial ligule 1-2 mm long, truncate or rounded above (SUZUKI, 1978).

As shown in Fig. 1A, *Sasa nipponica* MAKINO et SHIBATA had slender and non-branched culms with long internodes and strongly prominent nodes. Usually culms wither in the following year; the second-year culms are very fragile and easy to snap at the nodes (Fig. 1B), and are thus alternated with the newly developed culms (Fig. 1A). The plant had sympodial rhizomes from which simple culms emarged to form cespitose clumps. Clumps grow year by year by adding a new erect rhizome,

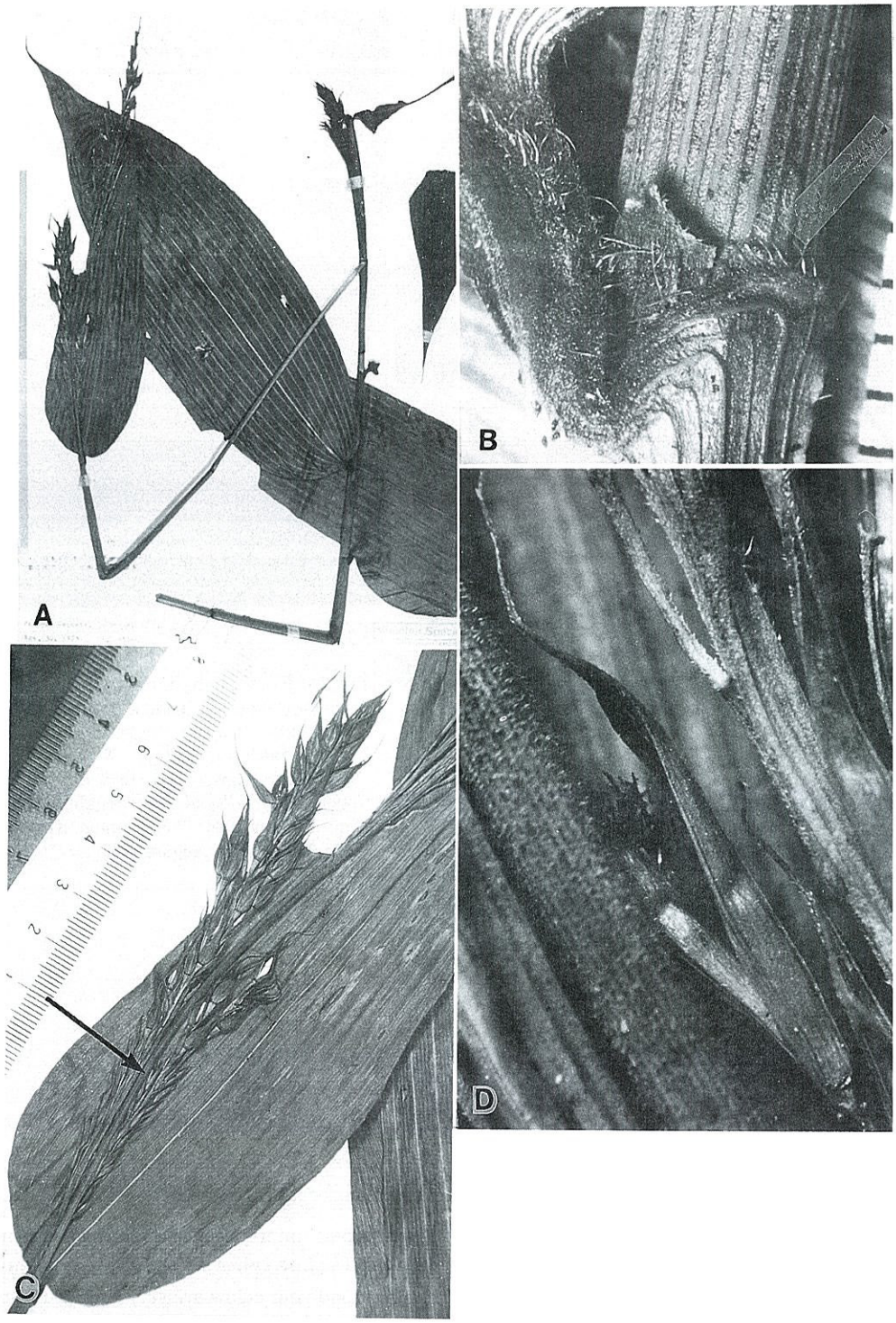

Fig. 3　*Olyra latifolia* with herbaceous culm. (A) A leafy peduncle branched at the base of another peduncle. (B) Adaxial ligule. (C) Synflorescences with various colored anthecium. Arrow show a hermaphrodite spiklet. (D) Hermaphrodite spikelet with one anther and gynoecium.

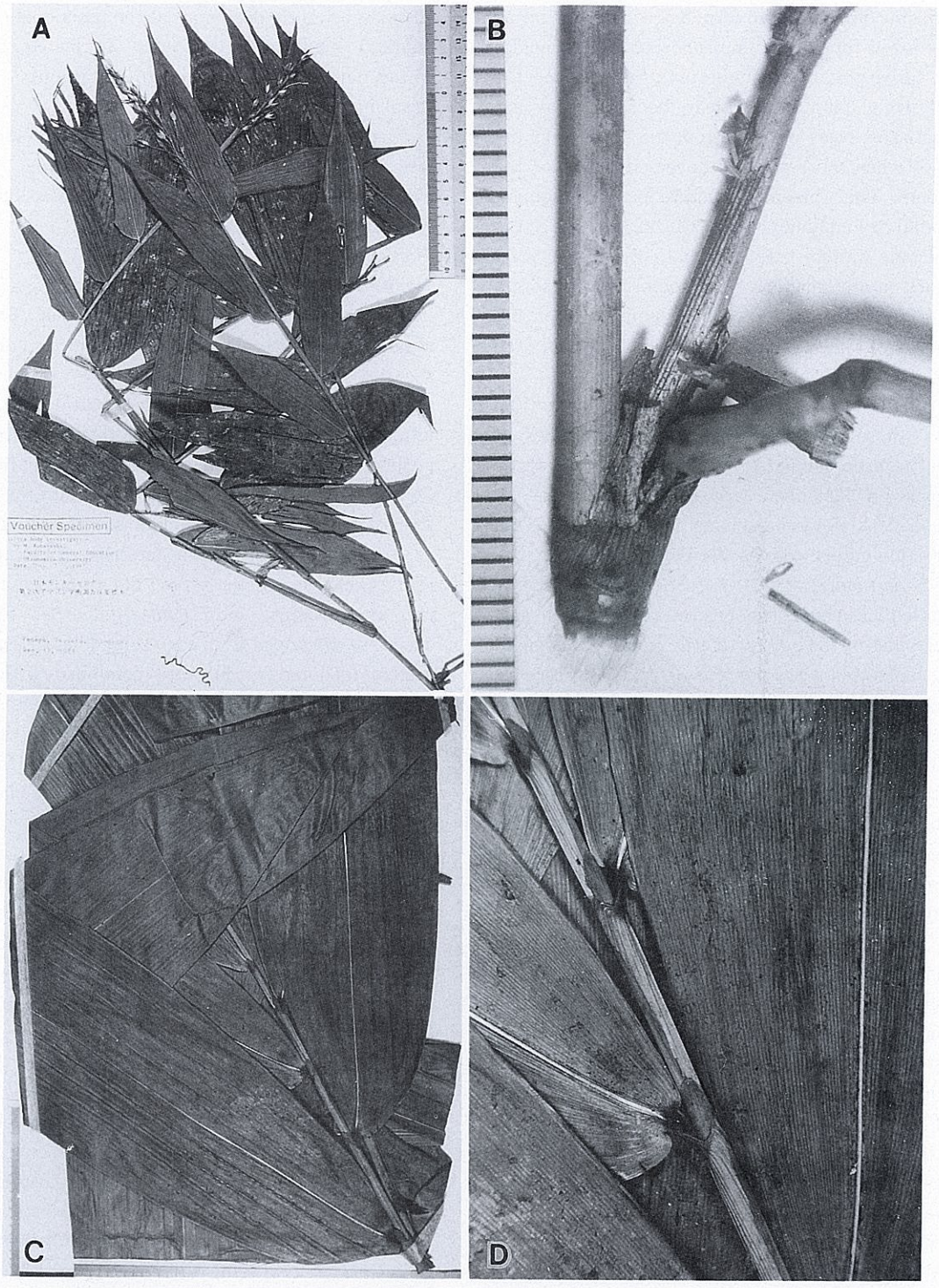

Fig. 4 Genus *Olyra* plants; (A, B) *O. latifolia* with lignified culm; (C, D) *O. micrantha*. (A) Three year-old ramose culm with one branch to a node, each branch terminating in a synflorescence. (B) Lignified culm. (D) Adaxial ligule linguiformis, 10 mm long.

and sometimes send a horizontal leptomorphic rhizome dowmward to form a new clump as far as the lower limit of the hums horizon. The boundary between each pachymorphic rhizome and the following culm is not clear, because many adventitious roots develop from the nodes near the base when the leaf litter covers the base of the clump. This rhizome structure is called amphipodial or amphimophic (MCCLURE, 1973), i. e., the rhizome system embraces both the monopodial (horizontally running or leptomorphic) rhizomes and the sympodial(erect and clumping or pachymorphic) rhizomes in the same plant (Fig. 1B) (MCCLURE, 1966).

Sasa developed various types of peduncles (Fig. 2): those branching from the upper nodes of leafy sterile culms (A: *S. cernua* MAKINO), those borne on decumbent and leafless culms, or independent flowering culms whether or not the prostate culms were covered by leaf litter or soils (B:*S. kurilensis* MAKINO et SHIBATA), independent leafless peduncles borne on the pachymorphic rhizomes or the base of sterile culms and covered by leaf litter (C: *S. nipponica*), and inflorescence borne on the top of leafy culms embraced by the leaf-theaths (D: *S. palmata* (MARLIAC) NAKAI). The last case was scarcely ever observed.

In the following paragraphs, we compare the above-mentioned characters with those of the herbaceus bambusoid grasses and report some significant findings for the first time.

Olyra latifolia

The plants had two different types: the one classified as No. 199 (Fig. 3) had a herbaceous culm with leafy peduncles branched at the base of another peduncle (A), leaf-blades ovate-oblong, attenuatedly acuminate, 23-29cm long, 8.5cm wide, adxial ligule truncate or short (B). The color of the anthecium was whitish, olivaceous, or reddish brown (C); the synflorescence branched divergent from the axis, the lower ones only with male spikelets, the upper or terminal ones only with female spikelets (C). A hermaphrodite spikelet with one blackish purple anther and gynoecium was observed (D) at the transient zone of the male to female spikelets (C: arrow). The other type of plant, classified as No.200 (Fig. 4A, B), had a three year-old woody culm (B). Each branch bore inflorescenes on the top. Leaf-blades were oblong lanceolate, coriaceous, 12-17cm long, 2.5-4.8cm wide, and slightly deciduous at the pseudopetiole. Adaxial ligule was the same as in No. 199. Anthecium color was whitish to olivaceous.

Olyra micrantha

This plant had very large leaf-blades, oblong-lanceolate, chartaceo-membranaceous, 41-51 cm long, 7-13cm wide (Fig. 4c). Adaxial ligule was linguiformis, 10mm long (Fig. 4D).

Piresia

Both *P. linearifolia* (Fig. 5A, B) and *P. goeldii* (Fig. 5C, D) had clump height less than 18cm, slender culms with long internodes, shorter culm-sheashs, and prominent nodes. Two peduncle types, one leafy erect and terminating in an inflorescence (C: arrow) and the other a prostate peduncle with reduced leaf (A: arrow) or leafless (D), were observed. A geniculated culm in *P. linearifolia* (A) and reflexed culm-sheath blades in *P. goeldii* (D) were also characteristic. The most remarkable character was the amphipodial rhizome structure in *P. linearifolia* (B). Two cdspitose developed from each sympodial rhizome system (denoted as S) were combined with a leptomorphic rhizome 9mm long and 0.5mm in diameter (L indicated by the black and white arrow). In addition, a successive 4mm long rhizome bud was observed (L pointed by the black arrow).

Cryptochloa unispiculata

Culm with long middle internodes, 5-9cm long, and persistent culm-sheaths (Fig. 6A). Nodes prominent, adventitious root rising at lower nodes less than 4cm above the base (B: arrows). Adaxial ligules, membranous and linguiformis, 3mm long (C).

Pariana

various growth forms were observed (Fig. 7): ascending culms (A, B), creeping and producing adventitious roots at nodes near the base, covered with laminated culm-sheath (C), or cespitose clump, slightly lignified at the base (D). All species had long and numerous (A, B), several (C), or only rudimental (D) oral setae. Culm-sheaths persistent. Oblong-lanceolate leaf-blades. Transverse veinlets were observed at the abaxial leaf surface (Fig. 8). *Olyra* plants also had these transverse veinlets.

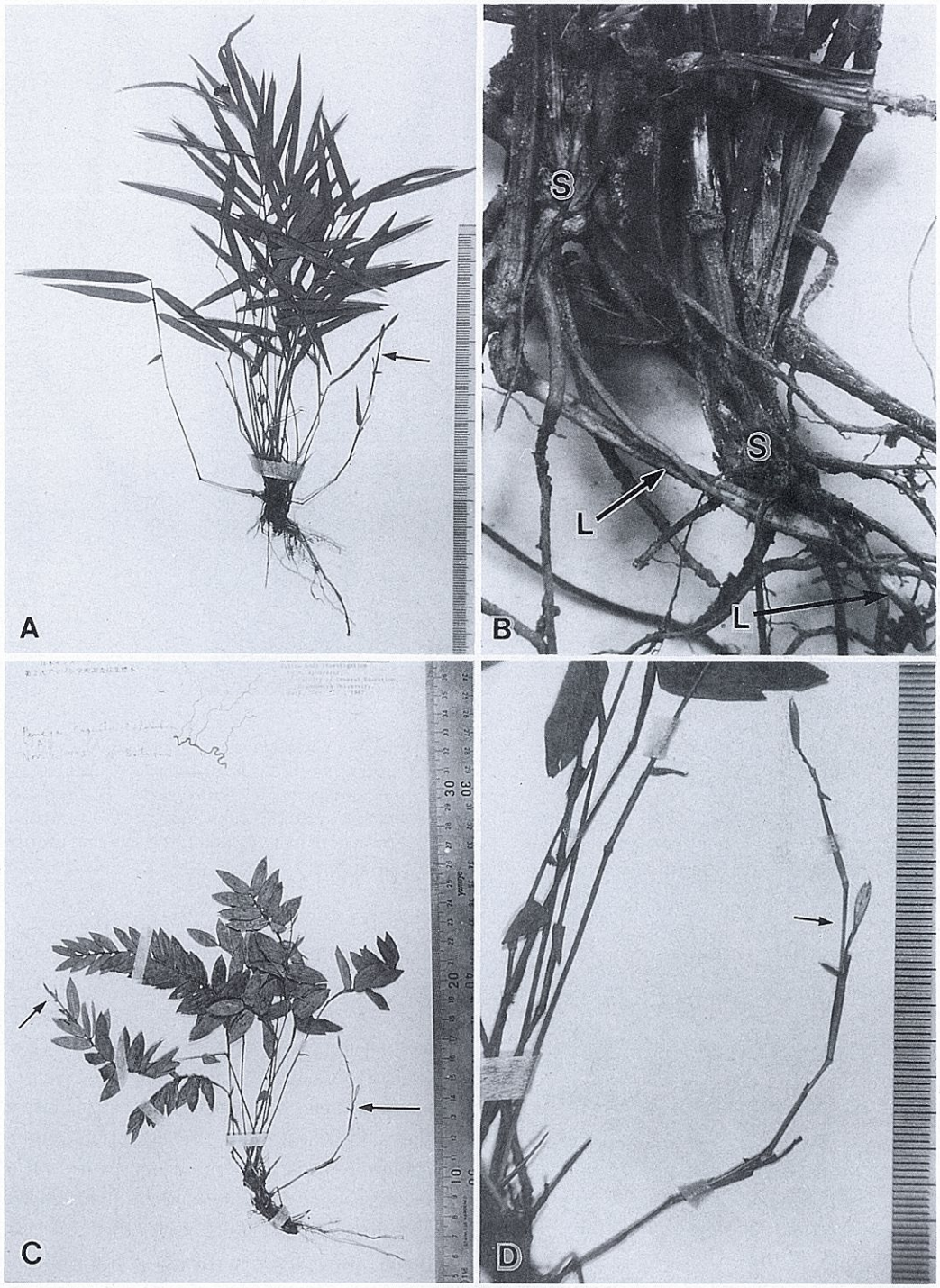

Fig. 5 *Piresia linearifolia* (A, B) and *P. goeldii* (C, D). A, C: Clump profiles; arrows show inflorescences. (B) Amphipodial rhizome structure (× 6). S or L denotes each sympodial rhizome system or leptomorphic rhizome, respctively. (D) Arrow shows the prostate leafless peduncle. Note the reflexed culm-sheath blades of erect culms.

Discussion

Herbaceous bambusoid grasses are known to have highly specialized inflorescences and spikelets. However, they are considered more

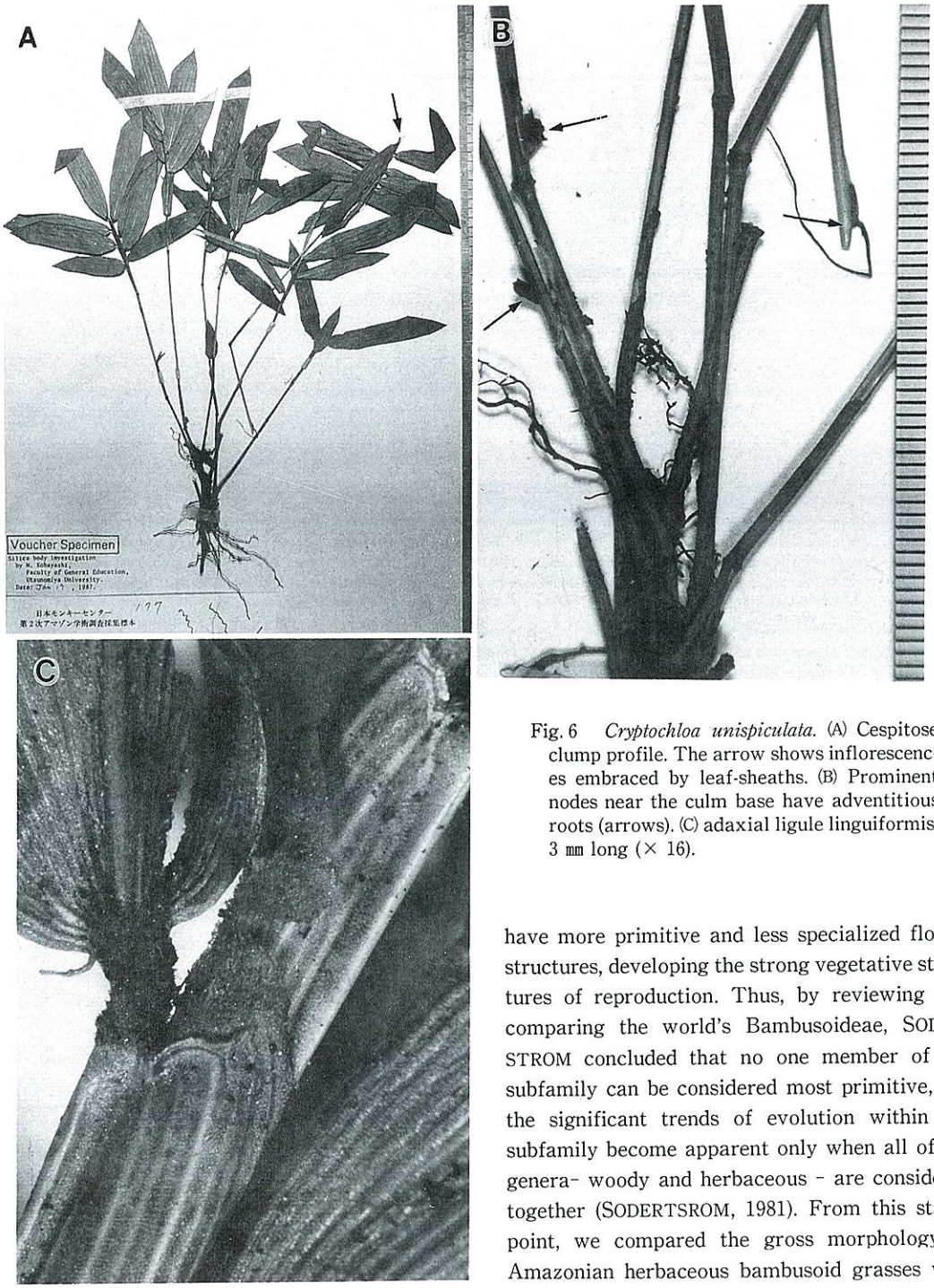

Fig. 6　*Cryptochloa unispiculata.* (A) Cespitose clump profile. The arrow shows inflorescences embraced by leaf-sheaths. (B) Prominent nodes near the culm base have adventitious roots (arrows). (C) adaxial ligule linguiformis, 3 mm long (× 16).

primitive than the woody bamboos because of their low ploidy levels, from 2n=14 to 44, with various ranges of aneuploidy, whereas the latter are tetraploid or hexaploid with ×=12. On the contrary, the woody bamboos such as *Bambusa* have more primitive and less specialized flower structures, developing the strong vegetative structures of reproduction. Thus, by reviewing and comparing the world's Bambusoideae, SODERSTROM concluded that no one member of the subfamily can be considered most primitive, but the significant trends of evolution within the subfamily become apparent only when all of the genera- woody and herbaceous - are considered together (SODERTSROM, 1981). From this standpoint, we compared the gross morphology of Amazonian herbaceous bambusoid grasses with the Japanese woody bamboos of *Sasa*.

They have the following common characters: several erect culms forming a cespitose clump (*Cryptochloa, Piresia, Pariana* sp.), partially lignified culms (certain type of *Olyra latifolia, Pariana* sp.), amphipodial rhizome system (*Piresia lineari-*

Fig. 7 Genus *Pariana* Plants. (A) *P. setosa*. (B) *P. interrupta*. (C) *P.* sp. Prostate culms covered with laminated culm-sheaths. (D) *P.* sp. Cespitose clump habit, culm base slightly lignified.

folia), prominent nodes near above the base occur the adventitious roots (*Cryptochloa, Pariana* sp.), persistent culm-sheaths (all plants), lanceolate broad leaf-blades (all plants except for *Piresia),*

transverse veinlets of abaxial leaf surface (*Olyra, Pariana),* oral setae (*Pariana)*, adaxial ligule (all plants), leafy peduncles (*Olyra, Piresia, Cryptochloa, Pariana* sp.), and prostate leafless peduncles (*Piresia, Pariana* sp.). Each species had a very similar character to that seen in *Sasa*, but with very distinct characters at the same time. Several species shared the characters common to *Sasa*. The situation is very like the shared primitiveness among the herbaceous bambusoid grass (SODERSTROM, 1981). Nonetheless, these common characters give rise to a similarity between the two distinctive bamboo groups in such distinctive habitats as lowland tropical rain forests and cool-temperate broad-leaved deciduous forests. Most of the common characters suggest a similarity of habitat: both groups inhabit the understory of wet forests, where the culm base of the clumps are more or less covered by leaf litter (Fig. 9).

Monocarpic long flowering intervals in woody bamboos have been accompanied by strong vegetative reproduction, partly based on the rhizome structure, which is called an amphipodial or amphimorphic rhizome system (MCCLURE, 1973).

While the amphipodal rhizome is common in Asiatic bamboos, only two South American bamboo taxa are known to have it: *Chusquea fendleri* MUNRO (MCCLURE, 1966, 1973) and *Aulonemia fulgor* SODERSTROM (SODERSTROM, 1988), which are both woody and grow in a montane habitat. However, the present study showed that the type can also be seen in such herbaceous bambusoid grasses as *Piresia*. The present obsevation is limited to the apparent gross forms for the clumping type as symodial and for the running type as leptomorphic, which are combined to form an amphipodial rhizome system in *Piresia*. However, the definition of the rhizome types is based on two viewpoints (MCCLURE, 1966; 1973): one is the morphology of the length, diameter, and shape of an internode of a rhizome, e. g., a leptomorphic vs. pachymorphic rhizome ; the other is based on the developmental viewpoint, e. g. monopodial vs. sympodial. An amphipodial rhizome has both types in the same plant. Bacause of the preliminary nature of the present study, further morphological and developmental studies should be carried out to identify the rhizome type in *Piresia* precisely. It is important to study the rhivome structures of *Cryptochloa* (SODERNOROM, 1982), *Diandrolyra* (SODERSTROM and ZULOAGA, 1985a), *Arberella*, and *Raddia* (SODERSTROM and ZULOAGA, 1985b), because the brief sketches and descriptons of rhizome structure and clumping habits in these taxa suggest the occurrence of the same rhizome type as seen in *Piresia*. Furthermore, study of the putative monocarpic *Olyra* speies, such as *O. ecaudata, O. taquara, and O. standleyi*, might have some fruitful results for clarifying the adaptive meaning of rhizome structure as related to flowering habit (SODERSTROM and ZULOAGA, 1989).

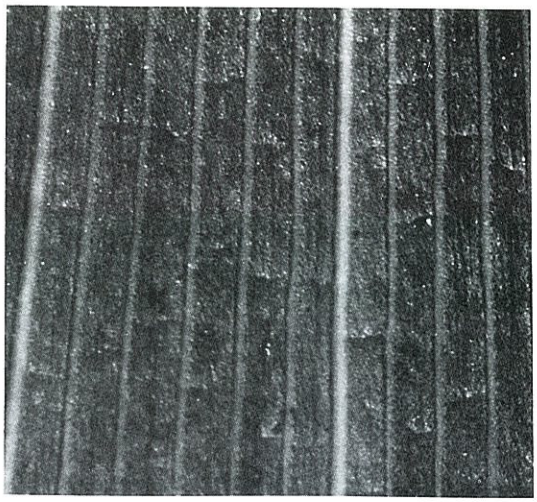

Fig. 8　Transverse veinlets of abaxial leaf surface of *P. interrupta* (× 10).

we are indeated to Dr. Emmet J. JUDZIEWICZ of the Smithsonian Institution, Washington, D. C., for his kind identification of bamboo specimens and his valuable suggestions during MK's stay at the Institution in early April 1989. We also thank Ms. Mary SANGREY, the bamboo technician of the Department of Botany, Smithsonian Institution, for her kind assistances.

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Fig. 9 Field photographs of herbaceous bambusoid grasses occurring in the understory of the lowland tropical rain forest around the Peneya River, Caqueta, Colombia. All plants occurred in canopy gaps of various sizes, where they were not inundated with water even in the rainny season (A) *Olyra micrantha*. (B) *Pariana interrupta*. (C) *Piresia linearifolia*.

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摘　要

1973年10月から74年にかけて行われた日本モンキーセンター第二次アマゾン学術調査隊に参加した里見は，南米コロンビア領カケタ河の支流ペネージャ川の右岸に設けられた調査地（緯度0度西経75度付近，標高約200 m，面積約20 km²の低地熱帯雨林の林床）から，多数のイネ科タケ亜科植物の標本を採集した。これらの標本の同定を米国スミソニアン研究所のDr. E. J. JUDZIEWICZに依頼した結果，つる性木本の*Arthrostylidium*属2種をのぞいて，他はすべて草本性タケ類であることがわかった。それらは，*Olyra*属2種，*Piresia*属2種，*Cryptochloa*属1種（以上オリラ連），および*Pariana*属4種（パリアナ連）と同定された。新熱帯の草本性タケ類は，花の構造が単性，1小穂1小花，あるいは2本から数十本のおしべを持つなど，高度に特殊化している反面，そのほとんどのものが，2倍体の染色体構成を持つことから，4倍体から6倍体の木本性タケ類に比べ原始的とみなされている。これらの標本の外部形態が日本産ササ属植物に酷似するものが散見されとことから，本研究ではササ属植物の属の概念の概略を述べ，ミヤコザサの栄養体や数種のササ属植物の花序に関する観察結果を参照しながら，両者の外部形態を比較した。その結果，ササ属植物を特徴づける株立ち形成，節の膨出，1節1枝分枝，稈鞘の宿存性，肩毛の発達，広披針形の葉身，葉の細脈間の格子目の存在，さらに花序の発生部位などの諸性質を，数種の草本性タケ類が，互いに欠けた特徴を補い合うように所有することがわかった。更に，その1種で稈高18 cmの*Piresia linearifolia*では，アジア産のいくつかの竹類に共通にしてみられるが，南米産タケ類ではこれまで，木本・高山生のタケ類において2例のみしか知られていない，amphipodial rhizome system（単軸性と仮軸性の地下茎を同一植物体に持つ形態）を持つことが示された。また，*Olyra latifolia*において草本性から木本性，単性花から両性花，など，巾広い種内変異を持つことが示された。

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巨樹は人の一生と比べることが出来ない長い年数を生きながらえて来ている。これには地域住民の保護があったからで，間違いなく文化財である。最近，この価値が人々に認識されて来て，昭和63年度，環境庁では全国の巨樹・巨木林の現況調査が行なわれた。これが少くとも引金となったと言えようが，各地で巨樹を紹介する書籍が次々と発行されている。それらを列挙した。

○　馬場　篤編　**会津の巨樹と名木**　会津生物同好会（〒965 会津若松市花巻町8番1号，振替口座郡山9477），平成2年3月1日発行。A5判，324頁。定価3,000円（〒別）。

○　東京都環境保全局自然保護部緑化推進室編　**樹—東京の巨樹**　東京都情報連絡室情報公開部都民情報課（〒100-81 東京都千代田区丸の内3丁目5番1号），平成2年3月発行。A4判，92頁。頒価310円（〒別）。

○　愛媛県林材業振興会議編　**木と語る—えひめの巨樹・名木**　財団法人愛媛の森林基金（〒790 松山市1番町4丁目4-2，愛媛県森林林業課内），平成2年3月31日発行。B5判，146頁。定価1,800円（送料，税込）。

○　中国新聞社編　**広島県文化百選　(7)花と木編**　中国新聞社（〒730 広島市中区土橋町7番1号，振替口座広島7-57），平成2年3月30日発行。B6判，218頁。定価1,700円（〒別）。　（里見信生）

○　清水建美（編著）　**乗鞍の自然**　A5判，172頁。信濃毎日新聞社発行。定価2,200円（税込み）。

清水建美，豊国秀夫，吉田利男，相馬　潔，井上　健，山本雅道の方々の分担執筆による，乗鞍岳の自然誌である。執筆者はいずれも，乗鞍岳をフィルドとして研究をしてこられた各分野の専門家で，研究の成果にもとづいて，広範な読者を対象として，このユニークな地域の自然の解説に努められたものである。内容は「乗鞍の自然環境」，「乗鞍の植生と植物」，「ハイマツ生態系」，「動物の生活」，「開発の影響」の五つにまとめられているが，研究分野別に縦割にされないで，それぞれがいずれも総合的に扱われている点に特徴がある。たとえば，ホシガラスはハイマツ生態系のなかで取り扱われているがここではホシガラスが食物としてハイマツの種子に依存するとともにその散布に大きな役割を果している側面が重視され，ハイマツ生態系全体のなかでの位置づけが明確にあたえられている。近年，普及書の出版が活発になったことは喜ばしいかぎりであるが，研究者の問題意識が伝わってくるものは残念ながらあまり多くない。この労作はその意味で研究者にとっても啓発されるところが多く，また，積雪時のハイマツの写真など貴重な資料も載せられていて大変興味深い。（注文先：〒380 長野市南県町657，信濃毎日新聞社出版部）　（古池　博）