

## *Aphyosemion bitteri* (Cyprinodontiformes: Nothobranchiidae), a new killifish species from the northern Massif du Chaillu, Gabon

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### Abstract

A new *Aphyosemion* species is described from Gabon, based on eight specimens collected in a small stream within the hydrographic system of the Ikoy River on the north-western edge of the Massif du Chaillu. *Aphyosemion bitteri*, new species, can be distinguished from all species of the genus by its maze-like red pattern on the caudal fin. It belongs to the *A. grelli* species group (Valdesalici & Eberl 2014) by sharing with *A. grelli* and *A. mengilai* the yellow basal two thirds and the greyish marginal third on the unpaired fins of females, but it can be easily distinguished from these two species by differing male coloration and meristics.

### Zusammenfassung

Aus Gabun wird eine neue *Aphyosemion*-Art beschrieben – auf der Grundlage von acht Exemplaren, die in einem kleinen Bach gefangen wurden, der zum hydrographischen System des Flusses Ikoy am nordwestlichen Rand des Massif du Chaillu gehört. *Aphyosemion bitteri*, die neue Art, lässt sich von allen anderen Arten der Gattung durch das labyrinthische rote Muster auf der Schwanzflosse unterscheiden. Sie wird der *A.-grelli*-Artengruppe (Valdesalici & Eberl, 2014) zugeordnet, denn mit *A. grelli* und *A. mengilai* hat sie gemeinsam, dass bei den Weibchen an den unpaaren Flossen das basale zwei Drittel gelb und das marginale ein Drittel gräulich gefärbt sind; die Farbgebung und meristische Merkmale der Männchen ermöglichen aber eine eindeutige Unterscheidung zu den beiden anderen Arten.

### Résumé

Une nouvelle espèce d'*Aphyosemion* est décrite provenant de Gabon, sur la base de huit spécimens collectés dans un petit cours d'eau, dans le système hydrographique de la rivière Ikoy, au bord nord-ouest du Massif du Chaillu. *Aphyosemion bitteri*, nouvelle espèce, peut être distinguée

de toutes les espèces du genre par son patron rouge, labyrinthique, sur la caudale. Elle fait partie du groupe d'espèces *A. grelli* (Valdesalici & Eberl 2014) en partageant avec *A. grelli* et *A. mengilai* les deux tiers jaune à la base et le tiers marginal grisâtre sur les nageoires impaires des femelles; mais elle peut être facilement distinguée de ces deux espèces par la différence de coloration du mâle et des caractéristiques méristiques.

### Sommario

Una nuova specie di *Aphyosemion* è descritto dal Gabon, sulla base di otto esemplari raccolti in un piccolo corso d'acqua all'interno del sistema idrografico del fiume Ikoy sul bordo nord-occidentale del massiccio del Chaillu. *Aphyosemion bitteri*, nuova specie, può essere distinta da tutte le specie del genere per il motivo a labirinto di colore rosso sulla pinna caudale. Appartiene al gruppo di specie *A. grelli* (Valdesalici & Eberl 2014) condividendo con *A. grelli* e *A. mengilai* pinne impari delle femmine di colore giallo sui due terzi basali e grigio sul terzo marginale, ma può essere facilmente distinguibile da queste due specie per la differente colorazione maschile e i parametri meristici.

### INTRODUCTION

The Massif du Chaillu is a mountain range starting in central Gabon just south of the Ogooué River and reaching into the southwestern part of the Republic of Congo (Huber & Radda 1977; Huber 1994; Valdesalici & Eberl 2014). Compared to the southern part of the Massif du Chaillu in Gabon, there are far less roads on its northern portion, which makes its exploration a difficult task. In 2001, two killifish hobbyists (F. Bitter and S. Hellner, Germany) collected an *Aphyosemion* population which was labelled under the code “GBH

2001/25”, but no information about the precise provenance of that collection was ever published. Colour photographs of one adult specimen of each sex taken by the latter collector were published in 2003 (Anonymous 2003), their origin stated only as “Massif du Chaillu”. The unpaired fins of the female show a striking similarity to those of females of *A. grelli*.

In July 2014, the second author returned to Ikobey in order to find more localities of *Aphyosemion grelli* (Valdesalici & Eberl 2013: Fig. 6; 2014: Fig. 4) and was able to collect in a stream about 1 km west of Ikobey along the road to Sindara this undescribed *Aphyosemion* which is herein formally described.

#### MATERIALS AND METHODS

Measurements and counts follow Amiet (1987), with modifications as per Valdesalici (2010). Measurements were taken with a digital caliper, under a dissecting microscope, to the nearest 0.1 mm. Measurements are presented as percentage of standard length (SL), except for those related to head morphology, which are expressed as percentage of head length (HL). The numbers of all visible rays of the paired and unpaired fins were counted. Scale count on the midlongitudinal series is the number of scales between the upper attachment of the opercular membrane and the caudal fin base. Excluded are the scales posterior to the hypural junction, which were counted separately. Nomenclature for the neuromast system on the head follows Scheel (1968) and Huber (2000) and that for the frontal squamation follows Hoedeman (1958). Osteological preparations (cleared and stained, C&S) were made according to Taylor & Van Dyke (1985), but not stained for cartilage. Type material is deposited in the Museo Civico di Storia Naturale “G. Doria” (MSNG), Genova, Italy

#### *Aphyosemion bitteri*, n. sp.

(Figs 1-3, Table I)

**Holotype:** MSNG 58337, male, 28.5 mm SL; Gabon, Province de la Ngounié, Département de Tsamba-Magotsi, 1 km west of Ikobey, Route Régionale 22 to Sindara, a small stream named Dondo belonging to the Ikoy River system (01°02.986' S, 10°58.726' E), 17 July 2014, Wolfgang Eberl & François Mengila.

**Paratypes:** MSNG 58338, 3 males, 23.2-27.4 mm

SL, 1 male, 26.7 mm SL C&S, and 3 females, 23.3-27.3 mm SL, collected with the holotype.

**Diagnosis:** Males of *Aphyosemion bitteri* can be distinguished from all other congeners by presenting a maze-like red pattern on the caudal fin. They also differ from all the other species of the genus, except members of the *A. grelli* species group, by having the basal two thirds of the unpaired fins of females yellow, and the marginal third greyish. Males of *A. bitteri* can be easily distinguished from males of *A. grelli* by a denser red pigmentation on the flanks consisting of four parallel horizontal lines becoming wider posteriorly (vs. two to three parallel horizontal lines of isolated red dots), by the dense red pigmentation of the unpaired fins, consisting of four horizontal bands on the dorsal fin, undulating coalescent red lines parallel to the fin rays on the caudal fin, and three horizontal red lines on the anal fin, sometimes coalescent and in some specimens forming a pattern similar to that of the caudal fin (vs. no red pigmentation on the unpaired fins or a few isolated red dots on the central part of the caudal), by having more scales in the circumpeduncular series in both sexes (13-14 vs. 12), less anal fin rays (11-12 vs. 13-14), and interrupted neuromast series in the median longitudinal series (vs. neuromast series in the median longitudinal series complete). Males of *A. bitteri* can be easily distinguished from *A. mengilai* by the dense red pigmentation of the unpaired fins (vs. sparse red pigmentation), by the continuous parallel horizontal red lines on the caudal peduncle wider than the interspaces (vs. interrupted red lines consisting of short series of small dots, in some cases forming a reticulated pattern), by having less dorsal and anal fin rays in both sexes (9-10 vs. 13-14 and 11-12 vs. 15-16, respectively), less scales around the caudal peduncle (13-14 vs. 15-18), less scales in the transverse series (9-10 vs. 11-12), and interrupted neuromast series in the median longitudinal series (vs. neuromast series in the median longitudinal series complete) and by a distinct maximum SL, with *A. bitteri* attaining less than 30 mm SL versus more than 40 mm SL for *A. mengilai*. Males of *A. bitteri* can be easily distinguished from males of *A. escherichi*, known from the same geographical area, by a dense red pigmentation on the flanks, consisting of four parallel horizontal lines becoming wider posteriorly which are as wide as the interspaces and fade into the red pigmentation of the caudal fin (vs. three to four very regular parallel horizontal lines of coalescent red dots with

the interspaces wider than the lines ending at the posterior edge of the caudal peduncle), by the narrow dark grey dorsal and ventral margins of the unpaired fins (vs. yellowish and wider with red submarginal bands), and by the red pigmentation of the unpaired fins, forming a maze-like pattern (vs. numerous isolated red dots on the median part of the caudal and the basal two thirds of the anal fin).

**Description:** See Figures 1-3 for general appearance and Table I for morphometric data of the type series. A small sized, slightly laterally compressed species; dorsal profile slightly convex, slightly concave to nearly straight on the caudal peduncle. Maximum body depth approximately at the level of the pelvic fins. Ventral profile slightly convex, slightly concave to nearly straight on the caudal peduncle. Snout slightly rounded, mouth directed upwards, lower jaw longer than upper jaw. Posterior end of the rictus at the same level as the centre of the eye. Caudal fin truncate to subtruncate.

Dorsal and anal fins located posterior to the mid-body, tips rounded.

Anterior neuromast series of the 'open' type. Anterior supraorbital series with one neuromast. Central supraorbital series with two neuromasts. Posterior cephalic neuromast series with two to three neuromasts. Preopercular canal with six pores. One neuromast on each scale of the median longitudinal series, some neuromasts missing on the caudal peduncle.

Scales cycloid, body entirely scaled except the ventral surface of the head; frontal squamation of the G-type; 28-30 scales in the mid-longitudinal series, with three to four scales posterior to the hypural plate; 9-10 transversal scales, 13-14 scales around the caudal peduncle. Small dorsal fin with 9-10 fin rays, first dorsal-fin ray inserts above the 4<sup>th</sup> to 5<sup>th</sup> anal-fin ray; anal fin with 11-12 rays; caudal fin with 27-28 rays. Pectoral fins with 16 rays, pelvic fins with 6 rays. Premaxilla and dentary



Fig. 1. *Aphyosemion bitteri*, holotype, MSNG 58337, male, 28.5 mm SL. Gabon, Province de la Ngounié, Ikoy River system. Photo by W. Grell.



Fig. 2. *Aphyosemion bitteri*, holotype, MSNG 58337, same data as above, preserved. Photo by S. Valdesalici.

Table I. Morphometric data of *Aphyosemion bitteri*.

|                                      | Holotype | All males (n=5) | females (n=3) |
|--------------------------------------|----------|-----------------|---------------|
| Standard length (mm)                 | 28.5     | 23.2-28.5       | 23.3-27.3     |
| <b>Percentage of standard length</b> |          |                 |               |
| Depth at pelvic fin                  | 20.7     | 19.8-21.7       | 19.6-23.1     |
| Predorsal length                     | 68.0     | 65.5-70.7       | 67.8-69.5     |
| Length of dorsal-fin base            | 12.9     | 10.9-14.7       | 9.8-12.0      |
| Preanal length                       | 62.1     | 52.1-63.4       | 63.0-64.8     |
| Length of anal-fin base              | 18.5     | 17.2-19.8       | 14.2-16.3     |
| Prepelvic length                     | 51.2     | 47.8-52.1       | 46.5-52.5     |
| Length of caudal peduncle            | 21.0     | 21.0-24.1       | 17.1-21.6     |
| Depth of caudal peduncle             | 11.9     | 11.9-13.4       | 11.1-12.5     |
| Head length                          | 30.1     | 26.7-31.1       | 26.3-28.8     |
| <b>Percentage of head length</b>     |          |                 |               |
| Snout length                         | 27.9     | 27.9-32.4       | 27.7-29.4     |
| Eye diameter                         | 30.1     | 24.4-33.8       | 27.7-28.8     |
| Interorbital width                   | 38.3     | 33.8-40.7       | 38.4-43.0     |

with many irregularly distributed unicuspid, slightly curved teeth of different size. Five branchiostegal rays. Vomerine teeth not present, anterior border of the vomer thickened. Lateral process of the post-temporal not present. Single anterodorsal process of the urohyal. Females show a pocket-like membrane over the urogenital papilla.

**Coloration in life:** Males (Figs 1 & 2). Flanks metallic blue-green. Body darker dorsally than ventrally. Three pale red streaks on the opercle, obliquely inclined upwards at an approximate 45° angle. Lower jaw opaque red. Sides of body with three horizontal stripes starting behind the opercle and ending on the posterior margin of the

caudal peduncle, anteriorly consisting of small red coalescent dots, gradually becoming wider towards the caudal peduncle, so that the metallic blue-green interspaces are narrower than the stripes. A fourth ventral stripe starting below the insertion of the pectoral and ending at the posterior end of the basis of the anal fin, more irregular and interrupted. Pectoral fin hyaline with an iridescent blue-green margin. Pelvic, dorsal, and anal fin blue-green. Dorsal fin with three regular horizontal red bands slightly wider than the interspaces, followed by a fourth distal irregular dark grey band; in some specimens, red pigmentation forming instead 4 to 5 more or less continuous rows of red spots. Caudal



Fig. 3. *Aphyosemion bitteri*, paratype, MSNG 58338, female, 27.3 mm SL. Gabon, Province de la Ngounié, Ikoy River system. Photo by W. Grell.

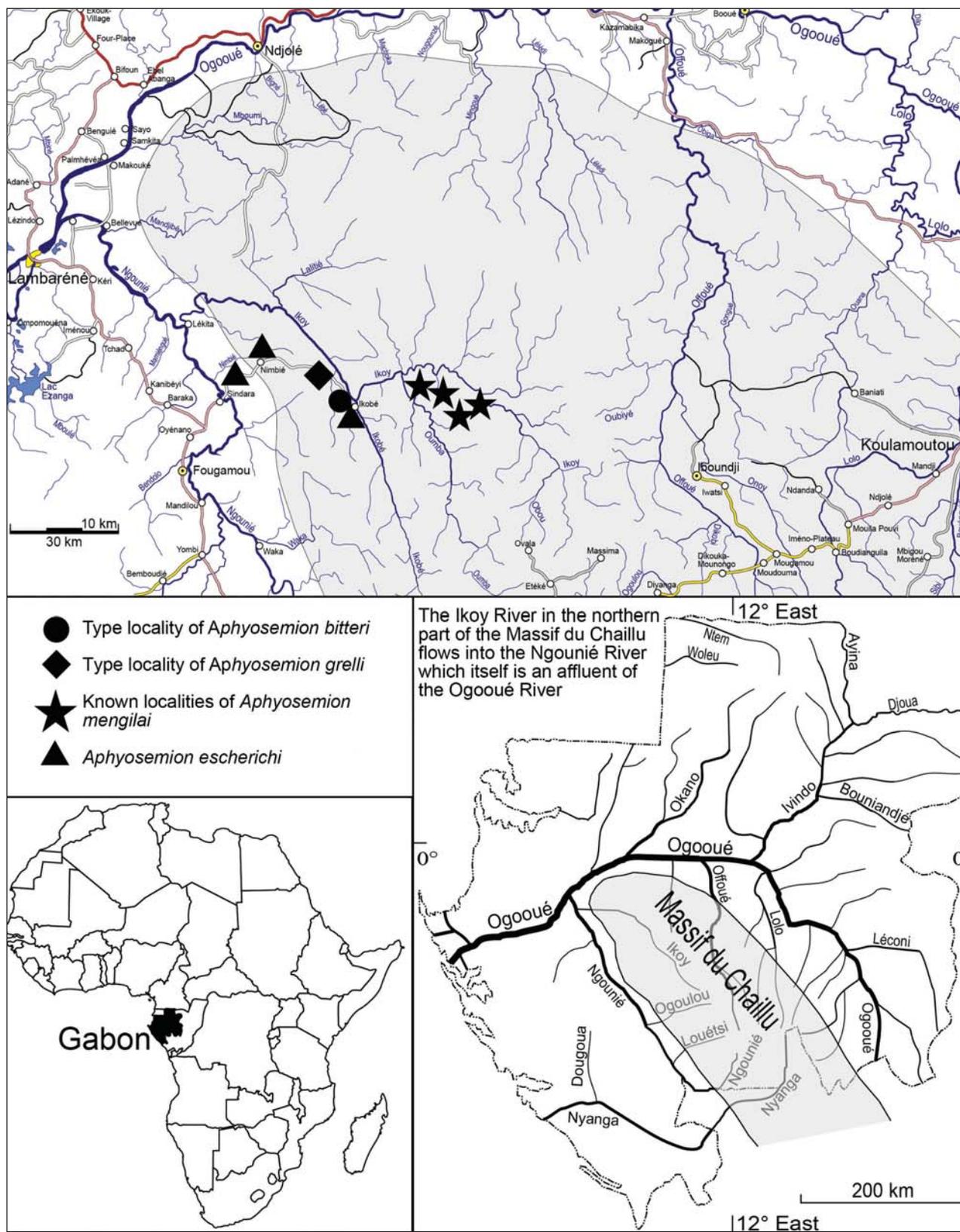


Fig. 4. Map of the northern portion of the Massif du Chaillu, with the position of the known locations of the representatives of the *A. grelli* species group and *A. escherichi*.



Fig. 5. Type locality of *Aphyosemion bitteri*, new species, the stream Dondo about 1 km west of Ikobey, field code GEM 2014/1. The water level is probably higher during the rain season. This place is used by local women as a washing place (notice the rocks whose surface is slippery due to the use of soap). Photograph taken on July 17, 2014 by W. Eberl.



Fig. 6. *Aphyosemion grelli*, holotype, SMNS 25471, male, 29.2 mm SL. Gabon, Province de la Ngounié, Ikoy River system. Photo by W. Eberl.



Fig. 7. *Aphyosemion mengilai*, holotype, SMNS 27069, male, 39.2 mm SL. Gabon, Province de la Ngounié, Ikoy River system. Photo by W. Eberl.

fin with dense red pigmentation in the form of undulating coalescent red lines parallel to the fin rays on iridescent, blue-green background, suggesting a maze-like red pattern). Anal fin with colour pattern similar to the dorsal fin, but with less numerous regular red lines that can be interrupted and coalescent. Pelvic fin blue-green with some red dots.

Females (Fig. 3). Flanks greyish-brown with four regular horizontal lines formed by reddish dots. All lines start behind the opercle, the two dorsalmost lines reaching the edge of the caudal peduncle, the line below these ends on the vertical through the insertion of the dorsal fin, the ventralmost line consisting of only four to five reddish dots. Ventral area whitish to yellowish. The scales of the median part of the flanks show narrow dark edges forming a subtle reticulated pattern. Lower jaw pale red. Pectoral fins hyaline. Pelvic, dorsal, anal, and caudal fins yellow with a broad, greyish margin along their distal third. Dorsal fin with a basal row of isolated red dots, short red streaks parallel to the fin rays at their central portion. Upper procurent caudal fin rays with two to three small red dots.

**Distribution and habitat notes** (Figs 4-5): So far only known from the type locality, the Dondo (Fig. 5), a small stream belonging to the hydrographic system of the Ikoy River, which is only about 1 km away. At the time of collection, the stream was not wider than 60 cm and not deeper than 20 cm. No other fish could be caught, and no aquatic vegetation was present; only freshwater shrimps, tadpoles, and aquatic insects were present.

**Etymology:** The new species is dedicated to Friedrich Bitter, German killifish hobbyist and member of the DKG (German Killifish Association), for his contribution to the knowledge on African killifishes.

## DISCUSSION

*Aphyosemion bitteri* belongs to the *A. grelli* species group, which includes also *A. grelli* (Fig. 6) and *A. mengilai* (Fig. 7). The assemblage is defined by an apomorphic colour pattern of males and females, consisting of greyish to dark grey margins on dorsal and anal fins (Valdesalici & Eberl 2014). This combination does not occur in any other *Aphyosemion*, in which a black margin, if present, is only found in males (Valdesalici & Eberl 2013; van der Zee & Sonnenberg 2010).

Members of the *A. grelli* species group are distributed in the same area and in the same hydrographic basin, the Ikoy River basin in the northern part of



Fig. 8. *Aphyosemion escherichi*, male, about 30 mm SL, not preserved. Gabon, village of Nimbié, stream Matoto, affluent of the Nimbié, Ngounié river system. Photo by W. Grell.



Fig. 9. *Aphyosemion escherichi*, male, about 30 mm SL, not preserved. Gabon, stream crossing the Route Regionale 22 at 9 km east of the ferry across the Ngounié in the direction of Ikobey, Ngounié river system. Photo by W. Grell.

the Massif of Chaillu. *Aphyosemion grelli* and *A. bitteri* were found in the western part of the lower Ikoy River drainage, whereas *A. mengilai* is known further east from the central Ikoy drainage and mainly from some localities in its tributary, the Oumba River.

Until today, members of the *A. grelli* species group have never been found in sympatry with other *Aphyosemion* species, perhaps based on the low number of known collection localities. Further collections might reveal sympatric species. Geographically, *A. bitteri* occurs close to *A. grelli*, found

at about 9 road kilometers to the northwest. During the second author's surveys in the Ngounié drainage, *A. escherichi* was found at Ikobey. The occurrence of *A. escherichi*, a lowland species distributed from the coastal plain of southwestern Equatorial Guinea to Pointe Noire in the Republic of the Congo (about 670 km of linear distance), sometimes only a few hundred meters from the seaside, is currently the only known *Aphyosemion* species except the *A. grelli* species group, known to inhabit the Ngounié valley into the Ikobé valley up to Ikobey. However, there are no records of *A. es-*

*cherichi* from the Massif du Chaillu, possibly because of its relatively high altitude. *Aphyosemion escherichi* (Figs 8-9) seems genetically close to *A. jorgenscheeli* (Collier 2007), indeed it clearly differs morphologically from members of the *A. grelli* species group and presents a completely different colour pattern (Sonnenberg & Blum 2005). Currently only streams crossing the road from Sindara to Ikobey were explored, and more localities of *A. grelli* and *A. bitteri* probably will be found as more streams became accessible after the construction of further public or forestry roads in the area.

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