Review of the genera of the family Sagittidae with separation of a new subfamily and description of a new species of the genus *Sagitta* from the Sea of Japan (Chaetognatha)

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Diagnoses and lists of species are given for the genera of Sagittidae. A new subfamily Flaccisagittinae is established for the genera *Flaccisagitta*, *Pseudosagitta*, *Accedosagitta*, and *Abosagitta*. A new species, *Sagitta sceptrum* sp. n., is described from the Sea of Japan.

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Introduction

Ritter-Záhony (1911) revised the genus *Sagitta* s. l. Tokioka (1965a, 1965b) subdivided it into several genera, and some other genera were added subsequently (Kassatkina, 1971, 1982, 2006; Bieri, 1991; etc.). However, some recent authors (Casanova & Goto, 1997; Casanova & Nair, 1999, 2002) still use *Sagitta* in a wide sense.

The aim of the present paper is to give diagnoses and lists of species for all genera of Sagittidae and to describe a new species of *Sagitta* from the Sea of Japan. A key to the genera of Sagittidae has been published by Kasatkina (2006).

A new subfamily, Flaccisagittinae, is established for four genera having saclike gelatinous structures at the base, between, or instead of lateral fins. These structures have no rays, are thicker than rayless zones of fins and differ from them in the inner anatomy. Their histology and histochemistry are not examined, but dead specimens with these structures have better buoyancy than those without them. For some further details, see Kassatkina (2006). All these genera have a flaccid body.

Species within the genera are listed in chronological order of their dates of publication.

Family **SAGITTIDAE** Claus & Groben, 1905

Subfamily FLACCISAGITTINAE subfam. n.

Type genus: *Flaccisagitta* Tokioka, 1965.

Diagnosis. Saclike gelatinous structures present at bases of lateral fins, between lateral fins, or instead of one or both pairs of lateral fins.

The subfamily comprises 4 genera.

Genus **Flaccisagitta** Tokioka, 1965

Type species: *Sagitta hexaptera* d'Orbigny, 1843.

Diagnosis. Two pairs of lateral fins on trunk, both with saclike gelatinous structures at bases. Saclike gelatinous structures between anterior and posterior fins absent. Corona ciliata located at eye level or higher. Portion of corona ciliata situated on trunk section smaller than its cephalic section in all specimens at every mature stage. Thick rays present in fins. Greater part of posterior fins located on trunk section in adult mature animals. No gut diverticula.

The genus comprises 5 species: *F. hexaptera* (d'Orbigny, 1843); *F. inflata* (Grassi, 1881); *F. pulchella* Kassatkina, 1982; *F. lucida* (Casanova, 1985); *F. adenensis* (Casanova, 1985).

Genus **Pseudosagitta** Germain & Joubin, 1912

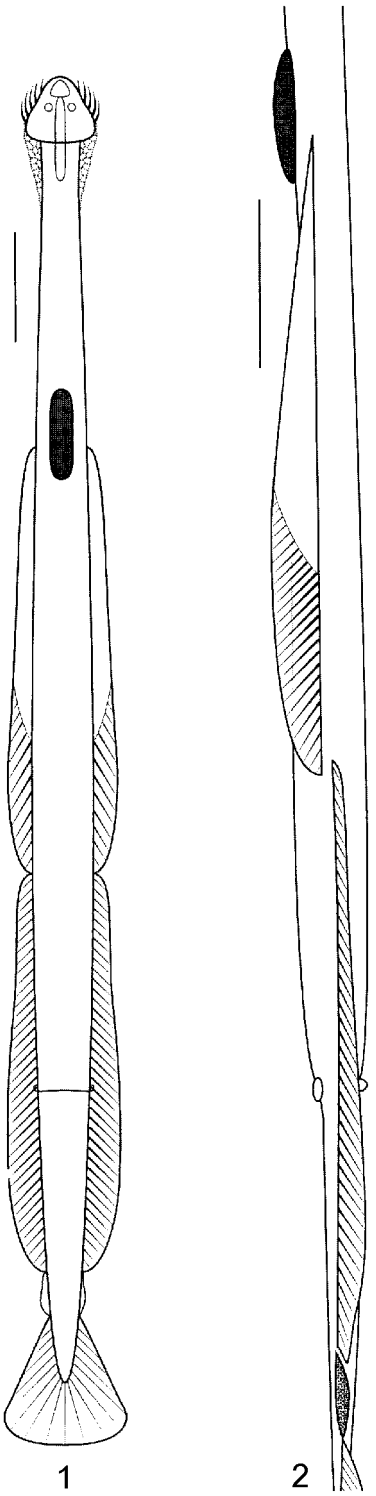
Type species: *Sagitta lyra* Krohn, 1853.

Diagnosis. Two pairs of lateral fins. Saclike gelatinous structures present between anterior and posterior fins. Corona ciliata located at eye level or higher. Thick rays present in fins. Greater part of posterior fins located on trunk section in adult mature animals. No gut diverticula.

The genus comprises 4 species: *P. lyra* (Krohn, 1853); *P. maxima* (Conant, 1896); *P. gazellae* (Ritter-Záhony, 1909); *P. scrippsae* (Alvariño, 1962).

Genus **Accedosagitta** Kassatkina, 1971

Type species: *Accedosagitta minuta* Kassatkina, 1971.



Figs 1-2. *Sagitta sceptrum* sp. n.: **1**, habitus; **2**, lateral view. Scale bars: 1 mm.

Diagnosis. One pair of lateral fins (anterior fins); thick rays absent in fins. Instead of posterior fins, flattened saclike gelatinous structures, the greater part of which is located on tail section in adult mature animals. Corona ciliata located at eye level or higher. No gut diverticula.

A single species, *A. minuta* Kassatkina, 1971.

Genus **Abosagitta** Kassatkina, 2006

Type species: *Abosagitta taeniata* Kassatkina, 2006.

Diagnosis. Saclike gelatinous structures instead of both pairs of lateral fins, with greater part of posterior ones located on trunk section in adult mature animals. Corona ciliata located at eye level or higher. No gut diverticula. Thick rays present in caudal fins.

The genus comprises 4 species: *A. taeniata* Kassatkina, 2006; *A. grata* Kassatkina, 2006; *A. rasilis* Kassatkina, 2006; *A. macra* Kassatkina, 2006.

Subfamily SAGITTINAE Claus & Groben, 1905

Type genus: *Sagitta* Quoy & Gaimard, 1827.

Diagnosis. Two pairs of lateral fins. Saclike gelatinous structures at bases of lateral fins or elsewhere absent.

The subfamily comprises 13 genera.

Genus **Sagitta** Quoy & Gaimard, 1827

= *Abaciasagitta* Bieri, 1991.

Type species: *Sagitta bipunctata* Quoy & Gaimard, 1827.

Diagnosis. Corona ciliata located at eye level or higher. Portion of corona ciliata situated on trunk section equal to or greater than its cephalic part in all specimens at every mature stage. Greater part of posterior fins located on trunk section in adult mature animals. Thick rays present in fins. No gut diverticula. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 15 species: *S. bipunctata* Quoy & Gaimard, 1827; *S. setosa* Müller, 1847; *S. bedoti* Beraneck, 1895; *S. pulchra* Doncaster, 1903; *S. glacialis* Molchanov, 1907 (with subspecies *S. g. glacialis* and *S. g. baltica* Ritter-Záhony, 1911); *S. euxina* Molchanov, 1907; *S. euneritica* Alvariño, 1961; *S. izuensis* Kitou, 1966; *S. nagae* Alvariño, 1967; *S. bruuni* Alvariño, 1967; *S. modesta* Kassatkina, 1971; *S. nutana* Kassatkina, 1982; *S. abyssicola* Chidgey, 1989; *S. kussakini* Kassatkina, 1997; *S. sceptrum* sp. n.

Sagitta sceptrum sp. n.

Holotype. Inventory no. SA-1-П-15, Sea of Japan, 41°55´N, 136°00´E, R/V "Professor Kaganovskiy", station 7, horizon 200-0 m, depth of the place 3000 m, plankton sample at 2:30 p.m. using Jeddy net, 21.X.2005; deposited

in the collection of Pacific Institute of Oceanography, Far East Division, Russian Academy of Sciences, Vladivostok.

Paratypes. 12 specimens from the same sample as holotype in the same collection.

Description (holotype). Body rigid and muscular, not flagging on a pincette. Head as broad as trunk. Neck hardly noticeable, there is no drastic narrowing in the region of seminal receptacle. Body length 11.8 mm. Tail region 23.3%, ventral ganglion 6.8% of body length. Body cavity lateral to gut with badly transparent material (perhaps spare nutritive substances), which, near the head septum, resembles diverticula, but a dissection shows that diverticula are absent. Corona ciliata (ciliary loop) short, without gyris, nearly equally situated on head and trunk section, starting from brain. Anterior end of anterior lateral fins located in front of ventral ganglion posterior level. Part of fin situated at level of ventral ganglion 0.37 times as long as ganglion, 2.5% of body length. Length of anterior fins 32.5% of body length, a little greater than length of posterior fins.

Anterior ends of posterior fins and posterior ends of anterior fins look fused in ventral and dorsal view. However, it is seen in lateral view that they are parallel to each other: anterior ends of posterior fins situated more dorsal than anterior fins in front of their posterior ends. Length of posterior fins 30.8% of body length; trunk part of posterior fins 1.2 times as large as tail part. Rays pierce both paired and unpaired fins, but nearly 2/3 of anterior fins devoid of rays. Alveolar tissue fringing only the neck. Sensory-locomotory corpuscules absent. One pair of hook rows and two pairs of dental rows on head: 6 hooks, 5 front teeth, and 15 posterior teeth on each side. Eyes with widely, but shallowly excavated pigment spot in center. The specimen is at 3rd maturity stage. Seminal sacks not filled with spermatophore, flattened and elongate, contacting both pairs of lateral fins. Tail fin about 4% of body length. Ovaries 10% of body length, containing a few ripe eggs and numerous immature eggs.

Comparison. The new species differs from all other species of *Sagitta* in the position of anterior fins relative to ventral ganglion.

Genus **Omittosagitta** Kassatkina, 1971

= *Tenuisagitta* Bieri, 1991.
= *Oculosagitta* Bieri, 1991.

Type species: *Sagitta japonica* Galzow, 1909.

Diagnosis. Corona ciliata located at eye level or higher. Portion of corona ciliata situated on trunk section equal to or greater than its cephalic part in all specimens at every mature stage. Posterior fins located in their greater part on tail section in adult mature animals or equally situated over trunk and tail sections in immature animals. Thick rays present in fins. No gut diverticula. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 17 species: *O. tenuis* (Conant, 1896); *O. longicauda* (Galzow, 1909); *O. japonica* (Galzow, 1909); *O. orientalis* (Molchanov, 1909); *O. helenae* (Ritter-Záhony, 1910); *O. bombayensis* (Lele & Gae, 1936); *O. popovicii* (Sund, 1961); *O. peruviana* (Sund, 1961); *O. megalophthalma* (Dallot & Ducret, 1969); *O. alvarinoe* Kassatkina, 1971; *O. galzowi* Kassatkina, 1982; *O. porrecta* Kassatkina, 1982 (with subspecies *O. p. porrecta* and *O. p. ochotensis* Kassatkina, 1982); *O. baculata* Kassatkina, 1982 (with subspecies *O. b. baculata* and *O. b. starkiana* Kassatkina, 1982); *O. minor* (Tokioka, 1942), **stat. et comb. n.** [= *Sagitta bedoti minor* Tokioka]; *O. littoralis* (Tokioka & Pathansali, 1985) (with subspecies *O. l. littoralis* and *O. l. tsusimica* Kassatkina, 1989); *O. diaphana* Kassatkina, 1995; *O. bacilaris* Kassatkina, 1995.

Notes. The genus *Omittosagitta* differs from *Sagitta* s. str. (Tokioka, 1965a) in the posterior fins, which are located in greater part on the tail section in adult mature animals or equally situated over the trunk and tail sections in immature animals.

"*Sagitta bedoti minor*" differs from *Sagitta bedoti* in the position of posterior fins (greater part of them situated on the tail section in *O. minor* and on the trunk section in *S. bedoti*), position of anterior fins (starting behind the level of the middle of the ventral ganglion in *O. minor* and at the level of its anterior margin in *S. bedoti*), size of rayless zone in fins and size of corona ciliata. It is neither conspecific, nor congeneric with *S. bedoti*.

Genus **Serratosagitta** Tokioka & Pathansali, 1963

Type species: *Sagitta serratodentata* Krohn, 1853.

Diagnosis. Hooks serrated. Corona ciliata located at eye level or higher. Portion of corona ciliata situated in trunk section equal to or greater than its cephalic part in all specimens at every mature stage. Greater part of posterior fins located on trunk section in adult mature animals. Thick rays present in fins. No gut diverticula. Inner nuclear eye zone smaller than peripheric one.

The genus comprises 6 species: *S. serratodentata* (Krohn, 1853); *S. pseudoserratodentata* (Tokioka, 1939); *S. pacifica* (Tokioka, 1940); *S. tasmanica* (Thomson, 1947); *S. selkirki* (Faggetti, 1958); *S. bierii* (Alvariño, 1961).

Genus **Caecosagitta** Tokioka, 1965

Type species: *Sagitta macrocephala* Fowler, 1905.

Diagnosis. Eyes present, but without pigment. Corona ciliata located at eye level or higher. Por-

tion of corona ciliata situated in trunk section equal to or larger than its cephalic part in all specimens at every mature stage. Posterior fins located in their greater part on tail section in adult mature animals or equally situated over trunk and tail sections in immature animals. Thick rays present in fins. No gut diverticula. Hooks not serrated. Head less than 9% of whole body.

The genus comprises 4 species: *C. macrocephala* (Fowler, 1904); *C. takasii* Kassatkina, 2003; *C. caeca* Kassatkina, 2003; *C. aberrantis* Kassatkina, 2003.

Genus **Eucaecosagitta** Kassatkina, 2003

Type species: *Eucaecosagitta angelae* Kassatkina, 2003.

Diagnosis. Greater part of posterior fins located on trunk section in immature animals. Eyes present, but without pigment. Corona ciliata located at eye level or higher. Portion of corona ciliata situated in trunk section equal or larger than its cephalic part in all specimens at every mature stage. Thick rays present in fins. No gut diverticula. Hooks not serrated. Head more than 9% of whole body.

The genus comprises 2 species: *E. angelae* Kassatkina, 2003; *E. jerryi* Kassatkina, 2003.

Genus **Bathysagitta** Kassatkina, 2001

Type species: *Bathysagitta scaphicephala* Kassatkina, 2001.

Diagnosis. Greater part of posterior fins located on trunk section in immature animals. Eyes, corona ciliata, gut diverticula, thick rays in fins absent. Hooks not serrated.

A single species, *B. scaphicephala* Kassatkina, 2001.

Genus **Aidanosagitta** Tokioka & Pathansali, 1963

Type species: *Sagitta neglecta* Aida, 1897.

Diagnosis. Corona ciliata located below eye level, sometimes on neck. Portion of corona ciliata situated in trunk section larger than or equal to its cephalic part in all specimens at every mature stage. Greater part of posterior fins located on tail section in all stages of mature animals. Thick rays present in fins. Gut diverticula present. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 33 species: *A. regularis* (Aida, 1897); *A. neglecta* (Aida, 1897); *A. septata* (Doncaster, 1902); *A. bedfordii* (Doncaster, 1902); *A. coreana* (Molchanov, 1907); *A. parva* (Oye, 1918); *A. oceania* (Gray, 1930); *A. crassa* (Tokioka, 1938); *A. naikaiensis* (Tokioka, 1939); *A. tumida* (Tokioka, 1939); *A. delicata* (Tokioka, 1939); *A. lacuna* (Tokioka, 1942); *A. johorensis* (Pathansali & Tokioka, 1963); *A. golicovi* Kassatkina, 1971; *A. modica* Kassatkina, 1971; *A. macilenta* Kassatkina, 1971; *A. scarlatoi* Kassatkina, 1971; *A. firmula* Kassatkina, 1971; *A. alvarinoae* (Pathansali, 1974); *A. ophicephala* (Pathansali, 1974); *A. guileri* (Taw, 1974); *A. erythraea* (Casanova, 1985); *A. nairi* (Casanova & Nair, 2002); *A. venusta* Kassatkina & Selivanova, 2003; *A. bella* Kassatkina & Selivanova, 2003; *A. murex* Kassatkina & Selivanova, 2003; *A. pilum* Kassatkina & Selivanova, 2003; *A. acus* Kassatkina & Selivanova, 2003; *A. lepida* Kassatkina & Selivanova, 2003; *A. acinacis* Kassatkina, 2007; *A. oblonga* Kassatkina, 2007; *A. candida* Kassatkina, 2007; *A. subulata* Kassatkina, 2007.

Genus **Demisagitta** Bieri, 1991

Type species: *Aidanosagitta demipenna* Tokioka & Pathansali, 1963.

Diagnosis. Corona ciliata located below eye level, sometimes on neck. Portion of corona ciliata situated in trunk section larger than or equal to its cephalic part in all specimens at every mature stage. Posterior fins located merely on tail section in all stages of mature animals. Thick rays present in fins. Gut diverticula present. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

A single species, *D. demipenna* (Tokioka & Pathansali, 1963).

Genus **Leptosagitta** Kassatkina, 1973

Type species: *Leptosagitta collariata* Kassatkina, 1973.

Diagnosis. Corona ciliata located below eye level, sometimes on neck. Portion of corona ciliata situated in trunk section larger than or equal to its cephalic part in all specimens at every mature stage. Greater part of posterior fins located on tail section in all stages of mature animals. Thick rays present in fins. No gut diverticula. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 10 species: *L. collariata* Kassatkina, 1973; *L. nudata* Kassatkina, 1973; *L. uschakovi* Kassatkina, 1973; *L. acicula* Kassatkina & Panteleyeva, 2001; *L. pogodini* Kassatkina & Panteleyeva, 2001; *L. eris* Kassatkina & Selivanova, 2003; *L. alba* Kassatkina & Selivanova, 2003; *L. icis* Kassatkina & Sergeev, 2004; *L. ocis* Kassatkina & Sergeev, 2004; *L. exigua* Kassatkina & Sergeev, 2004.

Genus **Mesosagitta** Tokioka, 1965

= *Decipisagitta* Bieri, 1991.

Type species: *Sagitta minima* Grassi, 1881.

Diagnosis. Corona ciliata located below eye level, sometimes on neck. Portion of corona cili-

ata situated in trunk section larger than or equal to its cephalic part in all specimens at every mature stage. Greater part of posterior fins located on trunk section in all stages of mature animals. Thick rays present in fins. Gut diverticula present. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 11 species: *M. minima* (Grassi, 1881); *M. decipiens* (Fowler, 1905); *M. sibogae* (Fowler, 1906); *M. philippini* (Michael, 1919); *M. tropica* (Tokioka, 1942); *M. neodecipiens* (Tokioka, 1959); *M. batava* (Biersteker & Spoel, 1966); *M. exilis* Kassatkina, 1971; *M. slunini* Kassatkina & Panteleeva, 2001; *M. formosa* Kassatkina & Selivanova, 2003; *M. velox* Kassatkina & Selivanova, 2003.

Genus **Solidosagitta** Tokioka, 1965

Type species: *Sagitta planctonis* Steinhaus, 1896.

Diagnosis. Inner nuclear eye zone larger than peripheric one. Corona ciliata located below eye level, sometimes on neck. Portion of corona ciliata situated in trunk section greater than or equal to its cephalic part in all specimens at every mature stage. Greater part of posterior fins located on trunk section in all stages of mature animals. Thick rays present in fins. Gut diverticula present. Hooks not serrated.

The genus comprises 3 species: *S. planctonis* (Steinhaus, 1896); *S. zetesios* (Fowler, 1905); *S. marri* (David, 1956).

Genus **Parasagitta** Tokioka, 1965

Type species: *Sagitta elegans* Verrill, 1873.

Diagnosis. Corona ciliata located at eye level or higher, sometimes starting from brain. Portion of corona ciliata situated in trunk section larger than or equal to its cephalic part in all specimens at every mature stage. Greater part of posterior fins located on trunk section in all stages of mature animals. Thick rays present in fins. Gut diverticula present. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 7 species: *P. elegans* (Verrill, 1873); *P. arctica* (Aurivillius, 1896) (with subspecies *P. a. arctica* and *P. a. brevis* Kassatkina, 1973); *P. melanognatha* (Molchanov, 1907); *P. brevicauda* Kassatkina, 1971; *P. septicoela* Kassatkina, 1971; *P. liturata* Kassatkina, 1973; *P. maculata* Kassatkina, 1973.

Genus **Ferosagitta** Kassatkina, 1971

= *Adhesisagitta* Bieri, 1991.

Type species: *Sagitta ferox* Doncaster, 1903.

Diagnosis. Corona ciliata located at eye level or higher, sometimes starting from brain. Portion of corona ciliata situated in trunk section larger than or equal to its cephalic part in all specimens at every mature stage. Posterior fins located in their greater part on tail section in adult mature animals or equally situated over trunk and tail sections in immature animals. Thick rays present in fins. Gut diverticula present. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 12 species: *F. hispida* (Conant, 1895); *F. ferox* (Doncaster, 1903); *F. robusta* (Doncaster, 1903); *F. americana* (Tokioka, 1959); *F. gloria* (Prado, 1961); *F. tokiokai* (Alvariño, 1967); *F. galerita* (Dallot, 1971); *F. paulula* Kassatkina, 1982; *F. cristallina* Kassatkina, 1995; *F. siamensis* (Casanova & Goto, 1997); *F. madhupratapi* (Casanova & Nair, 1999).

Genus **Oligoradiata** Kassatkina, 1971

Type species: *Oligoradiata mitis* Kassatkina, 1971.

Diagnosis. Thick rays absent, there are some rays in lateral and caudal fins. Corona ciliata located below eye level, sometimes on neck. Portion of corona ciliata situated in trunk section larger than or equal to its cephalic part in all specimens at every mature stage. Posterior fins located in their greater part on trunk section in adult mature animals or equally situated over trunk and tail sections in immature animals. Gut diverticula present. Inner nuclear eye zone smaller than peripheric one. Hooks not serrated.

The genus comprises 3 species: *O. mitis* Kassatkina, 1971; *O. pellucida* Kassatkina & Selivanova, 2003; *O. entis* Kassatkina & Sergeev, 2004.

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