

## Trematodes of Steller Sea Lion Caught off Hokkaido, Northern Japan

By

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Fourteen individuals of the Steller sea lion, *Eumetopias jubatus*, were caught off Kayabe District, Hokkaido, northern Japan in winter between 1976 and 1978 and examined for food habits, parasites, etc.

Although many parasites (trematodes, cestodes, nematodes, acanthocephalans and acari) were collected from this survey, the present report deals with two species of trematodes, *Phocitrema fusiforme* and *Pricitrema zalophi*. The trematodes obtained were fixed in acetic sublimate under slight cover glass pressure, stained with Heidenhain's hematoxylin and mounted in balsam. The specimens are deposited in the collection of the National Science Museum (Nat. Hist.), Tokyo.

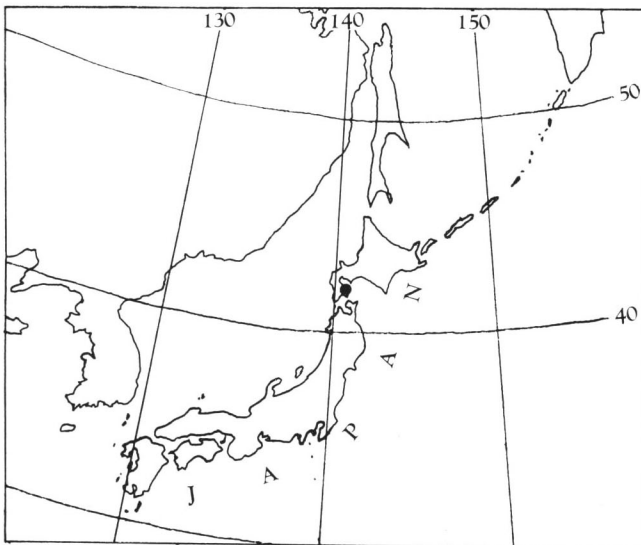


Fig. 1. Map showing the research locality of Steller sea lion (black dot).

We should like to thank the following persons for the loan of specimens : Prof. M. D. DAILEY (California State University, Long Beach, California, USA), Dr. S. KAMEGAI (Meguro Parasitological Museum, Tokyo, Japan), Dr. J. R. LICHTENFELS (USDA, Beltsville, Maryland, USA) and Dr. L. M. SHULTS (Institute of Marine Science, University of Alaska, Fairbanks, USA).

Family Opisthorchiidae

*Phocitrema fusiforme* GOTO et OZAKI, 1930

(Figs. 2-4)

*Habitat.* Small intestine of *Eumetopias jubatus*.

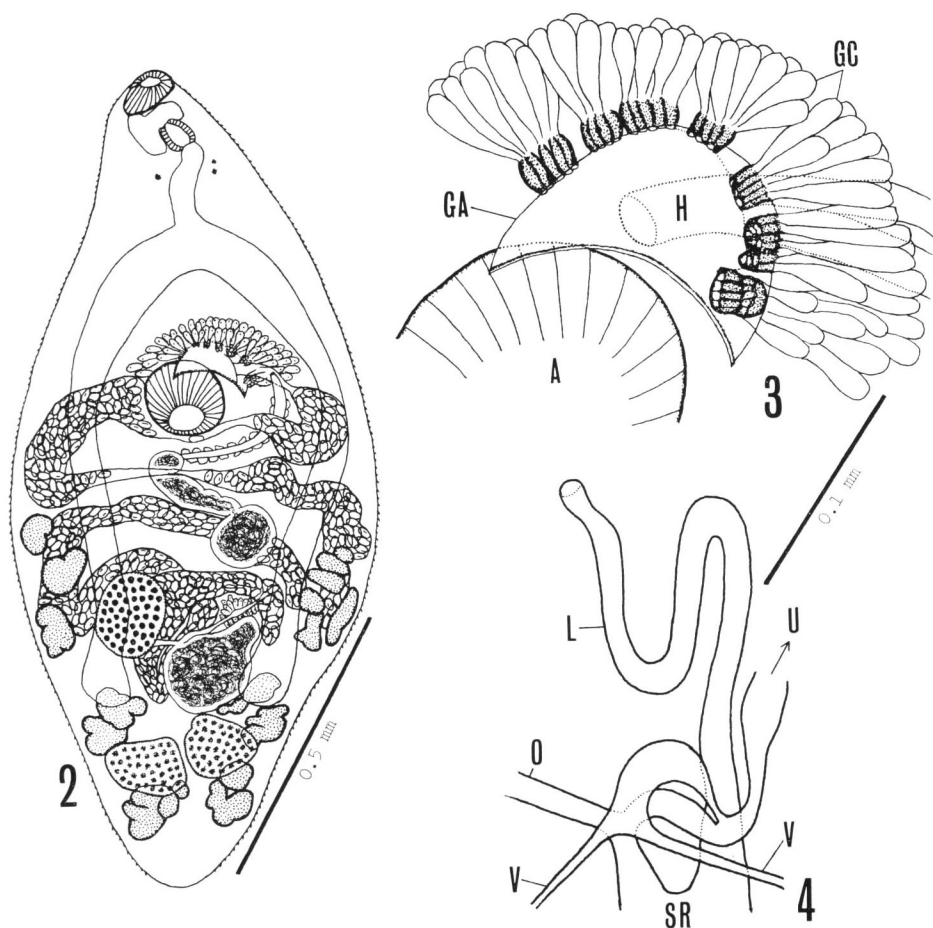
*Specimen No.* NSMT-PI 2482-2484.

*Description.* Body fusiform, 1.10-1.60 mm long by 0.55-0.75 mm wide. Cuticle spinose. Eyespots on either side of esophagus. Oral sucker terminal, funnel-shaped, 66-117×43-66  $\mu$ ; prepharynx 18-62  $\mu$  long; pharynx cylindrical, 46-61×25-48  $\mu$ ; esophagus 64-194  $\mu$  long, bifurcating midway between pharynx and acetabulum; caeca terminating at some distance anterior to testes. Acetabulum spherical, 104-133×122-156  $\mu$ , immediately pre-equatorial. Sucker ratio 1:2.0-3.5.

Testes oval or reniform, 97-204×107-219  $\mu$ , juxtaposed in posterior third of hindbody. Vas efferens arising from anterior end of testes, entering into seminal vesicle without forming vas deferens. Seminal vesicle sigmoid, consisting of proximal globular part and distal tubular part, the boundary between two parts is constricted, lying obliquely between ovary and acetabulum. Pars prostatica tubular, running postero-sinistral to acetabulum; hermaphroditic duct very short, entering into genital atrium at the left side. Genital atrium inverted cup-shaped, surrounded by gland cells which open into genital atrium through a dozen of bundles. Genital pore just anterior to acetabulum, occasionally covering it in part.

Ovary oval, 115-184×128-189  $\mu$ , right to midline, midlevel in hindbody. Oviduct arising from posterior part of ovary, connected with the duct of seminal receptacle and then receiving vitelline duct. Seminal receptacle elliptical, 75-143  $\mu$  wide, containing no sperms in some specimens, postero-sinistral to ovary. Laurer's canal arising from anterior end of seminal receptacle, winding, opening dorsad antero-sinistral to ovary. Mehlis' gland sinistral to ovary. Uterus beginning with irregular coils around ovary, then running forward in three transverse coils, exceeding caeca laterally, to genital atrium. Uterine eggs 26-33×13-17  $\mu$ . Vitellaria consisting of 4-7 groups of small follicles on either side in hindbody.

*Discussion.* This species was first described by GOTO and OZAKI (1930) on the material from *Phoca hispida* which had reared in the Hanayashiki Zoo, Tokyo. Re-examination of type-series of *Phocitrema fusiforme* (MPM Coll. No. 19339) revealed that there are no sperms in the seminal receptacle and "receptaculum seminis" given by GOTO and OZAKI (1930) is the proximal part of seminal vesicle. Some of our specimens also do not have sperms in the seminal receptacle which is usually situated at



Figs. 2-4. *Phocitrema fusiforme* GOTO et OZAKI, 1930. — 2. Entire worm (NSMT-PI 2482), ventral view. — 3. Genital atrium, ventral view. — 4. Ovarian complex, ventral view. A, acetabulum; GA, genital atrium; GC, gland cell; H, hermaphroditic duct; L, Laurer's canal; O, oviduct; SR, seminal receptacle; U, uterus; V, vitelline duct.

postero-sinistral to the ovary. In such a case, it is difficult to find the seminal receptacle.

PEARSON and COURTNEY (1977), examining the terminal genitalia of *P. fusiforme* in detail based on the material from *Alopex lagopus* and *Phoca vitulina* in Alaska (Prof. RAUSCH's collection), described and illustrated that "anterior portion of sac a semilunar pocket close against antero-sinistral face of ventral sucker, with anterior wall a gonotyl of centrocestine type comprising a series of about 10 deep, narrow, thick-walled invaginations. Gonotyl muscular, variable, may be divided into two or three lobes by one or two infoldings", and transferred this species from the family Opisthorchiidae to the family Heterophyidae. They also suggested that "vas deferens"

given by GOTO and OZAKI (1930) was the pars prostatica, and "gland cells about the pars prostatica" the clumped nuclei of the subtegument beneath the gonotyl. Undoubtedly "vas deferens" is the pars prostatica, but the so-called "ventro-genital sac" is not so complicated as described by PEARSON and COURTNEY (1977). Our "genital atrium" is inverted cup-shaped, surrounded by gland cells which open into the genital atrium through a dozen of bundles. Neither anterior pocket nor muscular gonotyl exists. Their "clumped nuclei of the subtegument beneath the gonotyl" seem to be the duct bundles of gland cells. The gland cells seem to be similar to those reported on some zoogonids, *Hudsonia* and *Neosteganoderma*, which made no mention of the existence of the bundles (CAMPBELL, 1975; OVERSTREET & PRITCHARD, 1977). We consider that *Phocitrema fusiforme* belongs to the family Opisthorchiidae.

According to MARGOLIS and DAILEY (1972), *Phocitrema fusiforme* has been recorded from *Callorhinus ursinus*, *Enhydra lutris* and *Phoca vitulina richardi* in Alaskan waters. In Japan, additional representatives of this species have been obtained from stray dog (YOSHIMURA, 1965; KAMIYA *et al.*, 1975; ISHIDA & SUZUKI, 1977), *Eumetopias jubatus* (YOSHIMURA, 1965), *Histriophoca fasciata*, *Phoca vitulina* and *Phoca kurilensis* (MIYAMOTO *et al.*, 1979) in northern Japan.

#### Family Heterophyidae

#### *Pricitrema zalophi* (PRICE, 1932)

(Figs. 5-9)

*Habitat.* Small intestine of *Eumetopias jubatus*.

*Specimen No.* NSMT-PI 2485-2488.

*Description.* Our specimens are divided into two types, the small type with sperms and the large type without sperms.

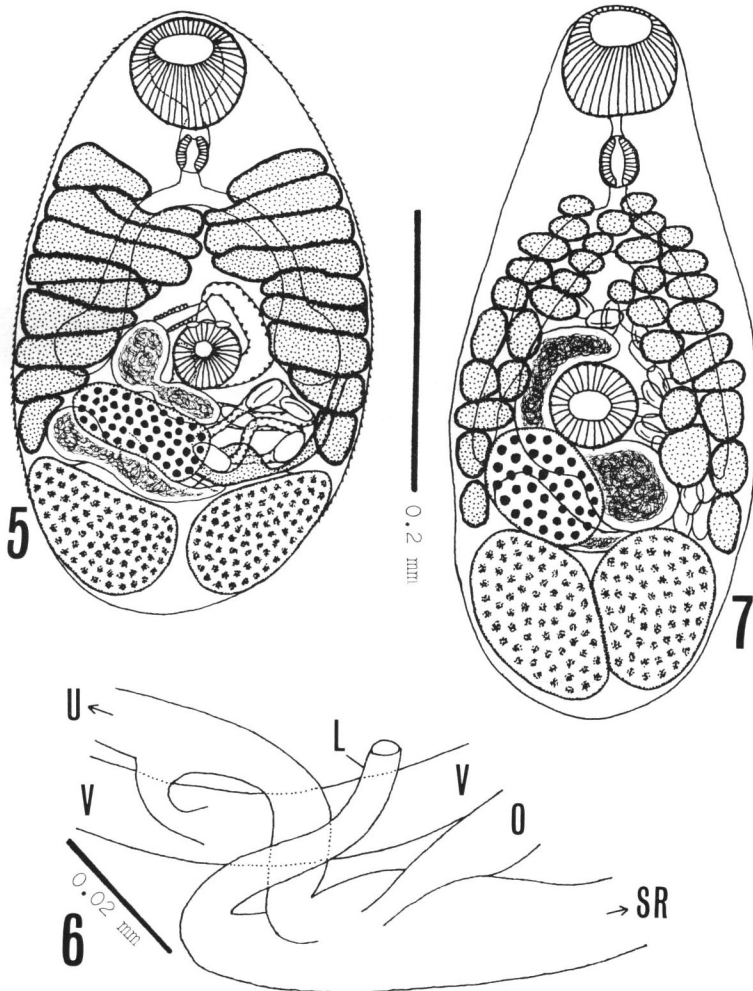
Small type. Body oval or pyriform, 0.40-0.44 mm long by 0.23-0.28 mm wide. Cuticle spinose. Oral sucker subterminal, spherical, 70-77×64-80  $\mu$ ; prepharynx short; pharynx globular, 23-28×23-31  $\mu$ ; esophagus short, bifurcating at boundary between anterior and middle third of body; caeca terminating at post-acetabular level. Acetabulum rounded, slightly smaller than oral sucker, 45-54×49-57  $\mu$ , immediately post-equatorial. Sucker ratio 1.2-1.6: 1.

Testes oval, 103-144×59-80  $\mu$ , juxtaposed in posterior half of hindbody. Vas efferens arising from anterior part of testes, entering into seminal vesicle without forming vas deferens. Seminal vesicle L-shaped, 25-40  $\mu$  wide, filled with sperms, extending postero-dextral to acetabulum. Pars prostatica very small, antero-dextral to acetabulum.

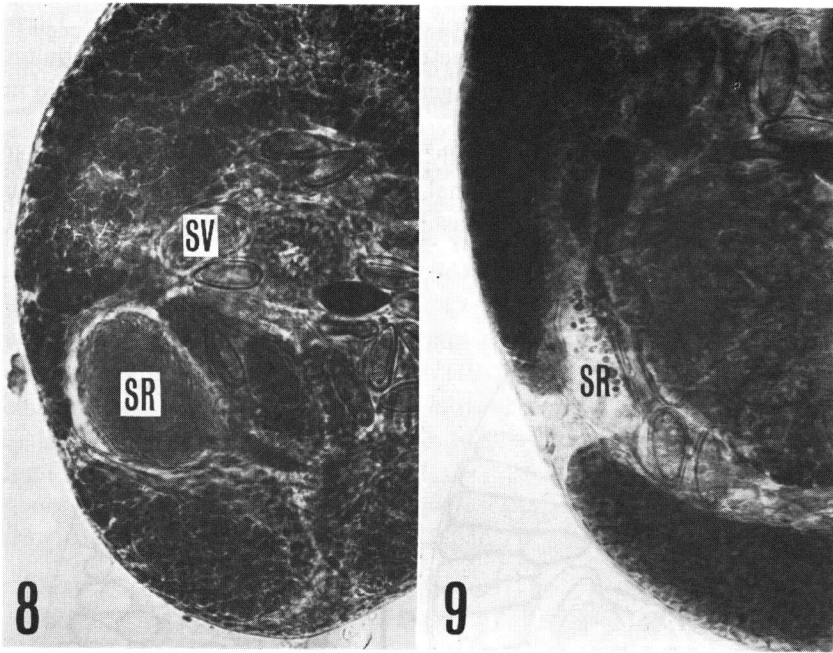
Ovary oval or elliptical, 46-80×64-129  $\mu$ , situated between acetabulum and right testis. Oviduct connected with the duct of seminal receptacle, giving off Laurer's canal, and then receiving vitelline duct. Seminal receptacle oval or elliptical, 46-103×36-70  $\mu$ , filled with sperms, dorso-posterior to ovary. Laurer's canal opening dorsad in midline between acetabulum and testes. Vitellaria consisting of large follicles, extend-

ing from level of pharynx to equator of hindbody, surrounded caeca. Uterus in a few loops between anterior border of testes and posterior part of acetabulum, then running left side of acetabulum to enter genital atrium. Uterine eggs 7–23 in number,  $31\text{--}35 \times 15\text{--}18 \mu$ .

Large type. This type has basically the same structure as that of small type, but no sperms are observed in the seminal vesicle and seminal receptacle, so that it is difficult to see these organs. The measurements are: Body  $0.49\text{--}0.65$  mm long by



Figs. 5–7. *Pricetrema zalophi* (PRICE, 1932). — 5. Entire worm (small type, NSMT-PI 2486), ventral view. — 6. Ovarian complex, dorsal view. — 7. Entire worm (paratype, USNM Helm. Coll. No. 26652; Orig.), ventral view. L, Laurer's canal; O, oviduct; SR, seminal receptacle; U, uterus; V, vitelline duct.



Figs. 8-9. *Pricetrema zalophi* (PRICE, 1932). — 8. Small type. Seminal vesicle and seminal receptacle filled with sperms. Eggs smaller. — 9. Large type. No sperms in seminal receptacle. Eggs larger. SR, seminal receptacle; SV, seminal vesicle.

0.36-0.43 mm wide. Oral sucker  $59-82 \times 80-98 \mu$ ; pharynx  $26-49 \times 21-36 \mu$ ; caeca ending just postero-acetabular level. Acetabulum  $54-75 \times 59-88 \mu$ ; sucker ratio 1.1-1.6:1. Testes  $103-219 \times 77-155 \mu$ . Ovary  $103-129 \times 129-186 \mu$ . Uterine eggs numerous, larger than those of small type,  $41-46 \times 18-22 \mu$ . This type may have parthenogenetic reproduction. The two types are occasionally parasitic in the same host individual.

*Discussion.* The genus *Pricetrema* contains four species: *P. zalophi* (PRICE, 1932) from *Zalophus californianus* in the zoological garden, Washington, D. C.; *P. erignathi* JURAKHNO, 1969 from *Erignathus barbatus nauticus* in the Bering Sea; *P. phocae* SHULTS, 1978 from *Phoca vitulina richardi* in Alaskan waters; *P. eumetopii* SHULTS, 1978 from *Eumetopias jubatus* in Alaskan waters. Of these, *P. zalophi* has been obtained from various marine mammals such as *Callorhinus ursinus*, *Enhydra lutris*, *Eumetopias jubatus* and *Zalophus californianus* on the west coast of North America (MARGOLIS & DAILEY, 1972), whereas the other three species have not been discovered additional representatives until now.

*P. erignathi* seems to be a doubtful species because JURAKHNO (1969) described it on the basis of an abnormally elongated specimen. He regarded the different body shape as important, and on this basis separated *P. erignathi* from *P. zalophi*.

SHULTS (1978) distinguished *P. phocae* from *P. zalophi* as being smaller, having cuticular spines almost twice as long, and the ratio of dimensions of organs to body

size. Also the caeca extend to the posterior margin of the acetabulum instead of to the posterior body margin. He also mentioned that *P. eumetopii* differed from *P. zalophi* with regard to its larger size, larger organs, larger cuticular spines, intestinal caeca that extend only to the posterior margin of the acetabulum, and different ratio of size of organs to size of body. *P. eumetopii* differed from *P. phocae* in its larger size, in having much larger but fewer vitelline follicles, larger cuticular spines, and a different ratio of dimensions of organs to body size. SHULTS (1978), however, did not give the measurement variations of the worms except for the body size and the length of the prepharynx.

To make clear the distinction between *P. zalophi*, *P. phocae* and *P. eumetopii*, we re-examined the following specimens: 1) Paratypes of *P. zalophi* (USNM Helm. Coll. No. 26652); 2) *P. zalophi* from *Zalophus californianus* and *Eumetopias jubatus* caught on the west coast of North America (Prof. DAILEY's collection); 3) *P. phocae* and *P. eumetopii* (Dr. SHULTS' collection). Having sperms in the seminal vesicle and seminal receptacle, these specimens correspond to the small type of our specimens.

Table 1. Measurements of *P. zalophi*, *P. phocae* and *P. eumetopii* (in micron).

Species	<i>P. zalophi</i>	<i>P. zalophi</i>	<i>P. zalophi</i> (DAILEY's coll.)	<i>P. zalophi</i> (DAILEY's coll.)	<i>P. phocae</i>
Host	<i>Zalophus californianus</i>	<i>Callorhinus ursinus</i>	<i>Zalophus californianus</i>	<i>Eumetopias jubatus</i>	<i>Phoca vitulina</i>
Author	PRICE (1932)	SHULTS (1978)?	Present authors	Present authors	SHULTS (1978)
Length	435	503-638	540-700	350-440	315-419
Width	215-263	174-251	280-360	190-260	148-232
Oral sucker	60-75	75 × 79	67-82 × 67-77	49-63 × 54-64	71 × 74
Pharynx	— × 29-33	34 × 46	36-54 × 34-49	26-31 × 18-28	23 × 39
Acetabulum	52-60	56 × 56	52-62 × 49-64	39-52 × 36-54	58 × 60
Sucker ratio		1.41: 1	1.12-1.37: 1	1.17-1.50: 1	1.23: 1
Testes	81-96 × 81-110	98 × 160	140-190 × 110-150	90-131 × 64-101	61 × 91
Ovary	55-75 × 67-92	72 × 93	90-110 × 110-140	46-62 × 59-72	37 × 54
Eggs	33 × 18	33 × 15	32-37 × 16-18	32-36 × 18-20	31 × 15

Species	<i>P. phocae</i> (SHULTS' coll.)	<i>P. eumetopii</i>	<i>P. eumetopii</i> (SHULTS' coll.)	Present specimen (small type)
Host	<i>Phoca vitulina</i>	<i>Eumetopias jubatus</i>	<i>Eumetopias jubatus</i>	<i>Eumetopias jubatus</i>
Author	Present authors	SHULTS (1978)	Present authors	Present authors
Length	390	690-818	380-530	400-440
Width	220	320-434	210-330	230-280
Oral sucker	72 × 75	86 × 87	64-80 × 72-80	70-77 × 64-80
Pharynx	39 × 26	39 × 53	39-49 × 31-39	23-28 × 23-31
Acetabulum	54 × 62	64 × 64	46-59 × 49-57	45-54 × 49-57
Sucker ratio	1.21: 1	1.36: 1	1.32-1.48: 1	1.24-1.63: 1
Testes	108-121 × 72-98	160 × 225	82-144 × 62-108	103-144 × 59-80
Ovary	49 × 90	147 × 118	46-72 × 70-93	46-80 × 64-129
Eggs	33-35 × 16-17	34 × 17	34-36 × 15-17	31-35 × 15-18

The measurements of the specimens are shown in Table 1. Variations are observed in the size of body and organs including eggs in each species. Because of the overlap of measurements, the three species are indistinguishable from each other.

In his original description, PRICE (1932) stated that "intestinal caeca . . . extending to near the posterior end of the body, their blind ends being hidden by the testes." Our re-examination of paratypes of *P. zalophi* and the other North American *P. zalophi* revealed the caeca terminating at the post-acetabular level, not reaching the testes, so that PRICE made a mistake in the caecal extension.

Cuticular spines and vitelline follicles are variable in size depending on the body size and the worm condition such as fresh material or not.

Taking these findings into consideration, both *P. phocae* and *P. eumetopii* are synonymous with *P. zalophi*.

In Japan, *Pricetrema* was previously known from *Vulpes vulpes schrencki* in Hokkaido (KAMIYA & OHBAYASHI, 1975), stray dog in Akita (ISHIDA & SUZUKI, 1977) and *Phoca kurilensis* in Hokkaido (MIYAMOTO *et al.*, 1979). These were not made the specific determination, but may be *P. zalophi* judging from the morphology and measurements.

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