Parasitology

cambridge.org/par

Review Article

Cite this article: Yamasaki H, Intapan PM, Maleewong W (2026) *Spirometra* infections in humans in Asia and Oceania. *Parasitology*, 1–18. https://doi.org/10.1017/S0031182026101644

Received: 24 November 2025
Revised: 13 January 2026
Accepted: 21 January 2026

Keywords:
Asia; Diagnosis; Molecular phylogeny; Oceania; Sparganosis; *Sparganum proliferum*; *Spirometra asiana*; *Spirometra mansoni*; Spirometrosis

Corresponding authors: Hiroshi Yamasaki;
Email: hyamasaki2015@yahoo.co.jp;
Wanchai Maleewong;
Email: wancha_ma@kku.ac.th

CAMBRIDGE
UNIVERSITY PRESS

Spirometra infections in humans in Asia and Oceania

Hiroshi Yamasaki[1,2], Pewpan Maleewong Intapan[3,4] and Wanchai Maleewong[3,4]

[1]Department of Parasitology, National Institute of Infectious Diseases, Japan Institute for Health Security, Tokyo, Japan; [2]Department of Tropical Medicine and Parasitology, School of Medicine, Juntendo University, Tokyo, Japan; [3]Department of Parasitology, Faculty of Medicine, Khon Kaen University, Khon Kaen, Thailand and [4]Mekong Health Science Research Institute, Khon Kaen University, Khon Kaen, Thailand

Abstract

The genus *Spirometra* (Cestoda: Diphyllobothriidae) is a group of tapeworms distributed worldwide and includes important species that cause sparganosis and spirometrosis in humans. Traditionally, it has been accepted that non-proliferative sparganosis is caused by *Spirometra erinaceieuropaei* and proliferative sparganosis by *Sparganum proliferum*. However, recent molecular studies have revealed that the species present in Asia are *Spirometra mansoni* and the recently described *Spirometra asiana*, not *S. erinaceieuropaei* endemic to Europe. It is questionable whether *Spa. proliferum* is a valid species: proliferative sparganosis cases in Asia might be caused by *S. mansoni*. Some human cases of multiple infections with plerocercoids of non-proliferative species may have been mistaken for proliferative sparganosis. This review focuses on sparganosis and spirometrosis in Asia and Oceania and overviews the molecular phylogeny, geographic distribution, current situation, innovative diagnostic methods and future perspectives for work on these species. Whether the species referred to as *Spa. proliferum* in Asia and *Spa. proliferum* in South America are conspecific is also discussed. Concerning *S. asiana*, little is known about its biology, biogeography and pathogenicity in humans. Accurate identification of these etiological agents through DNA analysis is important for the reliable assessment of zoonotic relevance and further understanding of the biology and epidemiology of these tapeworms.

Introduction

Tapeworms belonging to the genus *Spirometra* Faust, Campbell and Kellogg, 1929 (Cestoda: Diphyllobothriidae) are distributed worldwide. The larval plerocercoid (also known as a sparganum) parasitizes tissues of various vertebrates, including humans, and causes 2 types of sparganosis: non-proliferative and proliferative sparganosis. The former is caused by infection by the plerocercoids of (mainly) *Spirometra erinaceieuropaei* and *Spirometra mansoni* (e.g. Liu et al., 2015; Kuchta et al., 2024; Yamasaki et al., 2024b). These plerocercoids do not multiply in the second intermediate hosts. This contrasts with proliferative sparganosis, caused by plerocercoids of *Sparganum proliferum* which multiply asexually and metastasise in the second intermediate hosts (Scholz et al., 2019; Kuchta et al., 2021).

The adult worm dwells in the small intestines of carnivores, mainly felines and canines, causing spirometrosis. In rare cases, the plerocercoid can also develop into adult worm in humans (Scholz et al., 2019; Kuchta et al., 2021).

Humans become infected with the parasite by drinking untreated water contaminated by copepods (first intermediate hosts) that harbour the procercoid stage, by consuming raw or undercooked flesh of the second intermediate and paratenic hosts such as frogs, snakes and wild boars, or by using frog meat as poultices on skin wounds (Wiwanitkit, 2005; Anantaphruti et al., 2011; Liu et al., 2015; Chai et al., 2020). Sparganosis is an important food- and water-borne parasitic infection that is often overlooked and is certainly under-reported.

The first sparganosis case reported in Asia was a Chinese patient who died in Fujian province, China: the causative species was described as *Ligula mansoni* by Cobbold (1883). Subsequently, *L. mansoni* Cobbold, 1883 was proposed as a junior synonym of *Dubium erinacei europaei* Rudolphi, 1819 (Rudolphi, 1819) and placed within the genus *Diphyllobothrium* Cobbold, 1858 by some authors (see synonymy in Iwata, 1972). The generic name ‘*Dubium*’ was at Rudolphi’s time a collective term used for larval parasites of uncertain taxonomic placement. The abbreviated specific name ‘*erinacei*’ was used by Rudolphi later (Rudolphi, 1819) and was often used by later workers instead of ‘*erinacei europaei*’. Rudolphi’s name was paired with another collective generic term for larval cestodes, *Sparganum*, by Diesing (1854), as *Sparganum erinacei-europaei*. A new subgenus, *Spirometra*, was proposed within *Diphyllobothrium* by Faust et al. (1929). The name *Spirometra erinaceieuropaei* was accepted by Bray et al. (1994). This led to the long-standing assumption that *S. erinaceieuropaei* is the major etiological agent of sparganosis globally. However, recent molecular studies have revealed that the genuine *S. erinaceieuropaei* is present only in Europe, and that worms previously identified as *S. erinaceieuropaei, S. decipiens* (Diesing, 1850) and *S. ranarum* (Gastaldi, 1854) in Asia and/or Oceania in fact belonged to *S. mansoni* or *S. asiana* (Kuchta et al., 2021, 2024; Yamasaki et al., 2021, 2024b). All cases for which these parasite names were used were non-proliferative.

The first case of proliferative sparganosis was reported in a Japanese patient. The etiological agent was described as *Plerocercoides prolifer* based on the finding of numerous branched and peculiar-shaped plerocercoids (Ijima, 1905). The adult stage of this species was unknown. Under a provision of the International Code of Zoological Nomenclature (Article 42.2.1), larval parasites of unknown species may be assigned a collective-group generic name based on their larval form. Thus *P. prolifer* was renamed as *Sparganum* (*Getestius*) *proliferum* (Ijima, 1905) Stiles, 1908 (Stiles, 1908). Since then, it has been usual to regard *Spa. proliferum* as the species causing proliferative sparganosis (e.g. Moulinier et al., 1982; Liu et al., 2015; Kikuchi and Murayama, 2020).

This review focuses on *Spirometra* infections in Southeast and South Asia and Oceania, and overviews the causative species, endemic areas, current situation in humans, diagnostics and future perspectives. We also discuss the identity of *Spa. proliferum* and whether the organism reported from Asia under this name is different from *Spa. proliferum* from Venezuela.

Molecular phylogeny and biogeography

Molecular phylogeny

Morphological identification of *Spirometra* species is difficult due to morphological similarities among species. Features of adults, such as the shape of uterus and the number of uterine coils, vary depending on fixation methods and the age of individual tapeworms, making them inappropriate for distinguishing species (Iwata, 1972). Despite this, *S. erinaceieuropaei, S. decipiens* and *S. ranarum* have all been reported from Asia based on adult morphology. Not surprisingly, these morphological identifications and their geographical distributions have been questioned (Scholz et al., 2019).

Recent taxonomic revisions of *Spirometra* species in Asia have been conducted based on analysis of the complete sequences of the mitochondrial cytochrome *c* oxidase subunit 1 gene (cox1, 1566 bp) (Yamasaki et al., 2021). One hundred and eight haplotypes were identified in a haplotype network based on this gene using 149 sequences of *Spirometra* species from Asia. These haplotypes fell into 2 groups: a large group consisting of 106 haplotypes and a small group consisting of 2 haplotypes (Thanchomnang et al., 2021; Yamasaki et al., 2021). The former group included '*S. erinaceieuropaei*', originally identified as '*L. mansoni*' from Fujian and Guangdong provinces in China, as well as '*S. decipiens*' and '*S. ranarum*'. The molecular data indicate that all members of this large haplogroup should be assigned to *S. mansoni* (Kuchta et al., 2021, 2014; Yamasaki et al., 2021, 2024b). The smaller haplogroup included only the species recently described as *Spirometra asiana* Yamasaki, Sugiyama & Morishima, 2024 and mistakenly reported as *S. erinaceieuropaei* from South Korea.

These results have also been supported by a phylogenetic analysis. Worms from Asia referred to by various authors as *S. erinaceieuropaei, S. decipiens* and *S. ranarum* all belonged to the same monophyletic clade as *S. mansoni*, and a smaller group consisted of *S. asiana* (Figure 1 and Supplementary Figure 1). The cox1 sequences of 50 *S. asiana* specimens from Japan were all identical, and only 8 out of 1566 bases differed from those of specimens from South Korea. This is in contrast with the higher level of genetic diversity seen in *S. mansoni* (Yamasaki et al., 2021). *Spirometra mansoni* and *S. asiana* are phylogenetically closely related, but distinct species, and are neither *S. erinaceieuropaei* native to Europe, *S. theileri* from Africa, *S. decipiens* complex 1, *Spirometra* sp. 2 and *Spirometra* sp. 3 from North and South America nor *Spa. proliferum* from South America (Figure 1 and Supplementary Figure 1).

What is Spa. proliferum*?*

Several questions have remained about *Spa. proliferum*, (i) what is its taxonomic position?, (ii) is *Spa. proliferum* actually present in Asia?, (iii) why has the adult form of *Spa. proliferum* remained unknown despite extensive research in companion animals and wildlife? and (iv) why does *Spa. proliferum* proliferate asexually in the intermediate hosts?

Regarding question (i), Ijima (1905) speculated that the plerocercoids of *P. prolifer* might turn out to be *L. mansoni* if followed up to the mature stage.

Iwata (1972) transplanted plerocercoids incised at head or tail, or diagonally, of *Diphyllobothrium erinacei* (a synonym of *S. erinaceieuropaei* but in this case actually referring to *S. mansoni*) into the subcutaneous tissues and abdominal cavities of rabbits, guinea pigs and a monkey and observed that filamentous and branched plerocercoids regenerated that were histologically comparable to those of *Spa. proliferum*. He also reported that the numbers of plerocercoids recovered from the animals were less than the numbers of transplanted plerocercoids, indicating regeneration but not proliferation in the recipient animals. Based on the histological observations that the irregularly branched plerocercoids obtained in regeneration experiments and in the Japanese striped snake (*Elaphe quadrivirgata*) were comparable to those of the original specimen reported by Ijima (1905), Iwata and Inatomi (1972) stated that '*Spa. proliferum*' from Japan might be aberrant plerocercoids of *S. mansoni* that had regenerated.

As shown in Figure 1, *Spa. proliferum* from Venezuela, along with *S. decipiens* complex 1 from Chile and *Spirometra* sp. 2 from the USA, clustered with *Spirometra* sp. 2 and were all tentatively assigned to *Spirometra* sp. 2 by Kuchta et al. (2024). Thus, *Spa. proliferum* from Venezuela is phylogenetically close to *Spirometra* species from North and South America and distantly related to *S. mansoni* and *S. asiana* (Kuchta et al., 2021, 2024; Yamasaki et al., 2021, 2024b; Fredes et al., 2022). Although nomenclatural changes are likely soon, we will use the name *Spa. proliferum* in this review when that name was used in the original reports.

The genetic distance (*d* value) of cox1 between *Spa. proliferum* from Venezuela and *S. decipiens* complex 1 from Chile is 0.0821 (Fredes et al., 2022), which is slightly smaller than the *d* values between *S. mansoni* and *S. asiana* (0.0986–0.1350) and roughly equivalent to the *d* values between *Dibothriocephalus nihonkaiensis* and *Dibothriocephalus latus* (0.0852–0.0869) (Yamasaki et al., 2023). Although the *d* values alone cannot

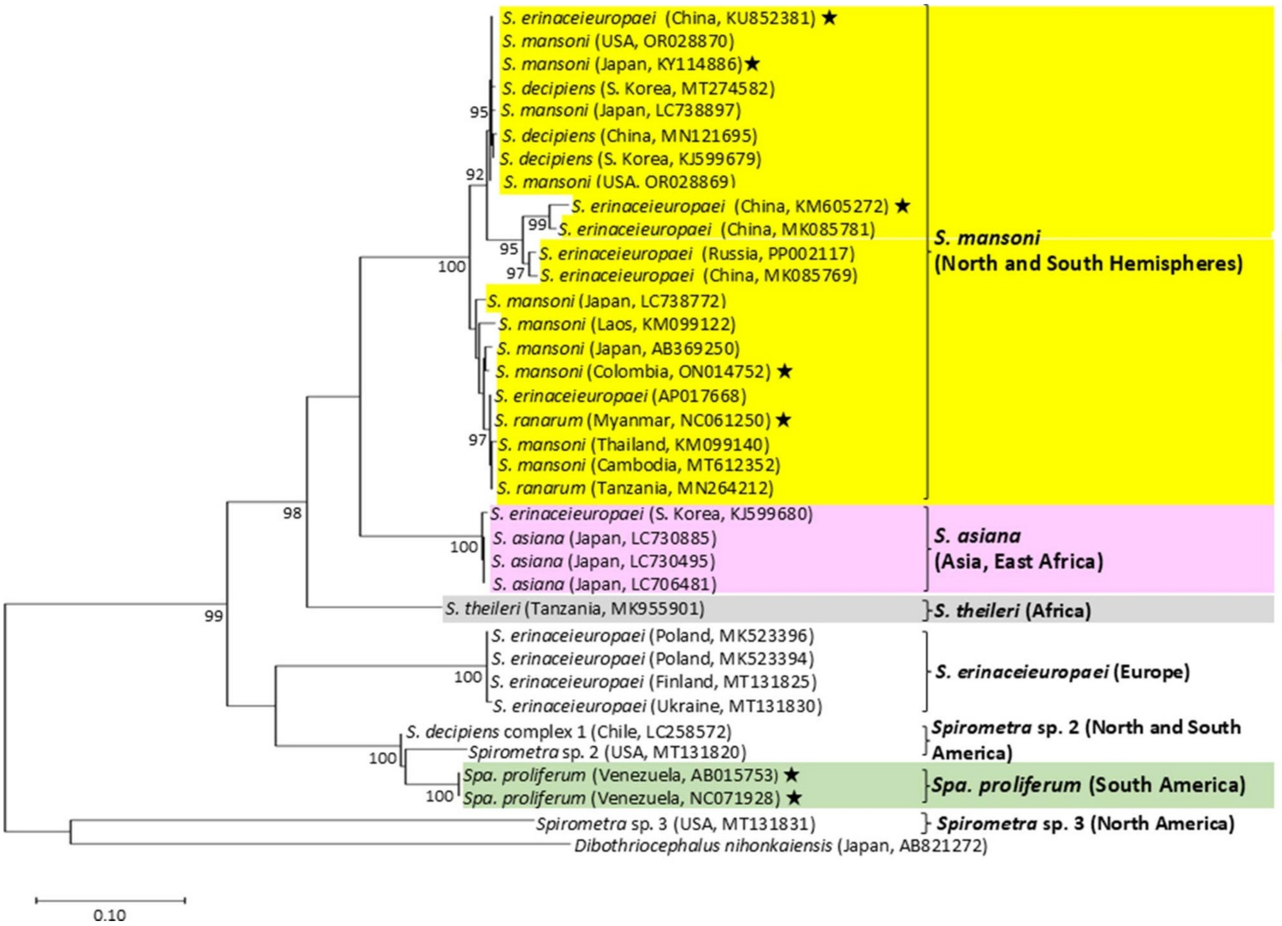

Figure 1. Maximum likelihood tree inferred from complete cox1 sequences of *Spirometra* species and related taxa. HKY + G + I was used as the best substitution model. The species name used for each sequence in the tree is the name assigned to it in the relevant GenBank accession number. The Russian species (registered as *S. erinaceieuropaei*) included in the tree, PP002117, is from Astrakhan at the northern end of the Caspian Sea and therefore technically belongs in Europe, very close to the accepted boundary with Asia. The etiological agents from cases of proliferative sparganosis in mammals are indicated with stars. *Spirometra decipiens* complex 1, *Spirometra* sp. 2 and *Spa. proliferum* from Venezuela have been tentatively assigned to *Spirometra* sp. 2 (Kuchta et al., 2024). Bootstrap values (>90% in 1000 replications) are shown at each node. The scale bar indicates the number of nucleotide substitutions/site. *Dibothriocephalus nihonkaiensis* was used as an outgroup.

determine whether a species is conspecific, it can serve as a reference.

Regarding question (ii), it has been reported that *Spa. proliferum* from Venezuela and Japan are conspecific based on mitochondrial and nuclear gene analyses (Kokaze et al., 1997; Miyadera et al., 2001). However, it is important to note that the Japanese isolate analysed by Kokaze et al. (1997) and Miyadera et al. (2001) were not Ijima's specimens, and there is no DNA data available for them. The Japanese specimen they used was reported in 1909 (Usui, 1909) and had been stored in formaldehyde for nearly a century. This raises questions about the quality of DNA in their sample. Some of their cloned cox1 sequences from Japan were identical to those form Venezuela (Miyadera et al., 2001), which raises the suspicion of contamination. Only the DNA data from Venezuela seems reliable (Kokaze et al., 1997; Miyadera et al., 2001; Kikuchi et al., 2021). Thus, there is no decisive evidence that the Japanese and Venezuelan specimens are conspecific.

Recently, *S. mansoni* has been reported as a causative species of proliferative sparganosis in Japan (Tokiwa et al., 2024), the USA (originally reported as *S. mansoni*/*S. ranarum*/*S. erinaceieuropaei*, Semenova et al., 2025) and Australia (originally reported as *S. erinaceieuropaei*, Young et al., 2025). All these cases were from dogs or cat and all the reports included molecular data. This clearly indicates that *S. mansoni*, not *Spa. proliferum*, causes proliferative sparganosis in Asia and Oceania, including North America (stars in Figure 1, Supplementary Figure 1 and Table 1). In these cases, *S. mansoni* may have proliferated asexually, but the possibility of multiple (non-proliferative) infections due to simultaneous or repeated exposures to the plerocercoids of *S. mansoni* needs to be considered.

Regarding question (iii), the purported adult worms of *Spa. proliferum* have been found in wild felids in Argentina (Arrabal et al., 2020). However, the identification was not reliable because the cox1 sequences (296 bp) used for identifying the species were short, and further analysis using longer sequences is needed (Fredes et al., 2022; Kuchta et al., 2024). If *S. mansoni* is the causative species of proliferative sparganosis in Asia, Oceania and North America, as outlined in the previous paragraph, then the adult stage of this '*Spa. proliferum*' is already known to parasitize in dogs, cats and wild animals (Nakamura et al., 1990; Yamasaki et al., 2024c).

Regarding question (iv), some genes that are putatively important for asexual proliferation of *Spa. proliferum*, such as a variety of tolloid-like protein (peptidases) and oncogene-like genes, have

Table 1. Etiological agents caused proliferative sparganosis with molecular data

Original identification	Origin	Target genes (sizes)	GenBank accession numbers and % identities	References	Remarks
Sparganum proliferum (?)	Thai patient (Kanpittaya et al., 1995; Phunmanee et al., 2001)	cox1 (151 bp, 156 bp)	AB612881, AB612882	Koonmee et al. (2011)	*Spa. proliferum* was suspected (Wiwanitkit, 2005; Anantaphruti et al., 2011), but it was identified as *S. erinaceieuropaei* (Koonmee et al., 2011), and eventually reconfirmed as *S. mansoni* (see Non-proliferative Sparganosis section in this study).
Spa. proliferum	Japanese patient (Usui, 1909; Yoshida, 1914)	nad3 (372 bp?) and tRNA-Pro, tRNA-Ile, tRNA-Lys and tRNA-Trp (∼600 bp?)	Not available, but identical to AB006203	Kokaze et al. (1997)	There is no evidence that *P. prolifer* from Japan and Venezuelan *Spa. proliferum* are conspecific. It is highly likely that *Spa. proliferum* from Asia is actually *S. mansoni* (see What Is *Spa. proliferum*? section in this study).
Spa. proliferum	Venezuelan patient (Moulinier et al., 1982), and passage in outbred mice (Noya et al., 1992)	nad3 (372 bp) and tRNA-Pro, tRNA-Ile, tRNA-Lys and tRNA-Trp (∼600 bp)	AB006203	Kokaze et al. (1997)	Tentatively assigned to *Spirometra* sp. 2 (Kuchta et al., 2024), but *Spa. proliferum* is used here to avoid confusion.
Spa. proliferum	Japanese patient (Usui, 1909; Yoshida, 1914)	cox1 (394 bp?) sdhB (269 bp?)	Not available Not available	Miyadera et al. (2001)	There is no evidence that *P. prolifer* from Japan and Venezuelan *Spa. proliferum* are conspecific. It is highly likely that *Spa. proliferum* from Asia is actually *S. mansoni* (see What Is *Spa. proliferum*? section in this study).
Spa. proliferum	Venezuelan patient (Moulinier et al., 1982), and passage in outbred albino mice (Noya et al., 1992)	cox1 (1566 bp) sdhB (269 bp)	**AB015753*** Not available	Miyadera et al. (2001)	Tentatively assigned to *Spirometra* sp. 2 (Kuchta et al., 2024), but *Spa. proliferum* is used here to avoid confusion.
Spa. proliferum	Venezuelan patient (Moulinier et al., 1982), and passage in Balb/c mice (Alarcon de Noya et al., 1992)	Mitochondrial genome (13 617 bp)	**NC071928***, OX421840	Kikuchi *et al.* (2021)	Ditto
Spa. proliferum	Ditto	Whole genome (653.4 Mb)	AP044632–AP044644	Kikuchi *et al.* (2021)	Ditto

(*Continued*)

Table 1. (*Continued.*)

Original identification	Origin	Target genes (sizes)	GenBank accession numbers and % identities	References	Remarks
Spa. proliferum	Ocelot (*Leopardus pardalis*) (Puerto Iguazú, Misiones, Argentina)	cox1 (296 bp), nad1 (343 bp) ATP synthase F0 subunit 6 (594 bp)	MK976918 MK976919 MK976920	Arrabal et al. (2020)	Uncertain, more analysis using longer sequence data needed (Fredes et al., 2022; Kuchta et al., 2024)
Spa. proliferum	Dog (Florida, USA)	18S rRNA (384 bp)	EU392209	West et al. (2008)	
Spa. proliferum	European (travelled through Bolivia, Brazil and Paraguay)	cox1 (? bp) nad3 (? bp) 12S rRNA (? bp)	Not available, 98% identity with *Spa. Proliferum* Not available, 96% identity with *Spa. Proliferum* Not available	Schauer et al. (2014)	Morphologically not characteristic of other Venezuelan specimens
Spirometra mansoni	Cat (Japan)	cox1 (1566 bp)	Not available, but identical to **KY114886***	Tokiwa et al. (2024)	Confirmed as *S. mansoni*
Spirometra erinaceieuropaei, S. mansoni or S. ranarum	Dog (Florida, USA)	cox1 (828 bp) nad (577 bp) 12S rRNA (406 bp)	PV035870: 100% identity with *S. erinaceieuropaei* (**KM605272***) and *S. mansoni* (**ON014752***), and 99.3% identity with *S. ranarum* (**NC061250***) PV040769: 99.1% identical to *S. ranarum* (NC061250) and *S. erinaceieuropaei* (ex., OX421841, AP017668) PV037666: 99.8% identity to *S. ranarum* (NC061250) and *S. erinaceieuropaei* (AP017668)	Semenova et al. (2025)	*S. mansoni* (This study)
S. erinaceieuropaei	Dog (Perth, Australia)	Mitochondrial genome (13 617 bp)	Not available, but identical to **KU852381***	Young et al. (2025)	*S. mansoni* (This study)

*Accession numbers with asterisks indicate cox1 sequences used for phylogenetic analysis.

been identified in budding plerocercoids using transcriptome analyses (Kikuchi et al., 2021).

Geographical distribution

The global distribution of *Spirometra* species has been reviewed (Kuchta et al., 2024). The distribution of *Spirometra* species in Asia and Oceania, including the eastern part of Africa and Mauritius, is shown in Figure 2, based on many data (Zhu et al., 2002; Okamoto et al., 2007; Yamasaki et al., 2007; Koonmee et al., 2011; Boonyasiri et al., 2013, 2014; Hoffdorf et al., 2015; Zhang et al., 2015; Badria et al., 2017; Le et al., 2017; Sato et al., 2017; Kuchta et al., 2024; Young et al., 2025). To date, there have been no reports of *Spirometra* infections from Mongolia.

Although *S. mansoni* is widely distributed in the Asia–Oceania region, the species has also recently been identified, based on DNA analysis, in Tanzania (originally reported as *S. ranarum*) (Eom et al., 2018), the United States (Sanders et al., 2025; Semenova et al., 2025), Mexico (Salazar-Grosskelwing et al., 2025), Costa Rica (Alvarado-Hidalgo et al., 2024) and Colombia (Brabec et al., 2022). A parasite identified as *S. decipiens* was reported in Cuba (Morales et al., 2022). However, the *S. decipiens*-specific primers used to amplify the target genes were actually based on the sequences of *S. mansoni* (misidentified as *S. decipiens* in Korea by Jeon et al., 2018a), and the amplified PCR products were not sequenced. The *Spirometra* species from Cuba therefore appears to have been misidentified and is reasonably interpreted as *S. mansoni*, but further verification is required to confirm the species identity. Thus, *S. mansoni* is widely distributed in the Northern and Southern Hemispheres. Meanwhile *S. asiana* appears to be restricted to Japan, South Korea and Tanzania (Figure 2); however, as molecular identification is increasingly performed, it is likely to be found in other regions (Yamasaki et al., 2024b).

The identity of putative *Spa. proliferum* reported from Réunion Island, located east of Madagascar in the Indian Ocean, is uncertain due to the lack of molecular data (Meric et al., 2010).

Morphological and molecular identification

Many researchers have considered *S. erinaceieuropaei* to be the main causative species of sparganosis. However, the morphology of adults neither of authentic *S. erinaceieuropaei* nor of *S. mansoni*, identified based on DNA analysis, was described until very recently (Kuchta et al., 2024).

Although the morphological identification of all stages of *Spirometra* species is very difficult and there are no clear diagnostic criteria for distinguishing the species, morphological differences observed between plerocercoids of *S. mansoni* and *S. asiana* are intriguing. The plerocercoids of *S. mansoni* found in frogs, snakes, wild boars and humans are slender forms, 0.5–1 mm in width (Figure 3A), whereas those of *S. asiana* found in wild boars (Figure 3B) and humans (Figure 3C,D) are thicker and wider (5–7 mm), giving the impression of being an adult worm at first glance. However, we must point out that the number of plerocercoids identified as *S. asiana* is still small. It remains to be determined whether the plerocercoids of *S. asiana* differ in size depending on their hosts (e.g. frogs and snakes) (Yamasaki et al., 2021, 2024b).

If the surgically excised plerocercoids and adult worms obtained by deworming are available, molecular identification of the causative species is recommended in medical and veterinary institutions. For that, the parasite samples should be fixed in molecular-grade ethanol (>80%) rather than formalin because formalin fixation cross-links and degrades the DNA (Bianchi et al., 1991), making the tissue solubilization and DNA extraction and PCR amplification more difficult.

Molecular techniques using mitochondrial cox1 sequences have become the most reliable tools for accurately identifying *Spirometra* species. PCR followed by DNA sequence analysis can be used for histopathological specimens (Yamasaki et al., 2007; Koonmee et al., 2011). Related approaches include pyrosequencing (Thanchomnang et al., 2016), multiplex PCR (Jeon et al., 2018a), cox1 sequencing (Yamasaki et al., 2021, 2024b) and restriction fragment length polymorphism (RFLP) (Yamasaki et al., 2024a). No molecular method for differentiating *S. mansoni, S. asiana* and *Spa. proliferum* using a single-reaction protocol has been established yet. However, *S. mansoni* (originally reported as *S. decipiens*) from Asia and *Spa. proliferum* from South America are distinguishable by pyrosequencing (Thachomnang *et al.*, 2016).

The easiest molecular method is RFLP. A restriction enzyme Hinc II (or Hpa I) cleavage site exists at position 590 of the cox1 of *S. mansoni*, whereas this site is absent in *S. asiana* and other *Spirometra* species (Yamasaki et al., 2024a). Therefore, if only *Spirometra* species from Asian and Oceanian regions are tested, and if the PCR-amplified cox1 is cleaved with Hinc II, the species can be identified as *S. mansoni* if it is not cleaved, it is *S. asiana*. Formalin-fixed specimens and formalin-fixed-paraffin-embedded sections are also available, but they are not recommended for molecular diagnosis due to problems in obtaining good-quality DNA. It is necessary to design primers that can amplify short regions (less than 300 bp) for such cases (Yamasaki et al., 2007; Koonmee et al., 2011).

Human sparganosis/spirometrosis cases and serodiagnosis

For human cases, PubMed, Google Scholar and Medical Central Journal (Igaku Chuo Zasshi) Web were searched using the keywords ‘sparganosis’, ‘*Spirometra* infection’, ‘*S. erinaceieuropaei*’, ‘*S. mansoni*’, ‘*Spa. proliferum*’, ‘proliferative sparganosis’ and ‘spirometrosis’. Cases reported in the most recent reviews from each country have been supplemented with additional information until 2025. Cases of Asians diagnosed outside Asia have also been added.

Non-proliferative sparganosis

In most cases, single plerocercoids are found, but multifocal cases have also been reported. Plerocercoids have been found in various tissues and organs, particularly subcutaneous tissues (chest, abdomen, trunk and thighs), with ocular, visceral and cerebral cases also often reported (Kagei, 2000; Yoshikawa et al., 2010; Anantaphruti et al., 2011; Liu et al., 2015; Kim et al., 2018; Nawa et al., 2025). Symptoms vary depending on the parasite’s location: tumour-like mass, cord-like protrusions or creeping eruption in the subcutaneous cases, paralysis and seizures in the cerebral cases and inflammation of the eyelids and conjunctiva in the ocular cases.

More than 2000 human sparganosis cases have been reported worldwide, with most (80%) from China. Numbers of human cases reported in Asia and Oceania are presented in Table 2.

In China, the first case of sparganosis was reported in 1882, with 1359 cases reported between 1949 and 2014 (Liu et al., 2015). At

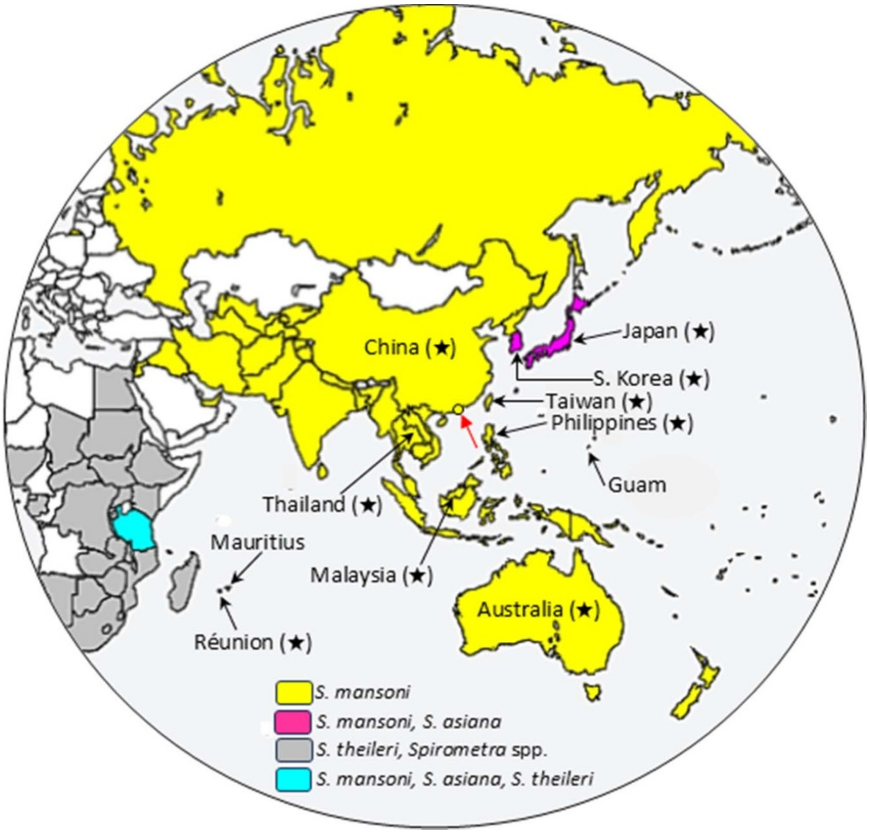

Figure 2. Distribution of *Spirometra* spp. in Asia and Oceania, including eastern part of Africa. Countries where *Spirometra mansoni* is distributed are coloured yellow, countries where *S. mansoni* and *Spirometra asiana* co-exist and *S. mansoni, S. asiana and Spirometra theileri* are distributed are indicated in magenta and turquoise, respectively. Countries where *S. theileri* and/or *Spirometra* spp. are distributed are shown in grey. Countries where cases of proliferative sparganosis have been reported are marked with stars after the country name. A red arrow indicates Hong Kong where cases due to *S. mansoni* have been confirmed.

least 33 additional cases were reported by 2025 (e.g. Yu et al., 2016; Du et al., 2018; see Table 2 for others), including a Chinese immigrant diagnosed in Germany (Bennett et al., 2014). In one case, the removed worm was mistakenly reported as an adult, even though it was obviously a plerocercoid (Fu et al., 2019).

In Japan, the first sparganosis case was found in 1881 in Kyoto. Kagei (2000) reported 546 cases from 1881 to 2000. A further 77 cases (Yoshikawa et al., 2010) and 32 cases (Nawa et al., 2025) were added to the total. A further 5 cases that were not included in these reports (Yamasaki et al., 2007; Ikuno et al., 2018) brings the total number to at least 660 by 2025, including a Japanese immigrant diagnosed in Germany (Tappe et al., 2013) and a sparganosis case due to *S. asiana* (Kudo et al., 2017; Yamasaki et al., 2021, 2024b). The species reported by Tappe et al. as *S. erinaceieuropaei* is undoubtedly *S. mansoni* based on the cox1 sequence (Yamasaki et al., 2021).

Kagei (2000) reported 16 Japanese cases of sparganosis with multiple lesions (2—6 plerocercoids per patient) and these cases are likely due to simultaneous ingestion of multiple plerocercoids or repeated infections, most probably due to *S. mansoni.*

In South Korea, 438 cases were reported between 1942 and 2015 (Kim et al., 2018), and at least 18 cases have been added by 2025 (e.g. Jo et al., 2016; Hong et al., 2017; see Table 2 for others). Jeon et al. (2015) reported 50 human sparganosis cases, of which 16 were caused by '*S. decipiens*' and 34 were infected with '*S. erinaceieuropaei*'. However, according to the latest taxonomy, these must be classified as *S. mansoni* and *S. asiana*, respectively (Yamasaki et al., 2024b). Interestingly, the image of a plerocercoid identified as *S. erinaceieuropaei* is shown (Jeon and Eom, 2018), but the plerocercoid closely resembles that of *S. asiana* (Kudo et al., 2017; Yamasaki et al., 2021). In South Korea, more human cases are due to *S. asiana* than to *S. mansoni*, while in Japan, the number of human cases caused by *S. asiana* is extremely low. The frequency of *S. mansoni* and *S. asiana* appears to vary by country and region (Yamasaki et al., 2024b).

The situation of sparganosis in North Korea is unknown. Lee et al. (2018) reported a case of a North Korean defector with eosinophilic gastritis due to suspected cerebral sparganosis.

In Thailand, 52 cases reported between 1943 and 2005 were collated (Anantaphruti et al., 2011), with at least 23 additional cases to 2025 (e.g. Akkarachinorate et al., 2013; Boonyasiri et al., 2013; see Table 2), including a Thai immigrant diagnosed in Switzerland (Muigg et al., 2019).

A case of pulmonary sparganosis with multifocal lesions was reported in Thailand 30 years ago (Kanpittaya et al., 1995; Phunmanee et al., 2001) and was considered at the time to be caused by *Spa. proliferum*, but molecular diagnosis using pathological tissue sections ultimately identified the cause as *S. mansoni* (Koonmee et al., 2011).

In India, 20 cases were reported between 1998 and 2000 (Kaur and Shukla, 2023). The number has been updated to 25 (from 1982 to 2023) (Nawa et al., 2024). Two additional cases have since been reported (Chougule et al., 2023; Rathore et al., 2024), bringing the total number of cases since 1982 to at least 27.

In other Asian countries and regions, sparganosis has sporadically been reported: 25 cases from Taiwan (Tsai et al., 1993, 2024; Chang et al., 1999; Tung et al., 2005; Chiu et al., 2010; Ho et al., 2013; Hong et al., 2013; Hsu et al., 2020), 12 cases from Hong Kong (Huang and Kirk, 1962; Ng et al., 1989; Ko, 1991; Tang et al., 2017), 6 cases from the Philippines (Ira-Concepcion, 1935 from

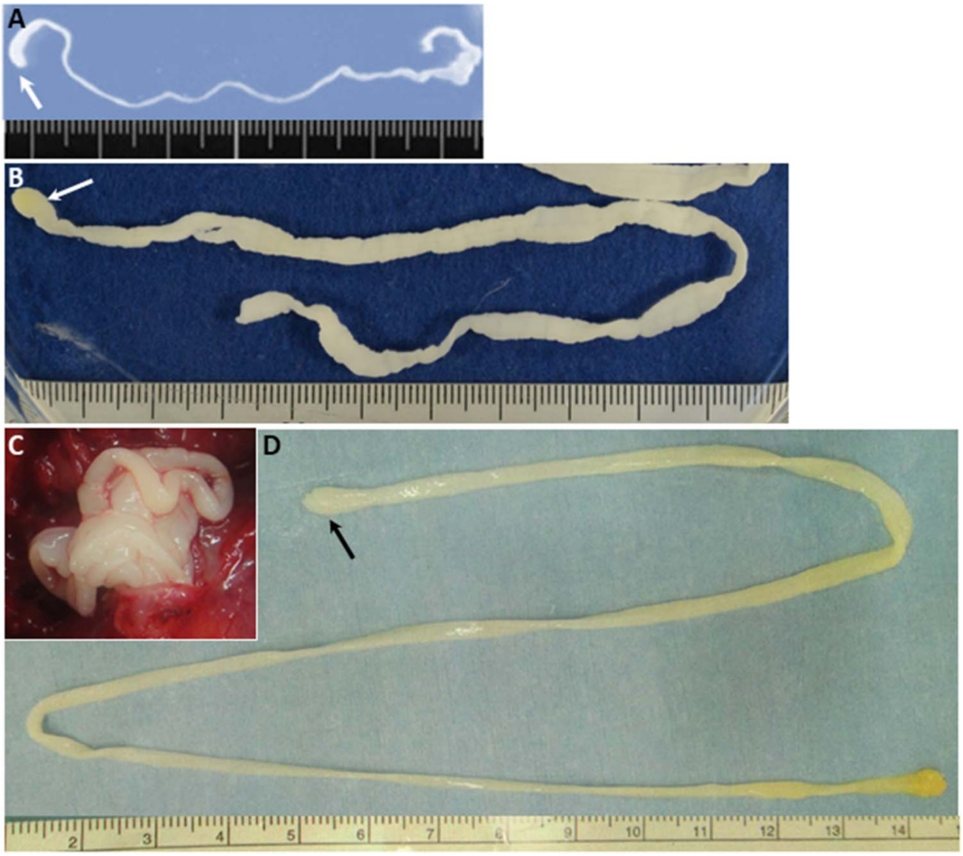

Figure 3. Morphological differences between plerocercoids of *Spirometra mansoni* and *Spirometra asiana*. (A) *S. mansoni* plerocercoid from human (Masuya et al., 2008); (B) *S. asiana* from wild boar; (C) and (D) *S. asiana* from human (Kudo et al., 2017). Arrows indicate the scolex. Note remarkable differences between the sizes of plerocercoids (A, B and D are shown at the same scale).

Yogore and Tangco, 1953; Eduardo, 1991; Kazanjian and Mattia, 1994; Tang et al., 2017), 5 cases from Sri Lanka (Wijesundera et al., 1997; Dissanaike et al., 2001; Alibhoy et al., 2007), 4 cases from Nepal (Sah et al., 2020), including a Nepalese immigrant diagnosed in United Kingdom (Blundell et al., 2022), 3 cases from Indonesia (Bonne, 1942; Margono et al., 2007) and 1 case each of a Myanmar man diagnosed in Thailand (Iampreechakul et al., 2020), a Bangladesh immigrant diagnosed in Switzerland (Gonzenbach et al., 2013), East Timorese refugee diagnosed in Australia (Munckhof et al., 1994; Tran et al., 2019) and a case of a Melanesian man diagnosed in Papua New Guinea (Ashford et al., 1978; Owen, 2005).

In Australia, there have been 5 case reports from 1905 to1994 and 3 cases were added in 2019. The etiological agents of the last 3 cases were identified as *Spirometra mansonoides* (Tran et al., 2019), a species described from North America (Mueller, 1935), but no justification for this identification was given. Human sparganosis has occurred in Australian-born people who had never travelled overseas (Hughes and Biggs, 2002; Tran et al., 2019; Barton et al., 2023). However, most Australians cook meat thoroughly and there is a low risk of disease. Nevertheless, sparganosis is likely an under-recognized zoonotic disease in Australia (Tran et al., 2019).

In addition to case reports of actual plerocercoids, serological tests for sparganosis greatly increase estimates of prevalence. In South Korea, seroprevalence was as high as 3.4% between 1993 and 2006, but it had decreased to 1.6% by 2006 (Lee et al., 2010). In Indonesia, the seroprevalence rates were 2.9%, 6.9% and 2.7% in North Sumatra, Bali and Papua provinces, respectively (Margono et al., 2007). The situation of human sparganosis in North Korea is unknown, but it was reported that 11 (4.1%) of 270 North Korean refugees were seropositive (Shen et al., 2007).

Proliferative sparganosis

Proliferative sparganosis is caused by plerocercoids which can invade various organs, including the subcutaneous tissue, bone and spinal cord, and then proliferate at a single site by continuous branching and budding, producing numerous progeny plerocercoids. The disease begins as a tumour-like subcutaneous nodule and has a poor prognosis, usually resulting in death (Ijima, 1905; Stiles, 1908; Moulinier et al., 1982; Lo et al., 1987; Nakamura et al., 1990; Kikuchi and Maruyama, 2020).

Eighteen cases of proliferative sparganosis were reported worldwide (Kikuchi and Maruyama, 2020), with an additional 5 to be added (Marjoribanks and Le Sueur, 1924; Connor et al., 1976; Lin et al., 1978; LaChance et al., 1983; Olson et al., 2003), bringing the total to 23, 17 of which were in Asia, including 6 in Japan. Other cases reported from Asian countries are listed in Table 2.

Although not all cases yielded abundant plerocercoids, proliferative sparganosis has traditionally been diagnosed based on the peculiar plerocercoid morphology and histology (e.g. Ijima, 1905; Usui, 1909; see Table 2 for others).

Ijima (1905) and Iwata and Inatomi (1972) stated that '*Spa. proliferum*' might be aberrant plerocercoids of the closed related to *L. mansoni* (Ijima, 1905) and *D. erinacei* (= *S. mansoni*) (Iwata and Inatomi, 1972). Although these statements seemed to have been

Table 2. Human sparganosis/spirometrosis reported in Asian and Oceanian regions

Country	No. of cases reported	Sparganosis and spirometrosis (relevant references)
China	1392	Non-proliferative cases from 1949 to 2014 (Liu et al., 2015); at least 31 cases since 2015 (Yu et al., 2016; Du et al., 2018; Luo et al., 2018; Xie et al., 2018; Deng et al., 2019; Fu et al., 2019; Meng et al., 2019; Xie et al., 2019; Wang et al., 2019; Zhu et al., 2019; Fan et al., 2021; Chen et al., 2022a; Chen et al., 2022b; Hu et al., 2022; Liu et al., 2022a; Liu et al., 2022b; Pang et al., 2022; Huang et al., 2023; Lu et al., 2023; Meng et al., 2023; Wen et al., 2023; Niu et al., 2024; Ru et al., 2024; Wang et al., 2024)
	1	Proliferative case (Ho and Huand, 1984)
	22	Spirometrosis (Tu et al., 1973; Wang et al., 2012)
Japan	660	Non-proliferative cases from 1881 to 1999 (Kagei, 2000); at least 114 cases since 2000 (Yamasaki et al., 2007; Yoshikawa et al., 2010; Tappe et al., 2013; Ikuno et al., 2018; Nawa et al., 2025)
	6	Proliferative cases caused by *Sparganum proliferum* (Kikuchi and Maruyama, 2020)
	16	Spirometrosis (Kagei, 2000; Yamaura et al., 2002)
South Korea	456	Non-proliferative cases from 1924 to 2015 (Kim et al., 2018); at least 18 cases since 2015 (Jo et al., 2016; Hong et al., 2017; Jeong et al., 2017; Kim et al., 2017a; Kim et al., 2017b; Choi et al., 2018; Kwon and Kwak, 2018; Ahn et al., 2019a, 2019b*b*; Oh et al., 2019; Wang et al., 2019; Hwang et al., 2020; Kim et al., 2020; Ko et al., 2020; Lee and Choi, 2022; Cho et al., 2024; Park and Peak, 2025)
	1	Proliferative case (Cho et al., 1985)
	2	Spirometrosis (Lee et al., 1984)
North Korea	1	Non-proliferative case (Lee et al., 2018)
Thailand	75	Non-proliferative cases from 1943 to 2005 (Anantaphruti et al., 2011); at least 20 cases since 2005 (Akkarachinorate et al., 2013; Boonyasiri et al., 2013, 2014; Noiphithak and Doungprasert, 2016; Carlson et al., 2017; Winichakoon et al., 2017; Chotmongkol et al., 2018; Muigg et al., 2019; Saksirisampant et al., 2020; Chotmongkol et al., 2021; Iampreechakul et al., 2025a, 2025b)
	3	Proliferative cases (Jirawattanasomkul and Noppakun, 2000; Settakorn et al., 2002; Anantaphruti et al., 2011; Laovachirasuwan *et al*., 2015)
India	27	Non-proliferative cases (Chougule et al., 2023; Kaur and Shukla, 2023; Nawa et al., 2024; Rathore et al., 2024)
Taiwan	25	Non-proliferative cases (Tsai et al., 1993; Chang et al., 1999; Tung et al., 2005; Chiu et al., 2010; Ho et al., 2013; Hong et al., 2013; Hsu et al., 2020; Tsai et al., 2024)
	3	Proliferative sparganosis (Lin et al., 1978; Liao et al., 1984; Lo et al., 1987; Liu et al., 2015)
Hong Kong	12	Non-proliferative cases (Huang and Kirk, 1962; Thk et al., 1989; Ko, 1991; Tang et al., 2017)
The Philippines	6	Non-proliferative cases (Ira-Concepcion, 1935 from Yogore and Tangco, 1953; Eduardo, 1991; Kazanjian and Mattia, 1994; Tang et al., 2017)
	1	Proliferative case (LaChance et al., 1983)
Sri Lanka	5	Non-proliferative cases (Wijesundera et al., 1997; Dissanaike et al., 2001; Alibhoy et al., 2007)
Nepal	4	Non-proliferative cases (Sah et al., 2020; Blundell et al., 2022)
Vietnam	1	Spirometrosis (Le et al., 2017)
Indonesia	3	Non-proliferative cases (Bonne, 1942; Margono et al., 2007)

(*Continued*)

Table 2. (*Continued.*)

Country	No. of cases reported	Sparganosis and spirometrosis (relevant references)
Malaysia	1	Proliferative case (Marjoribanks and Le Sueur, 1924)
Myanmar	1	Non-proliferative case (Iampreechakul et al., 2020)
Bangladesh	1	Non-proliferative case (Gonzenbach et al., 2013)
East Timor	1	Non-proliferative sparganosis (Munckhof et al., 1994; Tang et al., 2017)
Papua New Guinea	1	Non-proliferative sparganosis (Ashford et al., 1978; Owen, 2005)
Australia	8	Non-proliferative cases (Tang et al., 2017)

largely overlooked, Nakamura et al. (1990) supported it, stating that *Spa. proliferum* is not a rare species but an aberrant form of the commonly distributed species, *Spirometra erinacei* (a synonym of *S. erinaceieuropaei*, but actually referring to *S. mansoni*), and speculated that abnormalities in the immune system of the host might play an important role in proliferation.

In proliferative cases reported in Japan, Taiwan, Thailand and Malaysia, the patient's immune status was not documented (Ijima, 1905; Usui, 1909; Inoue, 1911; Yoshida, 1914; Akanuma, 1920; Tashiro, 1921; Marjoribanks and Le Sueur, 1924; Aoshima et al., 1989). A Chinese patient diagnosed with proliferative sparganosis had been treated with anticancer drugs (Ho and Huang, 1984), but the immune status of the patient was unknown.

Overseas, disseminated sparganosis cases have been reported in Hodgkin disease and AIDS patients (Connor et al., 1976; Olson et al., 2003; Meric et al., 2010), possibly due to mutated plerocercoids (Connor et al., 1976).

Schauer et al. (2014) reported a patient who had travelled to Bolivia, Brazil and Paraguay and was diagnosed with *Spa. proliferum* by DNA analysis. However, since the excised single plerocercoid showed neither proliferation nor branching, and the molecular data for the parasite are also not available in GenBank, the identity is uncertain. The authors speculated that *Spa. proliferum* might exhibit proliferative characteristics only in immunocompromised individuals.

In addition to proliferative sparganosis in immunocompromised patients, 3 proliferative sparganosis cases have recently been reported in cat and dogs in Japan, the USA and Australia (Tokiwa et al., 2024; Semenova et al., 2025; Young et al., 2025). Molecular data indicate that the causative species in these cases are all *S. mansoni* (Table 1 and Figure 1). Corticosteroids had been administered for 1 year to relieve itching in the cat case (Tokiwa et al., 2024).

Although the causal relationship between the asexual proliferation of plerocercoids and the immune status is unknown, these findings strongly support Ijima (1905) and Iwata's (1933, 1972) statements that proliferative sparganosis in Asia is likely caused by aberrant plerocercoids of *S. mansoni*, different from *Spa. proliferum* from Venezuela.

While the factor(s) causing plerocercoids to become aberrant remain unknown, transcriptome analysis of proliferative plerocercoids of Venezuelan *Spa. proliferum* has identified some genes involved in proliferation (Kikuchi et al., 2021), As mentioned above, some reports suggest that the host's immune status may be involved in asexual proliferation and aberrant forms, but this remains an issue that requires further investigation.

We consider that the species causing proliferative sparganosis in Asia and Oceania is *S. mansoni* and/or *S. asiana*, although there is as-yet no evidence that *S. asiana* causes proliferative sparganosis.

Spirometrosis

Spirometrosis (infection with adults) in humans rarely occurs. The adult worm usually inhabits the small intestine, producing symptoms that are generally mild, such as abdominal distension and diarrhoea (Kagei, 2000; Yamaura et al., 2002; Le et al., 2017). Twenty-two cases have been reported in China since 1932 (Tu et al., 1973; Wang et al., 2012). In Japan, 16 cases have been reported (Kagei, 2000; Yamaura et al., 2002), and 2 and 1 cases have been reported in South Korea (Lee et al., 1984) and Vietnam (Le et al., 2017), respectively (Table 2).

Infections with adult tapeworms reported in tropical regions in Asia (e.g. India and Bangladesh) where *Dibothriocephalus* species are not known to occur should be re-evaluated and the possibility of spirometrosis is considered (Kuchta et al., 2024).

In remote areas where patients with suspected sparganosis and spirometrosis often reside, hospitals and laboratory facilities may be poorly established, and infected individuals may not seek medical attention. There is thus likely to be a substantial under-reporting of sparganosis and spirometrosis. The numbers of the cases shown in Table 2 are probably very underestimated, especially in countries where sparganosis is endemic due to dietary habits of eating flesh of tadpoles, frogs and snakes and the use of frog meat as a traditional poultice in China (Li et al., 2011; Lu et al., 2014; Liu et al., 2015; Cui et al., 2017), South Korea (Liu et al., 2015), Thailand (Wiwanitkit, 2005; Anantaphruti et al., 2011; Saksirisampant et al., 2020), Myanmar (Chai et al., 2020) and Indonesia (Prasetyo and Safitri, 2019).

To date, no human sparganosis or spirometrosis cases have been reported in Lao PDR, Cambodia and Singapore. However, *Spirometra* infections have been confirmed in reptiles, amphibians and mammals in these countries (Okamoto et al., 2007; Jongthawin et al., 2014; Kavana et al., 2014; Sato et al., 2017; Jeon et al., 2018b; Ahasan et al., 2020; Thanchomnang et al., 2021; Yamasaki et al., 2021; Yudhana et al., 2021; Zendejas-Heredia et al., 2023; Kuchta et al., 2024; Nguyen et al., 2024), Iran (Badria et al., 2017), Guam Island (Holldorf et al., 2015) and New Zealand (Ugarte et al., 2005), although the species identified as *S. erinaceieuropaei* in these countries has been re-assigned to *S. mansoni* (Yamasaki et al., 2021, 2024b; Kuchta et al., 2024) (Figure 2).

Serodiagnosis of sparganosis

Various serological methods that detect specific IgG against *Spirometra* infections have been established using native and recombinant antigens. Platforms used for these include enzyme-linked immunosorbent assay (ELISA) (Lee et al., 2002; Cui et al., 2011; Rahman et al., 2014; Choi, 2024), multidot-ELISA (Nakamura-Uchiyama, 2005) and western blot (Chung et al., 2000; Rahman et al., 2011; Lu et al., 2021). These methods are labour-intensive and require sophisticated equipment and skilled technicians. Recently, innovative immunochromatography-based diagnostic tools (ICT) are being developed as alternatives to the conventional methods (Yamasaki et al., 2014, 2018, 2024a; Harasan et al., 2025). Detailed accounts of the principles of the ICT are available in Janwan et al. (2021) and Rodpai et al. (2021).

We initially developed an ICT kit for rapid diagnosis of sparganosis (Yamasaki et al., 2014), but later the kit was improved to test for larval migrans due to sparganosis, toxocariasis and gnathostomiasis on a single panel (Figure 4A) (Yamasaki et al., 2018). The kit has perforations so that individual tests can be removed and used alone (Figure 4B,C). Such tests are simple to perform: briefly, 5 uL of serum diluted in running buffer is applied into a well that is marked 'S'. Next, 60 uL of running buffer is applied into the well marked 'B'. ICT results are read at 15 min with the naked eye and judged as positive or negative by reference to a colour board, with the cutoff for positivity set at an intensity of 0.5. The appearance of red bands at the T-line and the C-line indicate a positive test (Figure 4), whereas only the C-line appears in a negative case.

The kit is useful not only for the diagnosis of *S. mansoni* and *S. asiana* infections and for follow-up after treatment but is also applicable for field surveys for sparganosis cases (Yamasaki et al., 2021, 2024a; Harasan et al., 2025). Since the kit occasionally shows cross-reactions with cysticercosis, careful consideration of factors

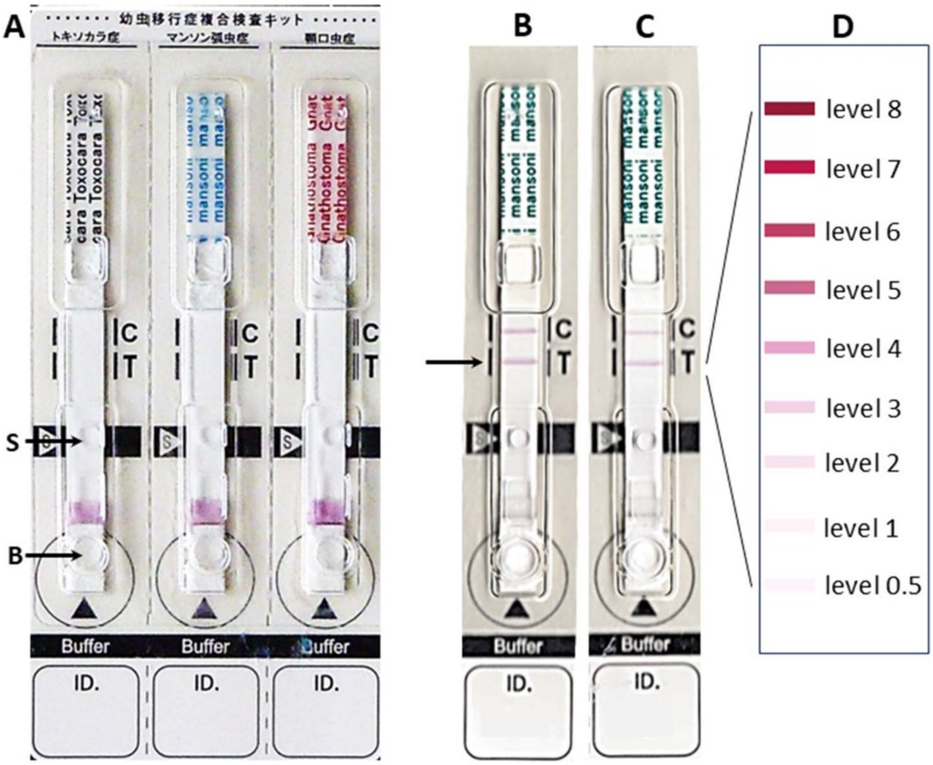

Figure 4. Immunochromatography-based point-of-care tool for the serodiagnosis of species causing larva migrans. (A) Device for toxocariasis (left), sparganosis (middle) and gnathostomiasis (right). Diagnostic results for *Spirometra mansoni* (B) and *Spirometra asiana* infections (C) using separate devices (Yamasaki et al., 2024a). (D) Colour board for evaluation. Wells S and B are for applying serum (or whole blood) and running buffer, respectively. An arrow at the T-lines (B, C) indicates the appearance of the positive bands.

such as dietary history, history of overseas travel and imaging findings is required when determining a diagnosis (Yamasaki et al., 2014).

It is expected that the ICT kits can also be used to diagnose proliferative sparganosis in South America, although this has not yet been tested to date. The ICT format has recently been modified to use whole blood instead of serum (Harasan et al., 2025) but this format is not yet commercially available.

Conclusions and perspectives

This review has summarized the latest information about the identities of *Spirometra* species and the current situation of sparganosis and spirometrosis in Asia and Oceania. Despite their importance as foodborne diseases, sparganosis and spirometrosis are neglected parasitic diseases in both developing and developed countries, and few public-health strategies exist for their prevention and control. Recently, it has been confirmed that *S. mansoni* can cause proliferative sparganosis in the Asia–Oceania region. Therefore, physicians, veterinarians and related professionals should be aware of the following: (i) the *Spirometra* species present in Asia–Oceania region are *S. mansoni* and *S. asiana*, but not *S. erinaceieuropaei*, (ii) if proliferative sparganosis is suspected, the causative species should not be identified to be *Spa. proliferum* based on morphological characteristics alone of the plerocercoids. Heavy or multiple infections caused by *S. mansoni* and/or *S. asiana* should be considered. Molecular identification is indispensable for diagnosing the causative species, (iii) *S. asiana* is a recently discovered species, and little is known about its biology, geographical distribution and pathogenicity in humans, further data are needed, and (iv) since wild boars serve as paratenic hosts for both *S. mansoni* and *S. asiana*, it is important to thoroughly cook wild boar meat to prevent infection.

Acknowledgements. We thank David Blair (James Cook University, Australia) for valuable suggestions, English editing and assistance with this paper's presentation through the National Research Council of Thailand (NRCT): High-Potential Research Team Grant Program (Contract no. N42A670561 to WM) and Roman Kuchta (Czech Academy of Sciences) for valuable comments on *Sparganum proliferum*. We also express our deep gratitude Oranuch Sanpool, Lakkhana Sadaow, Patcharaporn Boonroumkaew (Khon Kaen University and Mekong Health Science Research Institute, Thailand), Rutchanee Rodpai (Nakhonratchasima College, Thailand), Tongjit Thanchomnang (Mahasarakham University, Thailand), Penchom Janwan (Walailak University, Thailand), Sakhone Laymanivong (Ministry of Health, Lao PDR), Win Pa Pa Aung (University of Medicine 2, Myanmar), Yasuyuki Morishima and Hiromu Sugiyama (Japan Institute of Health Security, Japan) for collaborative research, and Naoko Wakiya, Miou Hisada and Mariko Yamashita (Japan Institute of Health Security, Japan) for their efforts in obtaining many references.

Author contributions. HY wrote the first draft of the manuscript and prepared the figures and table. PMI and WM reviewed and edited the manuscript. HY, PMI and WM approved the final version of the manuscript for submission.

Financial support. We have no financial support for preparing this review.

Competing interests. The authors declare no competing interests.

Ethical standards. Not applicable.

References

Ahasan SA, Azam S, Mohanto K, Rahman S, Islam MT, Anisuzzaman, Khan M, Begum NJ and Chowdhury EH (2020) Spirometrosis in Asiatic lion (*Panthera leo persica*) at the national zoo: Trace back to epidemiological studies reveals the potential risk of human sparganosis in Bangladesh. *IOSR Journal of Agriculture and Veterinary Science* **13**, 28–36.

Ahn JH, Yi JY, Kim SJ and Hur MH (2019a) Recurrent ipsilateral breast sparganosis: A case report. *Journal of Breast Diseases* **7**, 113–116 (cited in Table 2).

Ahn SK, Choi HJ and Kim JH (2019b) Subcutaneous sparganosis on abdomen mimicking multiple lipomas. *Korean Journal of Parasitology* **57**, 513–516 (cited in Table 2).

Akanuma N (1920) Postmortem findings of a case of *Plerocercoides prolifer* infection. *Iji-Shinbun* **1039**, 129–142 (in Japanese).

Akkarachinorate K, Udnan P, Chaisiri K, Komalamisra C, Dekumyoy P, Pakdee W, Praevanich R, Mongkhonmu S and Watthanakulpanich D (2013) Subcutaneous larva migrans of a sparganum in a gnathostomiasis-endemic area. *Case Reports in Clinical Medicine* **2**, 530–534.

Alarcón de Noya B, Torres JR and Noya O (1992) Maintenance of *Sparganum proliferum in vitro* and in experimental animals. *Internal Journal for Parasitology* **22**, 835–838. https://doi.org/10.1016/0020-7519(92)90135-8 (cited in Table 1).

Alibhoy AT, Fernando R and Perera F (2007) A case of cerebral sparganosis. *Ceylon Medical Journal* **52**, 93–94.

Alvarado-Hidalgo I, Campos-Camacho J, Arguedas-Morales Y, Romero-Vega LM, Alfaro-Alarcón A, Anchia-Ureña G, Bass LG, Berrocal-Ávila I, Hagnauer I, Olivares RWI, Solano-Barquero A, Traube-Rivera R, Montenegro-Hidalgo V and Rojas A (2024) Molecular, morphological and histopathological evidence of *Spirometra mansoni* in wild and domestic animals from Costa Rica. *Veterinary Parasitology: Regional Studies and Reports* **51**, 101030.

Anantaphruti MT, Nawa Y and Vanvanitchai Y (2011) Human sparganosis in Thailand: An overview. *Acta Tropica* **118**, 171–176.

Aoshima M, Nakata K, Matsuoka M, Kawabata M and Nakamura T (1989) A case of proliferative sparganosis associated with PIE syndrome and pulmonary embolism. *Nihon Koyuobu-Shikkan-Gakkai Zasshi* **27**, 1521–1527 in Japanese with English abstract.

Arrabal JP, Pérez MG, Arce LF and Kamenetzky L (2020) First identification and molecular phylogeny of *Sparganum proliferum* from endangered felid (*Panthera onca*) and other wild definitive hosts in one of the regions with highest worldwide biodiversity. *International Journal for Parasitology: Parasites and Wildlife* **13**, 142–149.

Ashford RW, Murthy DP and Parsons GA (1978) A case of sparganosis in Papua New Guinea. *Papua New Guinea Medical Journal* **21**, 347–348.

Badria M, Eslahi AV, Majidiania H and Pirestani M (2017) *Spirometra erinaceieuropaei* in a wildcat (*Felis silvestris*) in Iran. *Veterinary Parasitology: Regional Studies and Reports* **10**, 58–61.

Barton DP, Fahey H, Jenkins DJ and Shamsi S (2023) Zoonotic parasites in feral animals commonly consumed in Australia – Is there a risk? *Current Clinical Microbiology Reports* **10**, 66–73.

Bennett HM, Mok HP, Gkrania-Klotsas E, Tsai IJ, Stanley EJ, Antoun NM, Coghlan A, Harsha B, Traini A, Ribeiro DM, Steinbiss S, Lucas SB, Allinson KSJ, Price SJ, Santarius TS, Carmichael AJ, Chiodini PL, Holroyd N, Dean AF and Berriman M (2014) The genome of the sparganosis tapeworm *Spirometra erinaceieuropaei* isolated from the biopsy of a migrating brain lesion. *Genome Biology* **15**, 510.

Bianchi AB, Navonne NM and Conti CJ (1991) Detection of loss of heterozygosity in formalin-fixed paraffin-embedded tumor specimens by polymerase chain reaction. *American Journal of Pathology* **138**, 279–284.

Blundell S, Deshmukh M and McGregor A (2022) A painful breast mass. *Clinical Infectious Diseases* **75**, 2275–2277.

Bonne C (1942) Researches on sparganosis in the Netherlands East Indies. *American Journal of Tropical Medicine and Hygiene* **22**, 643–645.

Boonyasiri A, Cheunsuchon P, Srirabheebhat P, Yamasaki H, Maleewong W and Intapan PM (2013) Sparganosis presenting as cauda equina syndrome with molecular identification of the parasite in tissue sections. *Korean Journal of Parasitology* **51**, 739–742.

Boonyasiri A, Cheunsuchon P, Suputtamongkol Y, Yamasaki H, Sanpool O, Maleewong W and Intapan PM (2014) Nine human sparganosis cases in Thailand with molecular identification of causative parasite species. *American Journal of Tropical Medicine and Hygiene* **91**, 389–393.

Brabec J, Uribe M, Chaparro-Gutiérrez JJ and Hermosilla C (2022) Presence of *Spirometra mansoni*, causative agent of sparganosis, in South America. *Emerging Infectious Diseases* **28**, 2347–2350.

Bray RA, Jones A and Andersen KI (1994) Order Pseudophyllidea Carus, 1863. In Khalli LF, Jones A and Bray RA (eds.), *Key to the Cestode Parasites of Vertebrates*. Wallingford, USA: CAB International, 236–242.

Carlson AL, Pruetpongpun N, Buppajarntham A, Damronglerd P, Anderson NW and Apisarnthanarak A (2017) The brief case: Central nervous system sparganosis in a 53-year-old Thai man. *Journal of Clinical Microbiology* **55**, 352–355 (cited in Table 2).

Chai JY, Jung BK, Ryu JY, Kim HS, Hong SJ, Htoon TT, Tin HH, Na BK and Sohn WM (2020) Larval gnathostomes and spargana in Chinese edible frogs, *Hoplobatrachus rugulosus*, from Myanmar: Potential risk of human infection. *Korean Journal of Parasitology* **58**, 467–473.

Chang JH, Lin OS and Yeh KT (1999) Subcutaneous sparganosis – a case report and a review of human sparganosis in Taiwan. *Kaohsiung Journal of Medical Sciences* **15**, 567–571.

Chen XY, Fang YY, Tao LM, Liu M and Liang K (2022a) A case of ocular sparganosis in China: Episode of migration from muscle cone to subconjunctiva. *Korean Journal of Parasitology* **60**, 419–421 (cited in Table 2).

Chen Y, Chen X and Kang HC (2022b) Case report: Moving tumor-like foci behind refractory epilepsy-cerebral sparganosis successfully treated by surgery after failure of praziquantel treatment. *Frontiers in Neurology* **13**, 838849 (cited in Table 2).

Chiu CH, Chiou TL, Hsu YH and Yen PS (2010) MR spectroscopy and MR perfusion character of cerebral sparganosis: A case report. *British Journal of Radiology* **83**, e31–e34.

Cho BK, Chun CS, Choi WY and Cho SY (1985) A case of unusual sparganosis. *Korean Journal of Dermatology* **23**, 672–677 in Korean with English abstract.

Cho D, Park HY and Yoon JS (2024) Sparganosis in unilateral eyelid swelling patient. *Ophthalmic Plastic & Reconstructive Surgery* **40**, 715 (cited in Table 2).

Choi KS, Kang SH and Park GC (2018) A case of sparganosis in subcutaneous tissue of neck. *Journal of Clinical Otolaryngology* **29**, 307–310 (cited in Table 2) in Korean with English abstract.

Choi MH (2024) Serological diagnosis of tissue-invading parasites in Korea. *Annals of Clinical Microbiology* **27**, 81–91.

Chotmongkol V, Intapan PM and Jingjit K (2018) Dual cestode infection in a Thai patient (spinal sparganosis and racemose neurocysticercosis): A case report. *American Journal of Case Reports* **19**, 1090–1095 (cited in Table 2).

Chotmongkol V, Phuttharak W, Jingjit K, Chaisuriya N, Sanpool O, Chaichan S and Khamsai S (2021) Case report: Sparganosis of the cauda equina. *American Journal of Tropical Medicine and Hygiene* **104**, 298–302 (cited in Table 2).

Chougule MV, Mohite A, Joshi VP and Agrawal A (2023) Cerebral sparganosis: Rare parasitic infection of the brain. *Egyptian Journal of Neurosurgery* **38**, 72.

Chung YB, Kong Y, Yang HJ and Cho SY (2000) IgG antibody responses in early experimental sparganosis and IgG subclass responses in human sparganosis. *Korean Journal of Parasitology* **38**, 145–150.

Cobbold TS (1883) Description of *Ligura mansoni*, a new human cestode. *Zoological Journal of the Linnean Society* **17**, 78–83.

Connor DH, Sparks AK, Strano AJ, Neafie RC and Juvelier B (1976) Disseminated parasitosis in an immunosuppressed patient. Possibly a mutated sparganum. *Archives of Pathology and Laboratory Medicine* **100**, 65–68.

Cui J, Li N, Wang ZQ, Jiang P and Lin XM (2011) Serodiagnosis of experimental sparganum infections of mice and human sparganosis by ELISA using ES antigens of *Spirometra mansoni* spargana. *Parasitology Research* **108**, 1551–1556.

Cui J, Wang Y, Zhang X, Lin XM, Zhang HW, Wang ZQ and Chen JX (2017) A neglected risk for sparganosis: Eating live tadpoles in central China. *Infectious Diseases of Poverty* **6**, 58.

Deng K, Cui J, Qin Y, Zhu Y and Feng GZ (2019) First report of sparganosis manifested by pleuritis and decreased peripheral blood eosinophils in Jiangsu province, China. *Parasitology Research* **118**, 1653–1658 (cited in Table 2).

Diesing CM (1854) Über eine naturgemässe Vertheilung der Cephalocotyleen. Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Wien, Mathematisch-Naturwissenschaftliche Classe. *Wien* **13**, 556–616.

Dissanaike AS, Anthonis PR, Sheriffdeen AH, Ihalamulla RL and Karunaweera ND (2001) Two more cases of sparganosis from Sri Lanka. *Ceylon Journal of Medical Science* **44**, 19–22.

Du B, Tao Y, Ma J, Weng X, Gong Y, Lin Y, Shen N, Mo X and Cao Q (2018) Identification of sparganosis based on next-generation sequencing. *Infection Genetics & Evolution* **66**, 256–261.

Eduardo SL (1991) Food-borne parasitic zoonoses in the Philippines. *Southeast Asian Journal of Tropical Medicine and Public Health* **22**(Suppl), 16–22.

Eom KS, Park H, Lee D, Choe S, Kang Y, Bia MM, Lee SH, Keyyu J, Fyumagwa R and Jeon HK (2018) Molecular and morphologic identification of *Spirometra ranarum* found in the stool of African lion, *Panthera leo* in the Serengeti plain of Tanzania. *Korean Journal of Parasitology* **56**, 379–383.

Fan JF, Huang S, Li J, Peng RJ, Huang H, Ding XP, Jiang LP and Xi J (2021) A human case of lumbosacral canal sparganosis in China. *Korean Journal of Parasitology* **59**, 635–638 (cited in Table 2).

Faust EC, Campbell HE and Kellogg CR (1929) Morphological and biological studies on the species of *Diphyllobothrium* in China. *American Journal of Hygiene* **9**, 560–583.

Fredes F, Mercado R, Salas IP, Sugiyama H, Kobayashi H and Yamasaki H (2022) Morphological observation and molecular phylogeny of *Spirometra decipiens* complex 1 (Cestoda: Diphyllobothriidae) found in cat from Chile. *Parasitology International* **87**, 102493.

Fu YJ, Ding XP, Li QY, Liu DY, Yang ZQ and Feng L (2019) Intraspinal *Sparganum mansoni* infection with extraction of a live adult worm. *Neurology: Clinical Practice* **9**, 472–474 (cited in Table 2).

Gonzenbach RR, Kong Y, Beck B, Buc A, Weller M and Semmler A (2013) High-dose praziquantel therapy for cerebral sparganosis. *Journal of Neurology* **260**, 1423–1425.

Harasan J, Sadaow L, Boonroumkaew P, Rodpai R, Sanpool O, Yamasaki H, Intapan PM and Maleewong W (2025) Development of an immunochromatographic test for serodiagnosis of human sparganosis. *Parasitology Research* **124**, 128.

Ho TH, Lin MC, Yu WW, Lai PH, Sheu SJ and Bee YS (2013) Ocular sparganosis mimicking an orbital idiopathic inflammatory syndrome. *Orbit* **32**, 395–398.

Ho YM and Huand GM (1984) A case of proliferating sparganosis. *Acta Academiae Medicinae Zhong Shan* **5**, 67–69 in Chinese with English abstract.

Holldorf ET, Siers SR, Richmond JQ, Klug PE and Reed RN (2015) Invaded invaders: Infection of invasive brown treesnakes on Guam by an exotic larval cestode with a life cycle comprised of non-native hosts. *PLoS One* **10**, e0143718.

Hong D, Xie H, Zhu M, Wan H, Xu R and Wu Y (2013) Cerebral sparganosis in mainland Chinese patients. *Journal of Clinical Neuroscience* **20**, 1514–1519.

Hong SH, Kim T, Lee JM, Kim MJ and Kim SH (2017) A 63-year-old Korean woman with abnormal magnetic resonance imaging results. *Clinical Infectious Diseases* **65**, 1421–1422.

Hsu TH, Chung TT, Chen YA and Chung AH (2020) Cauda equina syndrome secondary to extramedullary spinal sparganosis. *Formosan Journal of Surgery* **53**, 230–232.

Hu JL, Liao KL, Feng XJ, Jiang DL, Liu HL, Zheng QC, Qiu H, Hua FZ, Xu GH and Xu CH (2022) Surgical treatment of a patient with live intracranial sparganosis for 17 years. *BMC Infectious Diseases* **22**, 353 (cited in Table 2).

Huang CT and Kirk R (1962) Human sparganosis in Hong Kong. *Journal of Tropical Medicine and Hygiene* **65**, 133–138.

Huang X, Jia C, Zhan Y, Fu S and Zhang H (2023) Subcutaneous sparganosis: A case report and literature review. *International Journal of Dermatology* **62**, 1067 (cited in Table 2).

Hughes AJ and Biggs BA (2002) Parasitic worms of the central nervous system: An Australian perspective. *Internal Medical Journal* **32**, 541–553.

Hwang JM, Hwang DS, Kang C and Lee JW (2019) Subcutaneous sparganosis mimicking soft tissue tumor: A case report. *International Medical Case Reports Journal* **12**, 47–50 (cited in Table 2).

Hwang M, Baek HJ and Lee SM (2020) Apparent sparganosis presenting as a palpable neck mass: A case report and review of literature. *Journal of the Korean Society of Radiology* **81**, 1210–1215 (cited in Table 2).

Iampreechakul P, Angsusing C, Hangsapruek S, Thammachantha S and Tanpun A (2025a) Sparganosis of the cauda equina: A rare case of lower thoracic cord edema and diagnostic challenges. *Asian Journal of Neurosurgery* **20**, 378–382 (cited in Table 2).

Iampreechakul P, Tirakotai W, Lertbutsayanukul P, Khunvutthidee S, Thammachantha S and Siriwimonmas S (2020) Spinal sparganosis coexisting with acquired arteriovenous fistula of the filum terminale. *World Neurosurgery* **136**, 341–347.

Iampreechakul P, Wangtanaphat K, Angsusing C, Hangsapruek S, Lertbutsayanukul P, Kiathirannon N, Thammachantha S, Tanpun A and Komonchan S (2025b) Disseminated and migratory sparganosis in the central nervous system: A case report and literature review of combined spinal and intracranial involvement. *Surgical Neurology International* **16**, 189 (cited in Table 2).

Ijima I (1905) On a new cestode larva parasitic in man (*Plerocercoides proliferum*). *The Journal of the College of Science, Imperial University of Tokyo, Japan* **20**, 1–20.

Ikuno H, Akao S and Yamasaki H (2018) Epidemiology of *Diphyllobothrium nihonkaiense* diphyllobothriosis, Japan, 2001–2016. *Emerging Infectious Diseases* **24**, 1428–1434.

Inoue G (1911) A case of *Plerocercoides prolifer*. *Japanese Journal of Dermatology and Urology* **12**, 622–624.

Iwata S (1933) Some experimental and morphological studies on the post-embryonal development of Manson's tapeworm *Diphyllobothrium erinacei* (Rudolphi). *Japanese Journal of Zoology* **5**, 210–247.

Iwata S (1972) Experimental and morphological studies of Manson' tapeworm, *Diphyllobothrium erinacei* (Rudolphi), special reference with its scientific name and relationship with *Sparganum proliferum* Ijima. *Progress of Medical Parasitology in Japan* **4**, 537–590.

Iwata S and Inatomi S (1972) On the branched plerocercoid (*Sparganum proliferum*) from Japanese snake. *Progress of Medical Parasitology in Japan* **4**, 587–590.

Janwan P, Intapan PM, Sadaow L, Rodpai R, Yamasaki H, Boonroumkaew P, Sanpool O, Thanchomnang T, Sadee P and Maleewong W (2021) Development of immunochromatographic test kit for rapid detection of specific IgG4 antibody in whole-blood samples for diagnosis of human gnathostomiasis. *Diagnostics* **11**, 862.

Jeon HK and Eom KS (2018) Spirometra. In Liu DY (ed.), *Handbook of Foodborne Diseases*. Boca Raton, USA: CRC Press, 709–714.

Jeon HK, Kim KH, Sohn WM and Eom KS (2018a) Differential diagnosis of human sparganosis using multiplex PCR. *Korean Journal of Parasitology* **56**, 295–300.

Jeon HK, Park H, Lee D, Choe S, Kim KH, Huh S, Sohn WM, Chai JY and Eom KS (2015) Human infections with *Spirometra decipiens* plerocercoids identified by morphologic and genetic analyses in Korea. *Korean Journal of Parasitology* **53**, 299–305.

Jeon HK, Park HS, Lee DG, Choe SG, Kang YS, Bia MM, Lee SH, Sohn WM, Hong SJ, Chai JY and Eom KS (2018b) Genetic and morphologic identification of *Spirometra ranarum* in Myanmar. *The Korean Journal of Parasitology* **56**, 275–280.

Jeong MK, Baik JH, An YY and Choi HJ (2017) Breast sparganosis mimicking ipsilateral breast tumor recurrence in a patient with a history of breast conserving surgery: A case report. *Iranian Journal of Radiology* **14**, e41599 (cited in Table 2).

Jirawattanasomkul S and Noppakun N (2000) Human sparganosis in Thailand. *Thai Journal of Dermatology* **16**, 131–135 (in Thai with English abstract).

Jo GD, Lee JY, Hong ST, Kim JH and Han JK (2016) Presumptive case of sparganosis manifesting as a hepatic mass: A case report and literature review. *World Journal of Radiology* **8**, 846–850.

Jongthawin J, Intapan PM, Sanpool O, Sadaow L, Laymanivong S, Thanchomnang T and Maleewong W (2014) Molecular evidence of

Spirometra erinaceieuropaei infection in snakes *Ptyas korros* from Lao PDR and Thailand and frogs *Hoplobatrachus rugulosus* from Myanmar. *Southeast Asian Journal of Tropical Medicine and Public Health* **45**, 1271–1278.

Kagei N (2000) Foodborne parasitic diseases: Sparganosis mansoni. *SRL Hokan* **24**, 115–121 (in Japanese).

Kanpittaya J, Boonsawad W, Intarapoka B, Kularbkaew C, Tesana S and Tantisirintr C (1995) A reported case of pulmonary sparganosis: Radiological aspect and review of articles. *ASEAN Journal of Radiology* **1**, 7–11.

Kaur S and Shukla P (2023) Cerebral sparganosis masquerading brain neoplasm: A rare incidental case. *Indian Journal of Medical Microbiology* **41**, 101–103.

Kavana NJ, Lim LHS and Ambu S (2014) The life-cycle of *Spirometra* species from Peninsular Malaysia. *Tropical Biomedicine* **31**, 487–495.

Kazanjian PH and Mattia AR (1994) Case 26-1994 – A 20-year-old Philippine woman with a soft-tissue mass in the forearm. *New England Journal of Medicine* **330**, 1887–1893.

Kikuchi T, Dayi M, Hunt VL, Ishiwata K, Toyoda A, Kounosu A, Sun S, Maeda Y, Kondo Y, Alarcón de Noya B, Alarcón de Noya O, Kojima S, Kuramochi T and Maruyama H (2021) Genome of the fatal tapeworm *Sparganum proliferum* uncovers mechanisms for cryptic life cycle and aberrant larval proliferation. *Communications Biology* **4**, 649.

Kikuchi T and Maruyama H (2020) Human proliferative sparganosis update. *Parasitology International* **75**, 102036.

Kim BM, Kim DJ, Chang MY, Kim YJ, Kim JH and You JK (2020) Axillary sparganosis, changes in ultrasound images over six months: A case report. *Radiology Case Reports* **15**, 177–180 (cited in Table 2).

Kim HS, Shin MS, Kim CJ, You SH, Eom YH, Yoo TK, Lee A, Song BJ and Chae BJ (2017a) Sparganosis of the unilateral breast: A case report *Korean Journal of Parasitology* **55**, 421–424 (cited in Table 2) https://doi.org/10.3347/kjp.2017.55.4.421.

Kim JG, Ahn CS, Sohn WM, Nawa Y and Kong Y (2018) Human sparganosis in Korea. *Journal of Korean Medical Science.* **33**, e273.

Kim SM, Amponsah EK, Eo MY, Cho YJ and Lee SK (2017b) Clinical manifestation of a patient with forehead sparganosis. *Journal of Craniofacial Surgery* **28**, 1081–1083 (cited in Table 2).

Ko BC, Park HJ, Oh JH, Ham SP and Park HJ (2020) A case of sparganosis of the lower extremities. *The Korean Journal of Dermatology* **58**, 427–428 (cited in Table 2).

Ko RC (1991) Current status of food-borne parasitic zoonoses in Hong Kong. *Southeast Asian Journal of Tropical Medicine and Public Health* **22**(Suppl), 42–47.

Kokaze A, Miyadera H, Kita K, Machinami R, Noya O, Alarcón de Noya B, Okamoto M, Horii T and Kojima S (1997) Phylogenetic identification of *Sparganum proliferum* as a pseudophyllidean cestode. *Parasitology International* **46**, 271–279.

Koonmee S, Intapan PM, Yamasaki H, Sugiyama H, Muto M, Kuramochi T, Kularbkeaw J, Kanpittaya J, Maleewong W and Nawa Y (2011) Molecular identification of a causative parasite species using formalin-fixed paraffin embedded (FFPE) tissues of a complicated human pulmonary sparganosis case without decisive clinical diagnosis. *Parasitology International* **60**, 460–464.

Kuchta R, Kołodziej-Sobocińska M, Brabec J, Młocicki D, Salamatin R and Scholz T (2021) Sparganosis (*Spirometra*) in Europe in the molecular era. *Clinical Infectious Diseases* **72**, 882–890.

Kuchta R, Phillips AJ and Scholz T (2024) Diversity and biology of *Spirometra* tapeworms (Cestoda: Diphyllobothriidea), zoonotic parasites of wildlife: A review. *International Journal for Parasitology: Parasites and Wildlife* **24**, 100947.

Kudo T, Fujioka A, Korenaga M, Yamasaki H, Morishima Y, Sugiyama H, Nakajima H and Sano S (2017) Molecular identification of intramuscular and subcutaneous *Spirometra erinaceieuropaei* sparganosis in a Japanese patient. *Journal of Dermatology* **44**, e138–e139.

Kwon OC and Kwak BS (2018) Breast sparganosis: A case report. *Journal of Parasitic Diseases* **42**, 442–443 (cited in Table 2).

LaChance MA, Clark RM and Connor DH (1983) Proliferating larval cestodiasis: Report of a case. *Acta Tropica* **40**, 391–397.

Laovachirasuwan P, Mootsikapun P, Maleewong W and Intapan PM (2015) Intraosseous proliferative sparganosis presenting as a pathological fracture: A case report and review of the literature. *Southeast Asian Journal of Tropical Medicine and Public Health* **46**, 558–563 (cited in Table 2).

Le AT, Lqt D, Nguyen HBT, Nguyen HNT and Do AN (2017) Case report: The first case of human infection by adult of *Spirometra erinaceieuropaei* in Vietnam. *BMC Infectious Diseases* **17**, 669.

Lee DG and Choi EJ (2022) Sparganosis presenting with pruritus and myoclonus. *OSP Journal of Case Reports* **4**, JCR–4–155 (cited in Table 2).

Lee KJ, Bae YT, Kim DH, Deung YK and Ryang YS (2002) A seroepidemiologic survey for human sparganosis in Gangweon-do. *Korean Journal of Parasitology* **40**, 177–180.

Lee MK, Hong SJ and Kim HR (2010) Seroprevalence of tissue invading parasitic infections diagnosed by ELISA in Korea. *Journal of Korean Medical Science.* **25**, 1272–1276.

Lee SH, Chai JY, Seo BS and Cho SY (1984) Two cases of human infection by adult of *Spirometra erinacei*. *Korean Journal of Parasitology* **22**, 66–71.

Lee SH, Nam SJ, Lee SJ, Kang CD, Choi DH, Choi JW and Lee SK (2018) Praziquantel treatment of eosinophilic gastritis suspected to be due to cerebral sparganosis. (in Korean with English abstract) *Korean Journal of Medicine* **93**,473–476. https://doi.org/10.3904/kjm.2018.93.5.473.

Li MW, Song HQ, Li C, Lin HY, Xie WT, Lin RQ and Zhu XQ (2011) Sparganosis in mainland China. *International Journal of Infectious Diseases* **15**, e154–e156.

Liao SW, Lee TS, Shih TP, Ho WL and Chen ER (1984) Proliferating sparganosis in lumber spine – A case report. *Journal of the Formosan Medical Association* **83**, 603–611 in Chinese with English abstract.

Lin TP, Su IJ, Lu SC and Yang SP (1978) Pulmonary proliferating sparganosis. A case report. *Journal of the Formosan Medical Association* **77**, 467–472.

Liu C, Chen Z, Shaban UT, Wang M, Zhou GQ, Wang N and Liu Y (2022a) Misdiagnosis of cerebral sparganosis coexisting with HIV/AIDS: A case report. *International Journal of Infectious Diseases* **117**, 264–266 (cited in Table 2).

Liu J, Zhang S, Guo H, Feng K and Jiang Q (2022b) Free-living sparganosis in the lumbosacral spine with long latency. *Lancet Infectious Diseases* **22**, 742 (cited in Table 2).

Liu Q, Li MW, Wang ZD, Zhao GH and Zhu XQ (2015) Human sparganosis, a neglected food borne zoonosis. *The Lancet Infectious Diseases* **15**, 1226–1235.

Lo YK, Chao D, Yan SH, Liu HC, Chu FL, Huang CI, Chang T and Liu HC (1987) Spinal cord proliferative sparganosis in Taiwan: A case report. *Neurosurgery* **121**, 235–238.

Lu C, Jin P, Liu Y, Li H, Liu C, Qiu M, Gou T, Jiang J, Meng X, Wang G and Mao H (2023) A case report and literature review of breast sparganosis. *Annals of Clinical and Medical Case Reports* **11**, 1–4 (cited in Table 2).

Lu G, Shi DZ, Lu YJ, Wu LX, Li LH, Rao CY and Yin FF (2014) Retrospective epidemiological analysis of sparganosis in mainland China from 1959 to 2012. *Epidemiology & Infection* **142**, 2654–2661.

Lu Y, Sun JH, Lu LL, Chen JX, Song P, Ai L, Cai YC, Li LH and Chen SH (2021) Proteomic and immunological identification of diagnostic antigens from *Spirometra erinaceieuropaei* plerocercoid. *Korean Journal of Parasitology* **59**, 615–623.

Luo B, Yang YF, Zheng MH, Zhou BY and Liu H (2018) A case report of perineal sparganosis mansoni from an endemic region. *Tropical Biomedicine* **35**, 487–491 (cited in Table 2).

Margono SS, Sutjahyono RW, Kurniawan A, Nakao M, Mulyani T, Wandra T and Ito A (2007) Diphyllobothriasis and sparganosis in Indonesia. *Tropical Medicine and Health.* **35**, 301–305.

Marjoribanks RM and Le Sueur EJO (1924) A case of *Sparganum prolifer*. Infection. (Preliminary note). *Transactions of the Royal Society of Tropical Medicine and Hygiene*. **18**, 70.

Masuya M, Aizawa H, Shirai W, Tokumitsu N, Sako K and Sugano S (2008) A case of sparganosis resected alive plerocercoid. *Journal of Nayoro City Hospital* **16**, 33–36 (in Japanese) (cited in Fig. 3).

Meng Y, Kuang Z, Liao L, Ma Y and Wang X (2019) Case report: Morphologic and genetic identification of cerebral sparganosis. *American Journal of Tropical Medicine and Hygiene* **101**, 1174–1176 (cited in Table 2).

Meng Y, Wan W, Xiong ZC, Wu P, Zhang N, Yu YQ, Huang SH, Liu ZL and Liu JM (2023) Sparganosis of a thoracic vertebra misdiagnosed as bore metastasis from lung cancer. *International Journal of Infectious Diseases* **135**, 67–69 (cited in Table 2).

Meric R, Ilie MI, Hofman V, Rioux-Leclercq N, Michot L, Haffaf Y, Nelson AM, Neafie RC and Hofman P (2010) Disseminated infection caused by *Sparganum proliferum* in an AIDS patient. *Histopathology* **56**, 824–828.

Miyadera H, Kokaze A, Kuramochi T, Kita K, Machinami R, Noya O, Alarcón de Noya B, Okamoto M and Kojima S (2001) Phylogenetic identification of *Sparganum proliferum* as a pseudophyllidean cestode by the sequence analyses on mitochondrial COI and nuclear *sdhB* genes. *Parasitology International* **50**, 93–104.

Morales A, Laird-Pérez RM, Capó V, Iglesias E, Fonte L, Plascencia-Hernández A, Calderón EJ, Eom KS, de Armas Y and Pérez-Gómez HR (2022) Genetic and morphological identification of *Spirometra decipiens* in snakes and domestic dog found in Cuba. *Pathogens* **11**, 1468.

Moulinier R, Martinez E, Torres J, Noya O, Noya BA and Reyes O (1982) Human proliferative sparganosis in Venezuela: Report of a case. *American Journal of Tropical Medicine and Hygiene* **31**, 358–363.

Mueller JF (1935) A *Diphyllobothrium* from cats and dogs in the Syracuse region. *Journal of Parasitology* **21**, 114–121.

Muigg V, Ruf MT, Schwarzkopf S, Huang S, Denisjuk N, Stürmann A, Ritzler M, Wampfler R, Roppert S and Neumayr A (2019) Case report: Human subcutaneous sparganosis in a Thai migrant. *American Journal of Tropical Medicine and Hygiene* **101**, 1170–1173.

Munckhof WJ, Grayson ML, Susil BJ, Pullar MJ and Turnidge J (1994) Cerebral sparganosis in an East Timorese refugee. *Medical Journal of Australia* **161**, 263–264.

Nakamura T, Hara M, Matsuoka M, Kawabata M and Tsuji M (1990) Human proliferative sparganosis: A new Japanese case. *American Journal of Clinical Pathology* **94**, 224–228.

Nakamura-Uchiyama F (2005) Multi dot-ELISA test for parasitic diseases. *Clinical Parasitology* **16**, 23–25 (in Japanese).

Nawa Y, Kokubo-Tanaka M and Yamasaki H (2025) Recent trends of sparganosis in Japan. *Clinical Parasitology* **36**, 22–24 (in Japanese).

Nawa Y, Tanaka M and Yoshikawa M (2024) Sparganosis in the Indian Subcontinent and the Middle East. *Parasites, Hosts and Diseases* **62**, 263–269.

Nguyen YTH, Nguyen LAT, Dong HV, Duong HD and Yoshida A (2024) Molecular identification of sparganum of *Spirometra mansoni* isolated from the abdominal cavity of a domestic cat in Vietnam. *Journal of Veterinary Medical Science* **86**, 96–100.

Niu ZF, Chen LJ, Zhang YH and Zhao L (2024) Case report: A suspected case of chronic pulmonary sparganosis characterized by migrating cavities and tunnel sign. *Frontiers in Medicine* **11** (cited in Table 2)1453043.

Noiphithak R and Doungprasert G (2016) A case of disseminated central nervous system sparganosis. *Surgical Neurology International* **7**, S958–S961 (cited in Table 2).

Noya O, Alarcón de Noya B, Arrechedera H, Torres J and Argüello C (1992) *Sparganum proliferum*: An overview of its structure and ultrastructure. (in Table 1) *International Journal for Parasitology* **22**, 631–640. https://doi.org/10.1016/0020-7519(92)90012-A.

Oh MY, Kim KE, Kim MJ, Chu A, Lee JY, Park JH, Kim JJ and Hwang KT (2019) Breast sparganosis presenting with a painless breast lump: Report of two cases. *Korean Journal of Parasitology* **57**, 179–184 (cited in Table 2).

Okamoto M, Iseno C, Shibahara T, Sato MO, Wandra T, Craig PS and Ito A (2007) Intraspecific variation of *Spirometra erinaceieuropaei* and phylogenetic relationship between *Spirometra* and *Diphyllobothrium* inferred from mitochondrial COI gene sequences. *Parasitology International* **56**, 235–238.

Olson PD, Yoder K, Fajardo L-G LF, Marty AM, van de Pas S, Olivier C and Relman DA (2003) Lethal invasive cestodiasis in immunosuppressed patients. *Journal of Infectious Diseases* **187**, 1962–1966.

Owen IL (2005) Parasitic zoonoses in Papua New Guinea. *Journal of Helminthology* **79**, 1–14.

Pang CM, Yang XL, Wang Y, Zhai H, Miao F and Zhang SM (2022) Metagenomic sequencing for diagnosis of sparganosis mansoni: A case report. *Chinese Journal of Schistosomiasis Control* **34**, 556–558 (cited in Table 2) (in Chinese with English summary).

Park HR and Peak SH (2025) Sparganosis in the brain. *Neurology* **104**, e210219 (cited in Table 2).

Phunmanee A, Boonsawat W, Indharapoka B, Tuntisirin C and Kularbkeaw J (2001) Pulmonary sparganosis: A case report with five years follow-up. *Journal of the Medical Association of Thailand* **84**, 130–135.

Prasetyo RH and Safitri E (2019) Sparganum in frog meat: A warning for the occurrence of human sparganosis. *Tropical Parasitology* **9**, 130–131.

Rahman M, Lee EG and Bae YA (2011) Two-dimensional immunoblot analysis of antigenic proteins of *Spirometra* plerocercoid recognized by human patient sera. *Parasitology International* **60**, 139–143.

Rahman SMM, Kim JH, Hong ST and Choi MH (2014) Diagnostic efficacy of a recombinant cysteine protease of *Spirometra erinacei* larvae for serodiagnosis of sparganosis. *Korean Journal of Parasitology* **52**, 41–46.

Rathore A, Padmanabha H, Mahale R, Arora A, Goyal A, Reddy J, Sipani M, Pruthi N, Lingaraju TS, Nagarathna S, Yasha TC, Saini J, Nashi S, Pooja M and Mathuranath PS (2024) Cerebral sparganosis – An unusual parasitic infection mimicking cerebral tuberculosis: Isolation of a live plerocercoid larva of *Spirometra mansoni*. *Annals of the Indian Academy of Neurology* **27**, 443–447.

Rodpai R, Sadaow L, Boonroumkaew P, Phupiewkham W, Thanchomnang T, Limpanont Y, Chusongsang P, Sanpool O, Ohmae H, Yamasaki H, Intapan PM and Maleewong W (2021) Comparison of point-of-care test and enzyme-linked immunosorbent assay for detection of immunoglobulin G antibodies in the diagnosis of human schistosomiasis japonica. *International Journal of Infectious Diseases* **107**, 47–52.

Ru SS, Cheng C, Jiang P and Zhang X (2024) Identification of a clinical *Spirometra mansoni* plerocercoid isolate using molecular and morphological data. *Acta Parasitologica* **69**, 1304–1308 (cited in Table 2).

Rudolphi CA (1819) In *Entozoorum Synopsis Cui Accedunt Mantissa Duplex Et Indices, Locupletissimi*. Belolini, Germany: Augustus Rücker, 821.

Sah R, Khatri A, Kharel R, Kc H, Rabaan AA, Tiwari R, Dhama K, Malik YS, Donovan S, Rodriguez-Morales AJ, Muigg V and Neumayr A (2020) Case report: Management of dead intraocular helminth parasites in symptomatic patients. *American Journal of Tropical Medicine and Hygiene* **103**, 719–722.

Saksirisampant W, Eamudomkarn C, Jeon HK, Eom KS, Assavapongpaiboon B, Sintuwong S and Tulvatana W (2020) Ocular sparganosis: The first report of *Spirometra ranarum* in Thailand. *The Korean Journal of Parasitology* **58**, 577–581 (cited in Table 2).

Salazar-Grosskelwing E, Rodriguez-Vinas RI, Bolio-González ME, Romero-Salas D, Ramos-Beltrán R, Solano-Barquero A and Rojas A (2025) First morphological and molecular characterisation of *Spirometra mansoni* (Cestoda, Diphyllobothriidae) in a domestic cat from Veracruz, Mexico. *Veterinary Parasitology: Regional Studies and Reports* **57**, 101189.

Sanders TL, Sobotyk C, Castro PDJ, Abdu A, Baade J, Borst M, Dangoudoubiyam S, Delcambre BA, Gruntmeir JM, Lee A, Leutenegger C, Lozoya C, Murphy G, Pulaski C, Schaefer J, Vatta A, Walden HDS, Lejeune M and Verocai GG (2025) Molecular characterization of *Spirometra* isolates across the USA. *Parasitology* **152**, 477–486.

Sato MO, Sato M, Yoonuan T, Pongvongsa T, Sanguankiat S, Kounnavong S, Maipanich W, Chigusa Y, Moji K and Waikagul J (2017) The role of domestic dogs in the transmission of zoonotic helminthes in a rural area of Mekong River basin. *Acta Parasitologica* **62**, 393–400.

Schauer F, Poppert S, Technau-Hafsi K, Mockenhaupt M, Muntau B, Häcker G, Tappe D and Jokob T (2014) Travel-acquired subcutaneous *Sparganum proliferum* infection diagnosed by molecular methods. *British Journal of Dermatology* **170**, 741–743.

Scholz T, Kuchta R and Brabec J (2019) Broad tapeworms (Diphyllobothriidae), parasites of wildlife and humans: Recent progress and future challenges. *International Journal for Parasitology: Parasites and Wildlife* **9**, 359–369.

Semenova V, Walden HDS, Bollenback K, Cook JRJ and Ossiboff RJ (2025) Canine proliferative sparganosis: A case report and review of larval cestodiasis in dogs. *Journal of Comparative Pathology* **219**, 48–51.

Settakorn J, Arpornchayanon O, Chaiwun B, Vanittanakom P, Thamprasert K and Rangdaeng S (2002) Intraosseous proliferative sparganosis: A case report and review of the literature. *Journal of the Medical Association of Thailand* **85**, 107–113.

Shen C, Li S, Zheng S, Choi MH, Bae YM and Hong ST (2007) Tissue parasitic helminthiases are prevalent at Cheongjin, North Korea. *Korean Journal of Parasitology* **45**, 139–144.

Stiles CW (1908) The occurrence of a proliferating cestode larva (*Sparganum proliferum*) in man in Florida. *Hygienic Laboratory Bulletin* **40**, 7–18.

Tang THC, Wong SSY, Lai CKC, Poon RWS, Chan HSY, Wu TC, Cheung YF, Poon TL, Tsang YP, Tang WL and Wu AKL (2017) Molecular identification of *Spirometra erinaceieuropaei* tapeworm in cases of human sparganosis, Hong Kong. *Emerging Infectious Diseases* **23**, 665–668.

Tappe D, Berger L, Haeupler A, Muntau B, Racz P, Harder Y, Specht K, Prazeres da Costa C and Poppert S (2013) Case report: Molecular diagnosis of subcutaneous *Spirometra erinaceieuropaei* sparganosis in a Japanese immigrant. *The American Journal of Tropical Medicine and Hygiene* **88**, 198–202.

Tashiro K (1921) A case of elephantiasis caused by *Plerocercoides prolifer*, with results of animal experiments using the plerocercoids. *Journal of Japan Surgical Society (Nihon Gekagakkai Zasshi)* **22**, 99–100.

Thanchomnang T, Sanpool O, Yamasaki H, Intapan PM and Maleewong W (2021) Molecular identification and genetic diversity of cestodes in Southeast Asia. In Petney TN, Saijuntha W and Mehlhorn H (eds.), *Biodiversity of Southeast Asian Parasites and Vectors Causing Human Disease. Parasitology Research Monographs 14*. Cham, Switzerland: Springer, 121–142.

Thanchomnang T, Tantrawatpan C, Intapan PM, Sanpool O, Lulitanond V, Tourtip S, Yamasaki H and Maleewong W (2016) Rapid identification of nine species of diphyllobothriidean tapeworms by pyrosequencing. *Scientific Reports* **6**, 37228.

Thk N, Wong WT, Fund CF and Leung CY (1989) Clinical sparganosis in Hong Kong. *Perspectives in Public Health* **109**, 138–140.

Tokiwa T, Fushimi M, Chou S, Yoshida A, Kinoshita K, Hikima A, Kikuchi T and Ozaki K (2024) Aberrant sparganosis in cat caused by *Spirometra mansoni* (Cestoda: Diphyllobothriidae): A case report. *BMC Veterinary Research* **20**, 148.

Tran Q (R), Tran MC and Mehanna D (2019) Sparganosis: An under-recognised zoonosis in Australia? *BMJ Case Reports* **12**, e228396.

Tsai CC, Joseph K and Chang IW (2024) Sparganosis presenting as a subcutaneous mass of the thigh. *Polish Journal of Pathology* **75**, 166–168.

Tsai MD, Chang CN, Ho YS and Wang ADJ (1993) Cerebral sparganosis diagnosed and treated with stereotactic techniques. Report of two cases. *Journal of Neurosurgery* **78**, 129–132.

Tu CT, Chiu MH and Chou YC (1973) Adult *Spirometra mansoni* infection. A case report. *Chinese Medical Journal* **11**, 155.

Tung CC, Lin JW and Chou FF (2005) Sparganosis in male breast. *Journal of the Formosan Medical Association* **104**, 127–128.

Ugarte CE, Thomas DG, Gasser RB, Hu M, Scott I and Collett MG (2005) *Spirometra erinacei/S. erinaceieuropaei* in a feral cat in Manawatu with chronic intermittent diarrhoea. *New Zealand Veterinary Journal* **53**, 347–351.

Usui R (1909) A case of Plerocercoides prolifer Ijima. *Igaku Chuo Zasshi* **7**, 79–84 (in Japanese).

Wang H, Tang Y, Yang Y, Xu WM, Wang J, Jin XY, Zhu SJ, Huang YM and Gan XX (2012) A case of concurrent infection with *Spirometra* adult worm and sparganum. *Chinese Journal of Parasitology and Parasitic Diseases* **30**, 40 (in Chinese).

Wang YG, Liu WP and He XS (2019) Pediatric epilepsy induced by a living parasite etiologically diagnosed as cerebral sparganosis. *Clinics in Surgery* **4**, 2349 (cited in Table 2).

Wang YJ, Lou Y, Chen L, Yang X, Cao AH and Du P (2024) A hepatic sparganosis misdiagnosed as intrahepatic mass-forming cholangiocarcinoma: A case report and literature review. *Frontiers in Oncology* **14**, 1391256 (cited in Table 2).

Wen G-J, Chen J, Zhang SF, Zhou Z-S and Jiao G-L (2023) Multiple sparganosis spinal infections mainly in the thoracic region: A case report. *World Journal of Clinical Cases* **11**, 8507–8511 (cited in Table 2).

West MD, Little SE and Johnson C (2008) Proliferative sparganosis in a Florida dog. Direct submission (in Table 1).

Wijesundera MS, Ratnatunga N, Kumarasinghe MP and Dissanaike AS (1997) First reports of subcutaneous sparganosis in Sri Lanka. *Ceylon Medical Journal* **42**, 30–32.

Winichakoon P, Salee P, Kaewpoowat Q and Supparatpinyo K (2017) Migratory CNS helminthiases in Maharaj Nakorn Chiang Mai hospital: A retrospective study. *Journal of the Infectious Diseases and Antimicrobial Agents* **34**, 119–127 (cited in Table 2).

Wiwanitkit V (2005) A review of human sparganosis in Thailand. *International Journal of Infectious Diseases* **9**, 312–316.

Xie D, Wang M, Chen X and Tuo H-Z (2019) A case report: 1-year follow-up of cerebral sparganosis mansoni with a stroke-like onset. *BMC Neurology* **19**, 105 (cited in Table 2).

Xie X, Hu JH, Sun GZ, Ding B and Feng L (2018) Orbital sparganosis in an 8-year boy: A case report. *BMC Ophthalmology* **18**, 13 (cited in Table 2).

Yamasaki H, Morishima Y and Sugiyama H (2024a) A new species causing plerocercoidosis discovered in Japan, *Spirometra asiana*. *Clinical Parasitology* **35**, 36–40 (in Japanese).

Yamasaki H, Nakamura T, Intapan PM, Maleewong W, Morishima Y, Sugiyama H, Kobayashi K, Takayama K and Kobayashi Y (2018) Application using immunochromatographic kit for the serodiagnosis of larva migrans. *Clinical Parasitology* **29**, 92–94 (in Japanese).

Yamasaki H, Nakamura T, Intapan PM, Maleewong W, Morishima Y, Sugiyama H, Matsuoka H, Kobayashi K, Takayama K and Kobayashi Y (2014) Development of a rapid diagnostic kit that uses an immunochromatographic device to detect antibodies in human sparganosis. *Clinical and Vaccine Immunology* **21**, 1360–1363.

Yamasaki H, Nakaya K, Nakao M, Sako Y and Ito A (2007) Significance of molecular diagnosis using histopathological specimens in cestode zoonoses. *Tropical Medicine and Health.* **35**, 307–321.

Yamasaki H, Sanpool O, Rodpai R, Sadaow L, Laummaunwai P, Un M, Thanchomnang T, Laymanivong S, Aung WPP, Intapan PM and Maleewong W (2021) *Spirometra* species from Asia: Genetic diversity and taxonomic challenges. *Parasitology International* **80**, 102181.

Yamasaki H, Sato MO, Kuramochi T and Mercado R (2023) Genetic characterization of *Dibothriocephalus latus* and *Dibothriocephalus dendriticus* (Cestoda: Diphyllobothriidae) from Chile based on haplotype analysis using mitochondrial DNA markers. *Parasitology International* **96**, 102767.

Yamasaki H, Sugiyama H, Morishima H and Sako Y (2024c) Molecular identification of *Spirometra* infections in companion animals and wildlife in Japan. *The Journal of Veterinary Medical Science* **86**, 409–412.

Yamasaki H, Sugiyama H, Morishima Y and Kobayashi H (2024b) Description of *Spirometra asiana* sp. nov. (Cestoda: Diphyllobothriidae) found in wild boars and hound dogs in Japan. *Parasitology International* **98**, 102798.

Yamaura H, Kikuchi K, Itoda I, Yasunami T, Totsuka K, Shimada M, Nakamura S, Hayashi N, Isoda T, Kusumoto S, Kobayakawa T, Kagei N and Araki K (2002) Two cases of *Spirometra erinacei* infection and one of sparganosis mansoni in three people who ate the same snake (*Elaphe quadrivirgata*). *Clinical Parasitology* **13**, 159–163 (in Japanese).

Yogore MGJ and Tangco AF (1953) Notes on sparganosis in a Filipino. *Acta Medica Philippina* **9**, 301–303.

Yoshida SO (1914) On a second and third case of infection with *Plerocercoides prolifer* Ijima, found in Japan. *Parasitology* **7**, 219–225.

Yoshikawa M, Ouji Y, Nishiofuku M, Lshizaka S and Nawa Y (2010) Sparganosis cases reported in Japan in the recent decade, 2000–2009. *Clinical Parasitology* **21**, 33–36 (in Japanese).

Young ND, Malik R, Brown A, Wang T, Ash A, Korhonen PK and Gasser RB (2025) Chromosome-contiguous reference genome for *Spirometra* to underpin future discovery research. *International Journal of Molecular Sciences* **26**, 6417.

Yu YL, Shen J, Yuan ZF, Xia ZZ, Gao F, Jiang LH and Jiang K (2016) Cerebral sparganosis in children: Epidemiologic and radiologic characteristics and treatment outcomes: A report of 9 cases. *World Neurosurgery* **89**, 153–158.

Yudhana A, Praja RN and Kartikasari AM (2021) Sparganosis (*Spirometra* spp.) in Asian water monitor (*Varanus salvator*): A medical implication for veterinarians, breeders, and consumers. *Veterinary World* **14**, 2482–2487.

Zendejas-Heredia PA, Colella V, Huggins LG, Schaper R, Schunack B and Traub RJ (2023) An integrated coproscopic and molecular method provides insights into the epidemiology of zoonotic intestinal helminths of dogs across Cambodia. *Transboundary and Emerging Diseases* **2023**, 2001871.

Zhang X, Cui J, Liu LN, Jiang P, Wang H, Qi X, Wu XQ and Wang ZQ (2015) Genetic structure analysis of *Spirometra erinaceieuropaei* isolates from central and southern China. *PLoS One* **10**, e0119295.

Zhu XQ, Beveridge I, Berger L, Barton DP and Gasser RB (2002) Single-strand confirmation polymorphism-based analysis reveals genetic variation within *Spirometra erinacei* (Cestoda: Pseudophyllidea) from Australia. *Molecular and Cellular Probes* **16**, 159–165.

Zhu YL, Ye LQ, Ding XS, Wu JM and Chen YX (2019) Cerebral sparganosis presenting with atypical postcontrast magnetic resonance imaging findings: A case report and literature review. *BMC Infectious Diseases* **19**, 748 (cited in Table 2).