

New microsporidian species infecting invasive and native stink bugs

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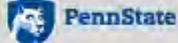
USDA ARS CMAVE, Florida

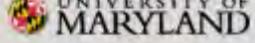


Funding

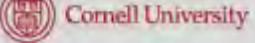
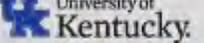
 United States Department of Agriculture National Institute of Food and Agriculture
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Collaborating Institutions

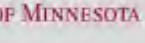
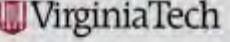
  

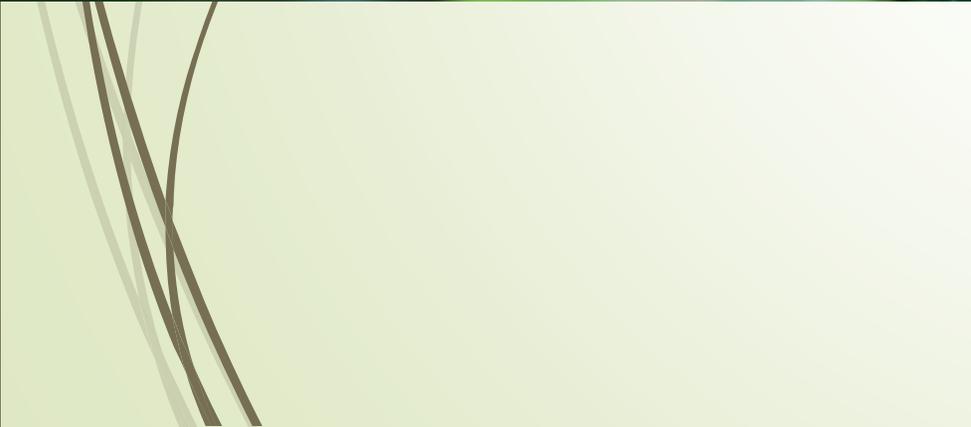


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Relatively few Hemiptera are hosts of Microsporidia



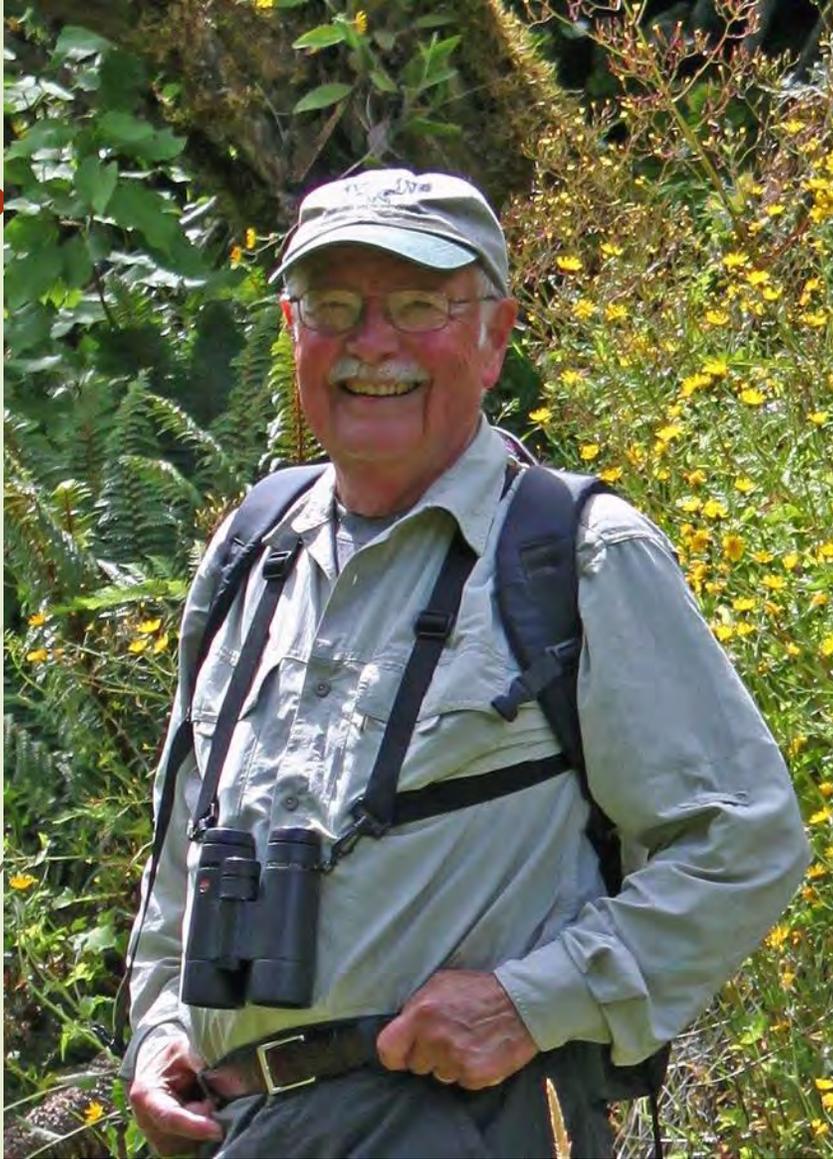
	Families	# species
Aquatic	Geridae	1
	Corisidae	1
	Notonectidae	1
	Veliidae	1
	Omaniidae	1
Terrestrial	Aphididae	1
	Lygaeidae	1
	Pentatomidae	3
	Cimicidae	1
	Pyrrhocoridae	1
	Cicadellidae	1
	Miridae	1
	Rhopalidae	1
	Plataspidae	1



Microsporidia from pentatomids

- ▶ 1 = European species (*Graphosoma lineatum*)
- ▶ 1 = North American species (green stink bug)
- ▶ 1 = transcriptome of BMSB collected in Allentown PA





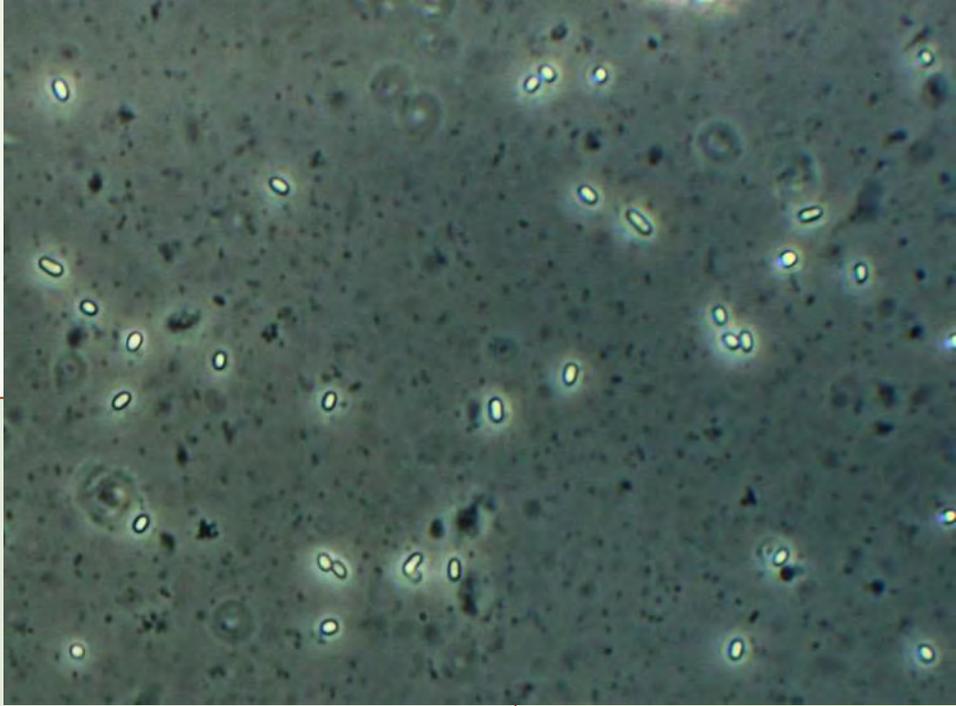
Joe Maddox
Illinois Natural History Survey

1968-1972

Microsporidia reported from native **green stinkbugs** in **Illinois** (reported at conference in 1978; no formal publication)

Chinavia hilaris



A microscopic image showing numerous small, oval-shaped organisms with bright, glowing outlines, likely BMSB microsporidia, against a dark background.

Early finds of BMSB microsporidia:

BMSB lab colonies crashing

*in a USDA Florida quarantine (2012)

[colony originating from **Delaware**]

***University of Maryland** (2015)

Bryan Petty and Anne Nielsen found
microsporidia in BMSB in **New Jersey** (2014)



➔ We found microsporidia in:

1. North America

1. BMSB (PA)

2. Green stink bugs, *Chinavia hilaris* (IL and PA)

3. Dusky stink bugs, *Euschistus tristigmus* (PA)

4. Brown stink bugs, *Euschistus servus* (PA)

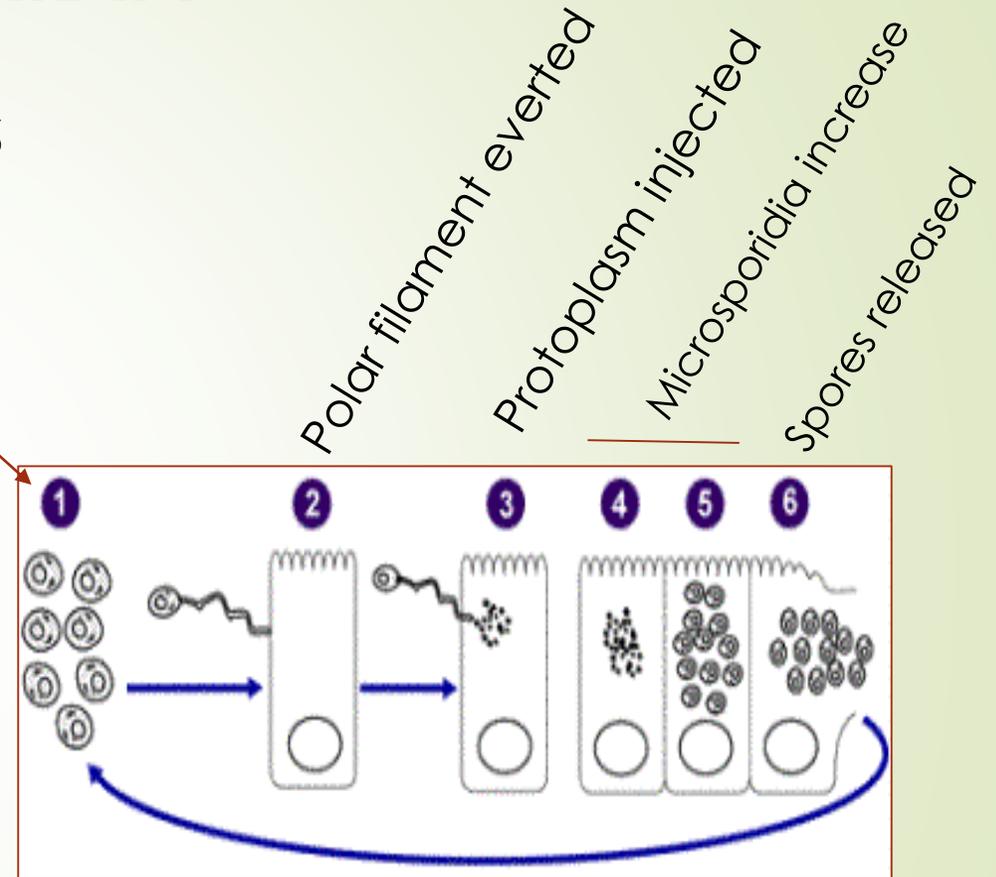
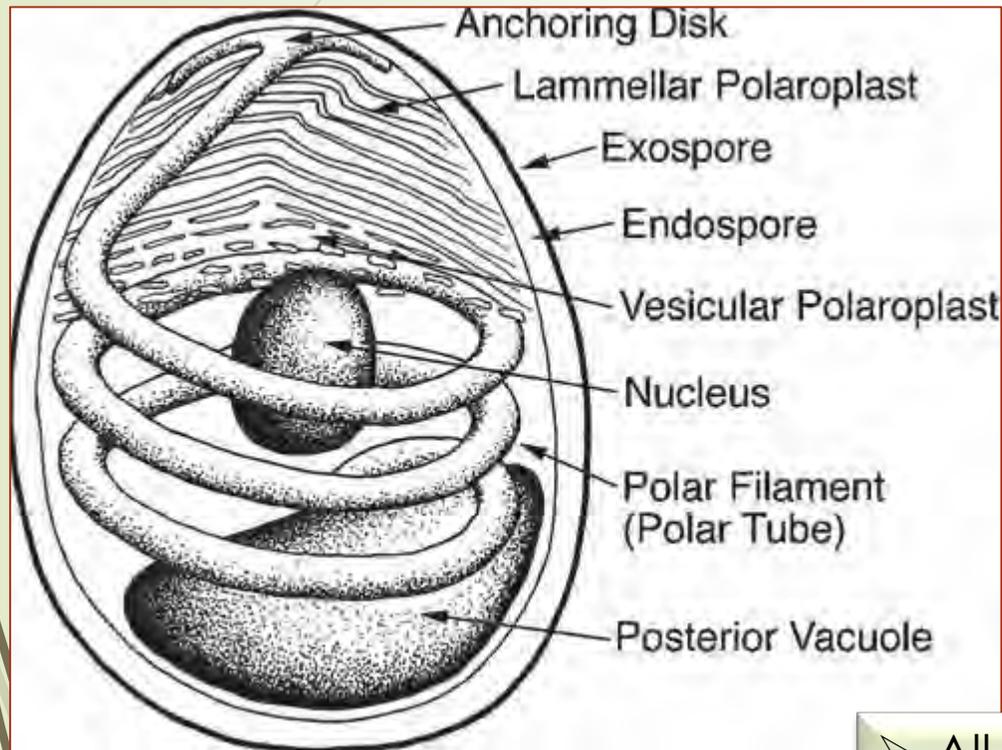
2. South Korea and China

1. BMSB

We compared morphology and ribosomal DNA

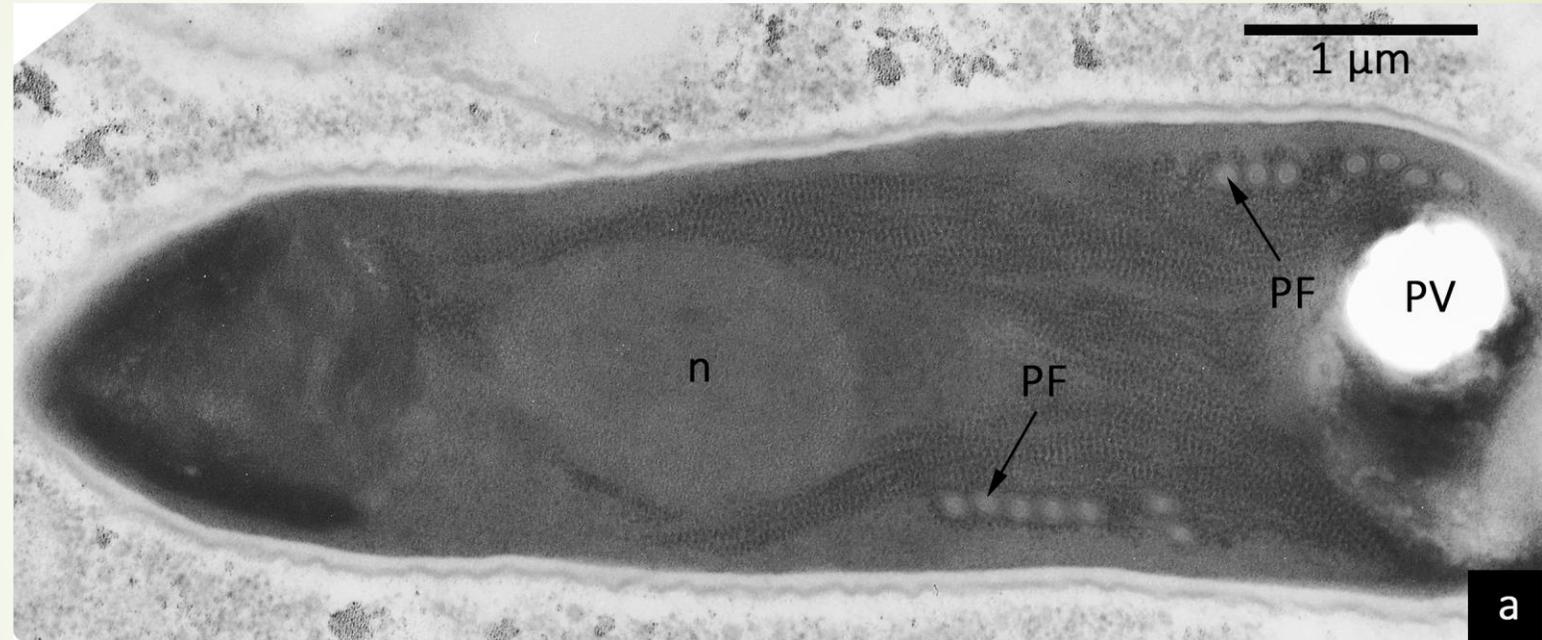
MICROSPORIDIA

environmental spores



- All development is **intracellular**
- Infections usually **decrease fecundity and longevity**
- Range from only certain tissues to throughout host's body

Nosema maddoxi



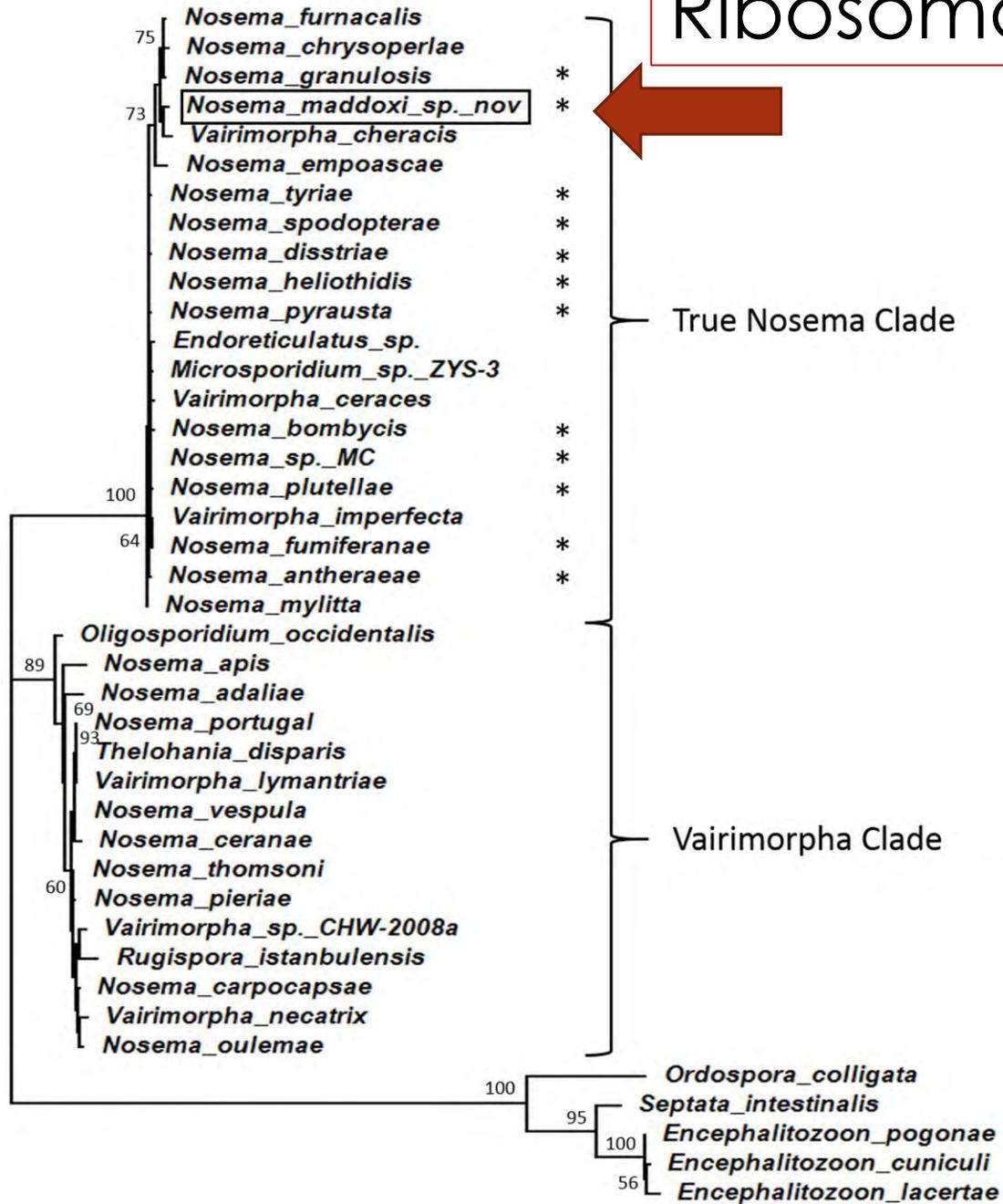
Uninucleate spores (4.7 x 2.2 μm)
Polar filaments with 7-9 turns
Systemic infections

There were still samples from infected green stink bugs from Illinois 1968
– before BMSB was in North America



Excellent rationalization for why not to throw out those old samples!

Ribosomal SSU



All the same microsporidian species

1. BMSB

1. North America
2. South Korea and China

2. Green (1968 and 2015), dusky and brown stink bugs

1. North America

HOLARCTIC DISTRIBUTION!



FIELD PREVALENCE IN 2 HOSTS

Illinois	1970-1972	14.3-51.5%
Northeast	2015-2016	0.0-28.3%

GREEN
BMSB

Summary

- ▶ 1. SSU of microsporidia from brown marmorated, green, brown and dusky stink bugs are the same:
 - ▶ *Nosema maddoxi* (Journal of Eukaryotic Microbiology doi:10.1111/jeu.12475)
- ▶ 2. Also SSU of samples from South Korea and China were the same: *Nosema maddoxi*
- ▶ 3. *Nosema maddoxi* is considered Holarctic because it has been found in BMSB in Asia---and green stinkbugs in North America, before establishment of BMSBs.
- ▶ Molecular work shows that this species is *Nosema*, although spores are unikaryotic (atypical for this genus).
- ▶ Koch's postulates proved pathogenicity to BMSBs and prevalence was >50% in green stink bugs in Illinois in 1972 and almost 30% in Pennsylvania in 2016.

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