IV. MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS)

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MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS)

Host	Host stage infected	Pathogens	Locality	Lab. or field study	Reference
Aedes aegypti	Larvae	Nosema algerae	USA (Florida)	Field	Hazard (1975)
"	"	Microsporida (Unidentified)	Puerto Rico	"	Kuno (1975)
Aedes annulipes	"	Thelohania volgensis	USSR (Povolže)	"	Khaliulin (1977)
Aedes beklemishevi	Larvae & adults	Amblyospora opacita	USSR (Siberia)	Lab.	Khadzieva & Gulii (1977)
"	Larvae	"	USSR (Middle Ob)	Field	Kukharchuk & Gulii (1976)
"	"	Thelohania volgensis sp. n.	USSR (Povolže)	"	Khaliulin (1977)
Aedes canadensis	"	Parathelohania opacitor	USA (Mississippi)	"	Fulton et al. (1974)
Aedes cantans	"	Amblyospora opacita	USSR (Povolže)	"	Khaliulin (1973)
"	"	"	USSR (Kazakhstan)	"	Levchenko (1975b)
"	"	"	USSR (Middle Ob)	"	Kukharchuk & Gulii (1976)
"	Adults	"	USSR (Siberia)	Lab.	Khadzieva & Gulii (1977)
"	Larvae	Amblyospora minuta	USSR (Povolže)	Field	Khaliulin (1973)
"	"	Parathelohania (= Thelohania) legeri	"	"	"
"	"	Thelohania sp.	USSR (Kazakhstan)	"	Levchenko (1975a, 1975b)
"	"	Thelohania volgensis	USSR (Povolže)	"	Khaliulin (1977)
Aedes caspius	"	Amblyospora opacita	USSR (Syrdaryan)	"	Deshevykh & Dzerzhinskii (1975)
"	"	Parathelohania legeri	"	"	"

MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS) (continued)

Host	Host stage infected	Pathogens	Locality	Lab. or field study	Reference
Aedes caspius	Larvae	Amblyospora bracteata	USSR (Ukraine)	Field	Kilochitskii (1977)
"	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
"	"	"	USSR (Azerbaijan)	"	Alikhanov (1973)
"	"	"	USSR (Ukraine)	"	Kilochitskii (1977)
"	"	Parathelohania obesa	USSR (Ukraine)	"	"
Aedes cataphylla	"	Amblyospora khaliulini	USSR (Povolže)	"	Khaliulin (1973)
"	"	Amblyospora minuta	"	"	"
"	"	Parathelohania legeri	"	"	"
Aedes cinereus	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
"	"	Amblyospora khaliulini	USSR (Povolže)	"	Khaliulin (1973)
"	"	Amblyospora minuta	"	"	"
"	"	Parathelohania legeri	"	"	"
Aedes communis	Larvae & Adults	Amblyospora opacita	USSR (Siberia)	Lab.	Khadzieva & Gulii (1977)
"	Larvae	"	USSR (Middle Ob)	Field	Kukharchuk & Gulii (1976)
"	"	Amblyospora minuta	USSR (Povolže)	"	Khaliulin (1973)
"	"	Amblyospora opacita	"	"	"
"	"	Parathelohania legeri	"	"	"
Aedes cyprius	"	Amblyospora opacita	"	"	"

MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS) (continued)

Host	Host stage infected	Pathogens	Locality	Lab. or field study	Reference
Aedes cyprius	Larvae	Amblyospora opacita	USSR (Kazakhstan)	Field	Levchenko (1975b)
"	Larvae & Adults	"	USSR (Siberia)	Lab.	Khadzieva & Gulii (1977)
"	Larvae	Amblyospora minuta	USSR (Povolže)	Field	Khaliulin (1973)
"	"	Microsporida (unidentified)	USSR (Mariskaya)	"	Khaliulin & Invanov (1973)
"	"	Parathelohania legeri	USSR (Povolže)	"	Khaliulin (1973)
"	"	Thelohania sp.	USSR (Kazakhstan)	"	Levchenko (1975a + 1975b)
Aedes diantaeus	"	Amblyospora minuta	USSR (Povolže)	"	Khaliulin (1973)
"	"	Amblyospora opacita	"	"	"
"	"	Parathelohania legeri	"	"	"
Aedes dorsalis	"	Amblyospora bracteata	USSR (Ukraine)	"	Kilochitskii (1977)
"	"	Amblyospora khaliulini	USSR (Povolže)	"	Khaliulin (1973)
"	"	Amblyospora minuta	"	"	"
"	"	Amplyospora opacita	USSR (Middle Ob)	"	Kukharchuk & Gulii (1976)
"	"	"	USSR (Ukraine)	"	Kilochitskii (1977)
"	"	Parathelohania legeri	USSR (Povolže)	"	Khaliulin (1973)
"	"	Parathelohania obesa	USSR (Ukraine)	"	Kilochitskii (1977)
Aedes excrucians	"	Amblyospora minuta	USSR (Povolže)	"	Khaliulin (1973)

MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS) (continued)

Host	Host stage infected	Pathogens	Locality	Lab. or field study	Reference
Aedes excrucians	Larvae	Amblyospora opacita	USSR (Povolže)	Field	Khaliulin (1973)
"	Larvae & Adults	"	USSR (Siberia)	Lab.	Khadzieva & Gulii (1977)
"	Larvae (IV)	Nosema sp.	Canada (Quebec)	Field	Belloncik et al. (1975)
"	Larvae	Parathelohania legeri	USSR (Povolže)	"	Khaliulin (1973)
"	"	Thelohania volgensis	"	"	Khaliulin (1977)
Aedes flavescens	"	Amblyospora khaliulini	"	"	Khaliulin (1973)
"	"	Amblyospora minuta	"	"	"
"	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
"	"	"	USSR (Ukraine)	"	Kilochitskii (1977)
"	"	Parathelohania legeri	USSR (Povolže)	"	Khaliulin (1973)
Aedes intrudens	"	Amblyospora minuta	"	"	"
"	"	Amblyospora opacita	"	"	"
"	"	Parathelohania legeri	"	"	"
Aedes kasachstanicus	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
Aedes mediovittatus	"	Microsporida (unidentified)	Puerto Rico	"	Kuno (1975)
Aedes montchadskyi	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)

MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS) (continued)

Host	Host stage infected	Pathogens	Locality	Lab. or field study	Reference
Aedes nigrinus	Larvae	Amblyospora opacita	USSR (Kazakhstan)	Field	Levchenko (1975b)
"	"	Thelohania sp.	"	"	Levchenko (1975b, 1975a)
Aedes pulchritarsis	"	"	"	"	Levchenko (1975a)
Aedes punctor	"	Amblyospora minuta	USSR (Povolže)	"	Khaliulin (1973)
"	"	Amblyospora opacita	"	"	"
"	"	Parathelohania legeri	"	"	"
Aedes rossicus	"	Amblyospora khaliulini	"	"	"
"	"	Amblyospora minuta	"	"	"
"	"	Parathelohania legeri	"	"	"
Aedes sierrensis	"	Pleistophora sp.	USA (California)	"	Sanders & Poinar (1976)
Aedes simanini	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
Aedes (Stegomyia) simpsoni	Adults	Microsporida (unidentified)	Uganda (Bwanda)	"	McCrae (1972)
Aedes stramineus	Larvae	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
Aedes vexans	"	"	USSR (Ukraine)	"	Kilochitskii (1977)
"	"	Amblyospora bracteata	"	"	"
Anopheles albimanus	"	Nosema algerae	USA (Florida)	Lab.	Anthony et al. (1976)
"	"	"	USA (Illinois)	"	Undeen (1976b)
Anopheles gambiae	"	Nosema sp.	Kenya	Field	Service (1977)

MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS) (continued)

Host	Host stage infected	Pathogens	Locality	Lab. or field study	Reference
Anopheles gambiae	Larvae	Parathelohania sp.	Kenya	Field	Service (1977)
"	"	Parathelohania africanus	Kenya	"	"
Anopheles grabhamii	"	Thelohania sp.	Puerto Rico	"	Kuno (1975)
Anopheles hyrcanus	"	Parathelohania legeri	USSR (Ukraine)	"	Kilochitskii (1977)
Anopheles maculipennis	"	Amblyospora opacita	USSR (Ush-Tobe)	"	Levchenko (1974)
"	"	Parathelohania legeri	"	"	"
"	"	"	USSR (Ukraine)	"	Kilochitskii (1977)
Anopheles quadrimaculatus	"	Nosema algerae	USA (Florida)	Lab.	Hazard (1975)
"	"	"	USA (Illinois)	"	Undeen (1976b)
"	"	Nosema sp. from a mite	USA (Florida)	"	Hazard (1975)
"	"	Parathelohania obesa	USA (Mississippi)	Field	Fulton et al. (1974)
Anopheles stephensi	"	Nosema sp.	Pakistan (Lahore)	"	Jafri et al. (1976)
"	Larvae & adults	Microsporida (unidentified)	India (Pondicherry)	Lab. & field	Vector Control Res. Center (1978)
Anopheles subpictus	"	"	"	Field	"
Culex erraticus	Larvae	Amblyospora minuta	USA (Mississippi)	"	Fulton et al. (1974)
Culex modestus	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
"	"	"	USSR	"	Deshevykh & Dzerzhinskii (1975)

MICROSPORIDAN PATHOGENS OF CULICIDAE (MOSQUITOS) (continued)

Host	Host stage infected	Pathogens	Locality	Lab. or field study	Reference
Culex modestus	Larvae	Parathelohania legeri	USSR	Field	Deshevykh & Dzerzhinskii (1975)
Culex pipiens	"	Amblyospora opacita	USSR (Kazakhstan)	"	Levchenko & Issi (1973)
"	"	Nosema algerae	USA (Illinois)	Lab.	Undeen (1976b)
Culex quinquefasciatus	"	"	USA (Florida)	Lab.	Hazard (1975)
"	"	Stempellia milleri	USA (Texas)	Field	Miller & Scanlon (1976)
"	"	Microsporida (unidentified)	Puerto Rico	"	Kuno (1975)
Culex restuans	"	Stempellia magna	USA (Mississippi)	"	Fulton et al. (1974)
Culex salinarius	"	Amblyospora opacitor	"	"	"
Culex secutor	"	Microsporida (unidentified)	Puerto Rico	"	Kuno (1975)
Culex territans	"	Amblyospora opacitor	USA (Mississippi)	"	Fulton et al. (1974)
Culex theileri	"	Weiseria spinosa	USSR (Ukraine)	Lab.	Kilochitskii (1977)

ABSTRACTS

*Alikhanov, G. Sh. (1973) /The effect of Thelohania opacita Kudo, 1922 on the growth and development of larvae of Aedes caspius caspius from natural populations./ Parazitologiya, 7, 389-391 (In Russ. Engl. summ.)

*Anthony, D. W. et al. (1978) Fecundity and longevity of Anopheles albimanus exposed at each larval instar to spores of Nosema algerae. Mosq. News, 38, 116-121

The average infection rates obtained with the adults of Anopheles albimanus when exposed at different larval instars to spores of Nosema algerae were 100% with the 1st and 2nd instar larvae and 88% and 92% with the 3rd and 4th instar larvae, respectively. The female adults which developed from infected larvae had greatly reduced reproductive capacity, less fertile eggs, and reduced longevity. The results suggest that N. algerae can be utilized to control natural populations of An. albimanus of mixed larval instars. Reduction in the population of the F_1 progeny was ca 54%.

Arata, A. A. (1977) The developing role of microbiological agents in vector control. Experientia, 33, 125-130.

Microsporidan protozoa are among the promising microbial agents of anopheline mosquitos which are being studied following the scheme of the World Health Organization for screening and evaluating the efficacy and safety of biological agents for control of disease vectors.

*Belloncik, S. et al. (1975) Observations préliminaires sur le parasitisme d'Aedes (Ochlerotatus) excrucians (Dipt.: Culicidae) par une microsporidie. Entomophaga, 20, 139-141

Fourth instar larvae of Aedes (O.) excrucians were found parasitized with a microsporidan, probably a species of Nosema. The spores measured 5.4 ± 0.3 by 3.6 ± 0.3 μ. The parasite infected the fat body and muscle tissues of the larvae. This is the first record of a Nosema infecting a mosquito in the province of Quebec.

Canning, E. U. & Sinden R. E. (1973) Ultrastructural observations on the development of Nosema algerae Vavra and Undeen (Microsporida, Nosematidae) in the mosquito Anopheles stephensi Liston. Protistologica, 9, 405-415 (Fr. summ.)

The ultrastructure of the different developmental stages of N. algerae in An. stephensi is described.

Chapman, H. C. (1974a) Basic concepts of biological control in an integrated program of mosquito abatement. Proc. Ann. Meet. Utah Mosq. Abatement Assoc., 27, 8-9

Nosema algerae is cited among the promising agents for mosquitos.

Chapman, H. C. (1974b) Pathogens against mosquitos. Proc. Tall Timbers Conf. Ecol. Anim. Contr. Habitat Mgt., Tallahassee, Fla., 5, 43-47

A summary of the observations on pathogens of mosquitos made over a period of 8 years in southwestern Louisiana is presented. About 22 species of microsporida were found to parasitize 28 species of mosquitos in 9 genera.

Chapman, H. C. (1974c) Nematode and protozoan parasites of mosquitos and their potential use for control. In: Aubin, A. et al. Le Controle des Moustiques/Mosquito Control, University of Quebec Press, Montreal, pp. 195-205 (Fr. summ.)

Problems related to the utilization of microsporidans as control agents against mosquitos are presented. Important species are cited and pertinent literature is briefly discussed.

*Deshevykh, N. D., & Dzerzhinskii, V. A. (1975) /Some pathogenic microorganisms of blood-sucking mosquitoes in the syrdar'yan food-plain./ In: Markevich, A. P., ed. /Problems of parasitology Proc. VIIth Scientific Conf. of the Parasitologists of the Ukrainian SSR. Pt. 1/, pp. 146-147 (In Russ.)

Parathelohania legeri (Thelohania legeri) and Amblyospora opacita (Thelohania opacita) were observed to parasitize larvae of Aedes caspius and Culex modestus. The conditions in which the infections were found and the external symptoms of infection are described. (Rev. Appl. Ent. Ser. B. (1978) 66, 103 (750)

Dzerzhinskii, V. A. et al. (1973) /Artificial infection of larvae of blood-sucking mosquitoes with the microsporidan Thelohania opacita under laboratory conditions/ In: Dubitskii, A. M., ed. Regulators of the number of blood-sucking flies in Southeastern Kazakhstan, pp. 65-71. (In Russ.)

*Fulton, H. R. et al. (1974) A survey of North Mississippi mosquitoes for pathogenic microorganisms. Mosq. News, 34, 86-90.

A one-year survey of microorganisms infecting natural mosquito populations was conducted in three counties of North Mississippi in 1972-1973. The following microsporidans were isolated from the larvae of field-collected mosquitos: Parathelohania obesa (Thelohania obesa) in Anopheles quadrimaculatus; Amblyospora opacitor (Thelohania opacitor) in Culex territans, Cx. salinarius and Aedes canadensis; Amblyospora minuta (Thelohania minuta) in Cx. erraticus; and Stempellia magna in Cx. restuans.

*Hazard, E. I. (1975) The use of microsporida (Protozoa) for the control of aquatic insect pests. Environmtl. Protect. Agency EPA-660/3-75-001. pp. 69-76 Discussion, pp. 69-81

The potential role and development of several important species of microsporidans as microbial agents against aquatic insect pests, including mosquitos are presented. Studies on host specificity and transmission of several species of microsporidans are briefly discussed.

Hazard, E. I. & Oldacre, S. W. (1976) Revision of microsporida (Protozoa) close to Thelohania, with descriptions of one new family, eight new genera, and thirteen new species. U.S. Dept. Agr. Tech. Bull. No. 1530, pp. 104

Theloniidae, fam. n., with 8 new genera are described. Notes are provided on about 50 species, 13 of them are described as new. A host list is provided for each species. A list is given of over 30 species of mosquitoes in 6 genera that are hosts of undescribed species of Amblyospora, and 14 species of Anopheles that are hosts of Parathelohania.

*Jafri, R. H. et al. (1976) Nosema infection in Anopheles stephensi larvae from Lahore, Pakistan. Pakistan J. Zool., 8, 232-234

Larvae of Anopheles stephensi collected from a pond were found infected with Nosema sp.

Jaronski, S. T. (1977) Cations, pH and spore filament extrusion in Nosema algerae. Abst. Pap. Xth Annua. Meet. Soc. Invertebr. Pathol. (Michigan), p. 6

K^+ and Na^+ were observed to play a key role in stimulating filament extrusion in Nosema algerae. The response to the cations was independent of the pH 7.0 - 9.0 range of the Tris buffer. Glycine-HCL and lysine-KOH buffers did not elicit any difference in the extent of filament extrusion.

*Khadzhieva, T. M. & Gulii V. V. (1977) /The microsporidan Thelohania opacita Kudo and metamorphosis in mass species of mosquitoes./ Izv. Sibir. Otd. Akad. Nauk SSR, 10, 109-112 (In Russ. Engl. summ.)

In laboratory tests, Amblyospora opacita (Thelohania) was observed to parasitize Aedes beklemishevi, Ae. cantans, Ae. communis, Ae. excrucians, Ae. pionips and Ae. cyprius. The parasite occurred mainly in the haemocytes and fat body of the different larval instars. During metamorphosis of the larvae into an adult, the spores are eliminated from the fat body or lysed in the haemolymph, thus adults usually do not show symptoms of infection. The parasites persist in the ovary of the adult female which permits survival and transmission of the parasites.

*Khaliulin, G. L. (1973) /Microsporidans of larvae of blood-sucking mosquitoes in Central Povolže./ Parazitologiya, 7, 370-373 (In Russ. Eng. summ.)

Collections made in 1967-1971 contained larvae of 12 species of Aedes that were infected with Amblyospora khaliulini (Thelohania opacita var. mariensis), Parathelohania legeri (Thelohania legeri), and Amblyospora minuta (Thelohania minuta). Infection did not exceed 2% in tests with transovarial transmission. Up to 50% infection was obtained with oral transmission of the parasite in the laboratory.

*Khaliulin, G. L. & Ivanov, S. L. (1973) /Coelomomyces sp. a parasitic fungus of mosquito larvae in the Mariskaya USSR./ Med. Parazitol. Parazit. Bolezni, 42, 487 (In Russ.)

Microsporida were found in methyl alcohol-fixed haemolymph smears taken from a Coelomomyces-infected 4th instar larvae of Aedes cyprius.

*Khaliulin, G. L. (1977) /Thelohania volgensis sp. n. (Microsporida), parasitic in larvae of blood-sucking mosquitoes./ Parazitologiya, 11, 270-271 (In Russ.)

Thelohania volgensis sp.n. is described from larvae of Aedes excrucians, Ae. beklemishevi and Ae. cantans.

*Kilochitskii, P. Ya. (1977) /A study of microsporida, parasites of blood-sucking mosquitoes in the south of the Ukraine./ Vest. Zool., No. 4, 71-75. (In Russ. Engl. summ.)

Eight out of 15 species and subspecies of mosquitos collected were infected with 6 species of microsporida. Amblyospora opacita (Thelohania opacita) was found in the larvae of Aedes caspius, Ae. dorsalis, Ae. flavescens and Ae. vexans; Amblyospora bracteata (Thelohania bracteata) in Ae. caspius, Ae. dorsalis and Ae. vexans; Parathelohania obesa (Thelohania obesa) in Ae. caspius and Ae. dorsalis; Parathelohania legeri in Anopheles maculipennis and An. hyrcanus; and Weiseria spinosa in Culex theileri. These species of microsporida are reported for the first time in this region. Brief descriptions and measurements of spores of each parasite species are given.

Knell, J. D. & Zam, S. G. (1978) A serological comparison of some species of microsporida. J. Invertebr. Pathol., 31, 280-288

Six microsporidan isolates, including Nosema algerae were studied using a double-immunodiffusion technique for determining the taxonomic relationships of these different species. This technique is sensitive and can be very useful for separating morphologically similar microsporidan isolates. One disadvantage is that a large quantity of spores is required, at least 6×10^{10} to produce a usable titre in rabbits and an additional 10^{10} or more spores to set up gel diffusion tests. At present, this quantity cannot be produced with most microsporidan species. Spores however can be collected, amassed and stored at 27°C up to 5 months without losing their antigenic activity.

*Kukharchuk, L. P. & Gulii, V. V. (1976) [Microsporida infection of common species of mosquitoes in the middle ob region.] Izv. Sibir. Otd. Akad. SSSR Biol. 5, 76-79 (In Russ. Engl. summ.)

Larvae of Aedes dorsalis, Ae. beklemishevi, Ae. cantans and Ae. communis were infected with Amblyospora opacita (Thelohania opacita). This is the first record of Ae. opacita in Ae. dorsalis and Ae. beklemishevi.

*Kuno, G. (1975) Preliminary survey of microorganisms associated with some insects in Puerto Rico. J. Agr. Univ. Puerto Rico, 59, 69-74 (Span. summ.)

Unidentified microsporidan species were isolated from Aedes mediovittatus, Culex quinquefasciatus and Cx. secutor; Thelohania sp. from Ae. aegypti and Anopheles grabhamii. Laboratory attempts to determine pathogenicity of the parasites were not successful. This is the first report of microsporidan parasites in Ae. mediovittatus, An. grabhamii and Cx. secutor.

Legner, E. F. et al. (1974) The biological control of medically important arthropods. CRC Critical Rev. in Environmental Contr., 4, 85-113

A review article with 535 references. A section discusses pathogens of mosquitos, including microsporidan infections.

*Levchenko, N. G. (1974) [A new host for the microsporida Thelohania opacita Kudo, 1922.] Izv. Akad. Nauk. Kaz. SSR Biol., No. 4, 76-77

Fourth instar larvae of Anopheles maculipennis collected from an irrigated field near Osh-Tobe in 1973, were infected with Parathelohania legeri (Thelohania legeri) and Amblyospora opacita (Thelohania opacita). An. maculipennis is a new host for A. opacita

*Levchenko, N. G. (1975a) [New foci of microsporidioses of blood-sucking mosquitoes and simuliid flies discovered in the southeastern and central Kazakhstan.] Izv. Akad. Nauk. Kaz. SSR Biol., No. 4, 48-50 (In Russ.)

A survey for pathogens of culicids and simulids was made in 1973. Infections with Thelohania species were observed in larvae of Aedes cyprious, Ae. cantans, Ae. nigrinus and Ae. pulchritarsis. Infection rates varied from 5 to 25% and up to 80% in some areas.

*Levchenko, N. G. (1975b) [On invasion of mosquitoes with microsporidan Thelohania sp. in Central Kazakhstan.] Med. Parazitol. Parazit. Bolezni, 44, 59-62 (In Russ. Engl. summ.)

Amblyospora opacita (Thelohania opacita) and Thelohania sp. were found in field-collected larvae of Aedes cyprinus, Ae. cantans and Ae. nigrinus. The rate of infection in the field was 20-86%. The mortality rate of the infected larvae was 80-99%. Observation was made on the mode of infection and transmission of the parasites.

Levchenko, N. G. (1975c) [Parasitic protozoa of midges and other hydrobionts of the montane and arid zones of Kazakhstan.] In: Markevich, A. P., ed., [Problems of parasitology. Proc. VIIIth Scientific Conf. of Parasitologists of the Ukrainian SSR. Pt. 1] pp. 306-308, (In Russ.)

Amblyospora opacita (Thelohania opacita) was reported to parasitize 10 species of Aedes and Culex.

*Levchenko, N. G. & Issi, I. V. (1973) [Microsporida of blood-sucking diptera.] In: Dubitskii, A. M., ed., Regulators of the number of blood-sucking flies in southeastern Kazakhstan, pp. 42-64 (In Russ.)

Up to 18% infection of Amblyospora opacita (Thelohania opacita) was observed in field collected larvae of Aedes flavescens, Ae. caspius, Ae. montchadskyi, Ae. kasachstanicus, Ae. simanini, Ae. cinereus, Ae. stramineus, Culex modestus and Cx. pipiens. (Cited in Levchenko, 1974).

*McCrae, A. W. R. (1972) Age-composition of man-biting Aedes (Stegomyia) simpsoni (Theobald) (Diptera: Culicidae) in Bwanda county, Uganda. J. Med. Entomol., 9, 545-550

Infection of microsporidans in adults of Aedes (Stegomyia) simpsoni is reported.

*Miller, F. M. & Scanlon, J. E. (1976) Persistence and dispersal of Stempellia milleri (Microsporida: Nosematidae), a protozoan parasite of Culex pipiens quinquefasciatus. Mosq. News, 36, 91

Studies conducted in Texas in 1971 and 1972 showed that Stempellia milleri can infect larvae of Culex quinquefasciatus in natural and artificial larval breeding sites. Infection occurred 58 days and 11 days after introduction of the parasites in the natural and artificial breeding places respectively. St. milleri established for a short time in the natural mosquito population but did not survive the dry condition during the summer. In the artificial site, the parasites persisted for more than two months.

*Sanders, R. D. & Poinar, G. O., jr (1976) Development and fine structure of Pleistophora sp. (Cnidospora: Microsporida) in the mosquito Aedes sierrensis. J. Invertebr. Pathol., 28, 109-119

Larvae of Aedes sierrensis infected with Pleistophora sp. were collected from treeholes in California. Eleven out of 6000 larvae collected were infected. The mode of infection, development and pathogenic effects, and fine structure of the parasite are described. The spores appeared to be distinct and probably represent a new species.

*Service, M. W. (1977) Mortalities of the immature stages of species B of the Anopheles gambiae complex in Kenya: Comparison between rice fields and temporary pools, identification of predators, and effects of insecticidal spraying. J. Med. Entomol., 13, 535-545.

6.7% and 8.8% of the larvae of An. arabiensis collected from pools, ponds and rice fields were infected with microsporidans. Common species observed were Parathelohania africanus and unidentified species of Nosema and Parathelohania. 8.2% of the larvae collected from the rice fields had mixed infection of Coelomomyces and microsporidans.

Sprague, V. (1977) Systematics of the Microsporidia. In: Comparative Pathobiology. Bulla, L. A. jr, and Cheng, T. C., eds., Vol. 2, pp. 1-510 Plenum Press, New York.

Undeen, A. H. (1975) Growth of Nosema algerae in pig kidney cell cultures. J. Protozool., 22, 107-110

The stages of development of Nosema algerae growing in vitro in pig kidney cells cultured in Eagles minimum essential medium are described. The parasites germinated, multiplied and produced spores in the cells. These were infective to Anopheles stephensi. The optimum temperature for the germination and infection of the spores was 35°C. This system provides means for observing the early development of N. algerae.

Undeen, A. H. (1976a) In vivo germination and host specificity of Nosema algerae in mosquitoes. J. Invertebr. Pathol., 27, 343-347

Susceptibility studies showed that Anopheles stephensi and An. albimanus are most susceptible to Nosema algerae; An. quadrimaculatus and Culex pipiens are relatively unsusceptible and An. atroparvus are highly resistant. Differences in susceptibility were not correlated with the rate of spore germination in the midgut of the larvae of the species studied. The differences in the pH and the rate of spore movement in the midgut have not been correlated with the rate of spore germination in the mosquito species. The resistance to infection can probably be explained by the ability of the mosquito larvae to withstand penetration of the polar filament or spiroplasm.

Undeen, A. H. & Alger, N. E. (1976b) Nosema algerae: Infection of the white mouse by a mosquito parasite. Exptl. Parasitol., 40, 86-88

Subcutaneous injection of Nosema algerae spore suspensions into white mice caused transient and localized infection. The spores which were taken directly from the mosquito tissues and incubated in human plasma rarely germinated. A high percentage of germination occurred in the plasma only after water-soaking or Ludox density gradient treatment of the spores. These treatments were necessary to break the spore latency period before germination, which is not likely to occur during injection of the spores through mosquito bites into vertebrates.

Undeen, A. H. & Alger, N. E. (1977) Agglutination and immunofluorescence tests for infection of mammals by Nosema algerae (Cnidospora: Microsporida) Sci. Biol. J., 3, 259-262

Van Essen, F. W. & Anthony, D. W. (1976) Susceptibility of nontarget organisms to Nosema algerae (Microsporidia: Nosematidae), a parasite of mosquitoes. J. Invertebr. Pathol., 28, 77-85

Only one species, Notonecta undulata (Notonectidae: Hemiptera) out of nine predators tested, was susceptible to Nosema algerae. The notonectids were infected after feeding on diseased larvae. Several tissues were found to be infected. The spores of the parasite from the infected notonectids when fed to Anopheles quadrimaculatus and An. albimanus caused 90 and 100% infection respectively. Possible reasons for the susceptibility of the notonectids to N. algerae are discussed.

Vector Control Research Centre, Pondicherry, India (1978) Pathogens and parasites, In: Indian Council of Medical Research, Annual Report 1977, pp. 68-83

This reports on the studies being conducted on the pathogens and parasites of mosquitos in Pondicherry, India. An identified species of microsporida was isolated from field collected and laboratory colony of larvae and adults of Anopheles stephensi. An. subpictus was also found infected with the same microsporida.

Weiser, J. (1977) Contribution to the classification of Microsporidia, Věstnik Ceskoslovenske Stolecnosti Zoologicke, 41, 308-320