First report of an intranuclear microsporidian parasite in an invertebrate

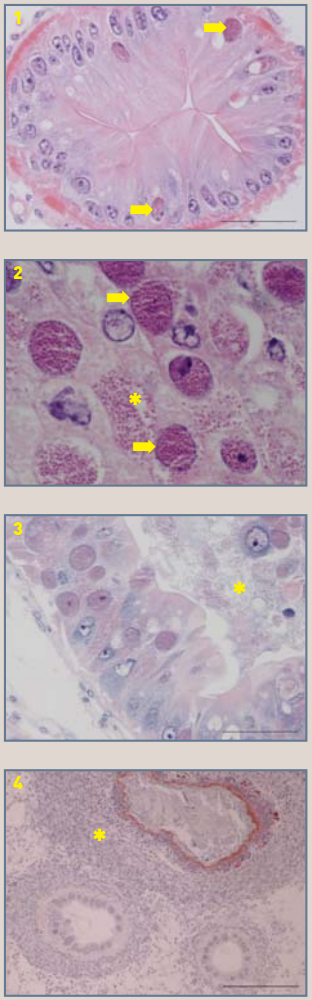
G. D. Stentiford, D. M. Stone, K. S. Bateman, S. W. Feist
The Centre for Environment, Fisheries & Aquaculture Science, Weymouth
http://www.cefas.co.uk

Microsporidians are obligate intracellular parasites that infect a wide range of eukaryotic hosts. In the majority of species, development takes place within the cytoplasm via proliferation (merogony) and formation of mature spores (sporogony). However, one family (Enterocytozoonidae) contain a genus that undergo merogony and sporogony within host cell nuclei. To date, only a few such species have been described in vertebrates, all infecting finfish hosts.

Numerous microsporidian parasites infect crustacean myofibres while fewer species have been described infecting the cytoplasm of hepatopancreatic epithelial cells. To date, no species have been shown to infect host cell nuclei.

Cancer pagurus are captured in baited creels and are the subject of an important European fishery

Here we report the first description of an intranuclear microsporidian in an invertebrate. The host is the commercially exploited European edible crab (*Cancer pagurus*) from the English Channel, United Kingdom.



Figures 1-4: Manifestation of intranuclear microsporidian infection. (1) Early infection was depicted by small numbers of infected hepatopancreatic epithelial cell nuclei (HP) (arrows). (2) Advanced infections were characterised by nuclear (arrows) and cytoplasmic (asterisk) infection. (3) Sloughing of infected cells and free parasites into the HP lumen during advanced infection (asterisk). (4) Degeneration and haemocytic infiltration of tubules (asterisk).

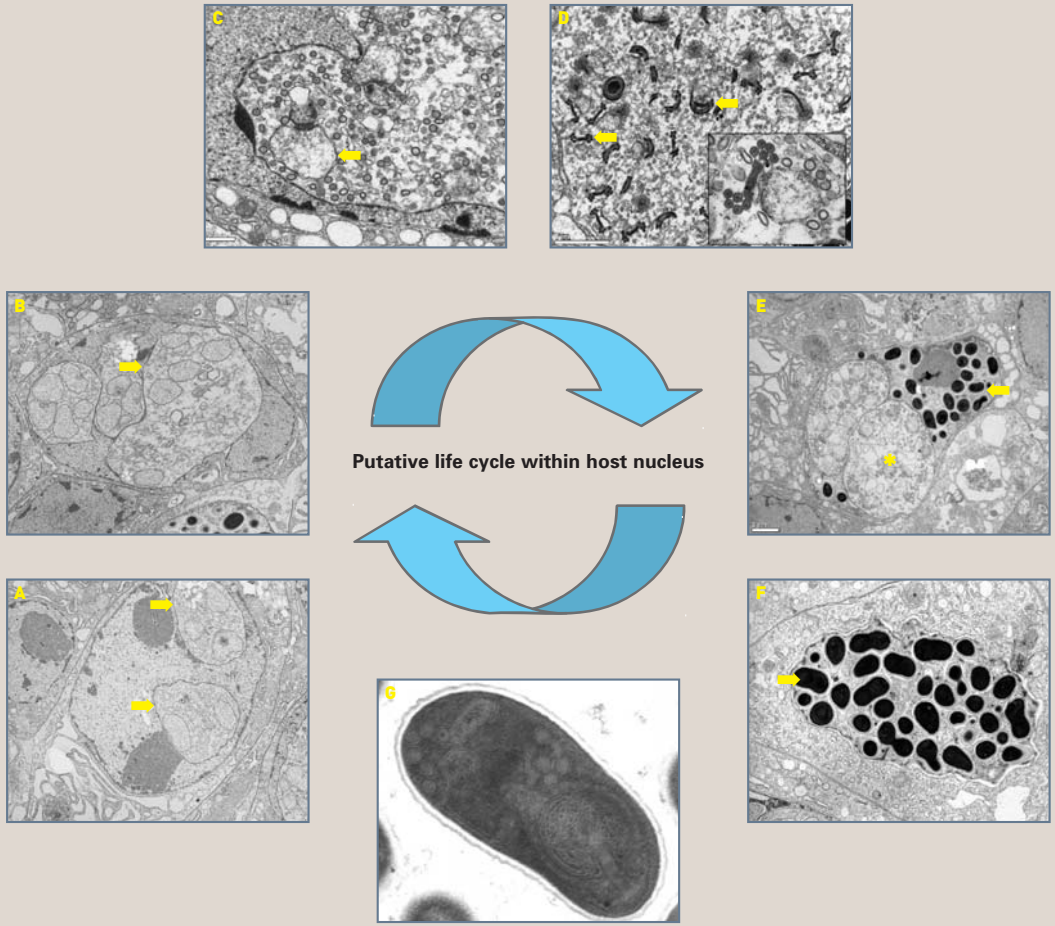


Figure 5: The parasite undergoes complete development within the host nucleoplasm. Multiple binucleate meronts (A) (arrows) developed into multinucleate plasmodia, displacing host chromatin in the early development stages (B) (arrow). Later development of plasmodia led to production of electron lucent vesicles that appeared to associate with parasite nuclei (C) (arrow). Development of an early polar filament and anchoring disk occurred within plasmodia (i.e. prior to plasmotomy) (D and inset) (arrows). Presumably, sporoblasts bud from the plasmodium and lay free within the nucleoplasm of the host cell nucleus (stage not observed). Further development leads to the production of mature spores in the host nucleoplasm (E and F) (arrows). Multiple stages of the parasite can be present within individual nuclei (E) (arrow and asterisk). Mature spores contain anchoring disk, nucleus, polaroplast and a polar filament with 4-5 coils. An electron lucent coat surrounds each spore (G). Eventual degradation of the host nuclear membrane presumably leads to liberation of mature spores to the host cytoplasm and tubule lumen (see Fig 2 and 3). Transmission is likely to be via ingestion of spores (or infected hosts).

Molecular analysis will clarify the relationship between this parasite and the only other intranuclear microsporidian genus *Nucleospora*, in finfish. However, its presence in an invertebrate host coupled with its infection site and its pathological and ultrastructural features suggest this to be the type species of a new genus within the Microsporidia.