Bonamiosis of oysters caused by Bonamia exitiosa

Ryan B. Carnegie
International Council for the Exploration of the Sea
Conseil International pour l’Exploration de la Mer

H. C. Andersens Boulevard 44–46
DK-1553 Copenhagen V
Denmark
Telephone (+45) 33 38 67 00
Telefax (+45) 33 93 42 15
www.ices.dk
info@ices.dk

Recommended format for purposes of citation:


Series Editor: Stephen Feist.

Prepared under the auspices of the ICES Working Group on Pathology and Diseases of Marine Organisms.

The material in this report may be reused for non-commercial purposes using the recommended citation. ICES may only grant usage rights of information, data, images, graphs, etc. of which it has ownership. For other third-party material cited in this report, you must contact the original copyright holder for permission. For citation of datasets or use of data to be included in other databases, please refer to the latest ICES data policy on the ICES website. All extracts must be acknowledged. For other reproduction requests please contact the General Secretary.

DOI: http://doi.org/10.17895/ices.pub.2079

ISSN 0109–2510

© 2017 International Council for the Exploration of the Sea
Bonamiosis of oysters caused by Bonamia exitiosa

Ryan B. Carnegie

Susceptible species
Various oysters, primarily in the genus Ostrea (O. chilensis, O. angasi, O. edulis, O. stentina, O. auporia, O. equestris, O. puelchana, O. lurida) but also Crassostrea ariakensis and C. virginica and probably Saccostrea glomerata (Dinamani et al., 1987; Burreson et al., 2004; Carnegie et al., 2006; Corbeil et al., 2006; Abollo et al., 2008; ICES, 2013; Carnegie et al., 2014; Hill et al., 2014).

Disease name
Bonamiosis

Aetiological agent
*Bonamia exitiosa*, Phylum Haplosporidia (Carnegie et al., 2000), a parasite of oyster hemocytes. Transmission is presumed to be direct.

Geographical distribution
*Bonamia exitiosa* was originally described from *Ostrea chilensis* in New Zealand (Dinamani et al., 1987; Hine et al., 2001). Since 2003, the parasite has been observed on both Atlantic and Pacific coasts of the USA, detected south of Cape Hatteras in the east (Burreson et al., 2004; Dungan et al., 2012) but also in Massachusetts (ICES, 2014, and in California in the west (Hill et al., 2014); in southeastern Australia (Corbeil et al., 2006; Carnegie et al., 2014); along the Atlantic and Mediterranean coasts of Europe and North Africa, including Spain, France, the United Kingdom, Italy, Portugal and Tunisia (Abollo et al., 2008; Hill et al., 2010; Narcisi et al., 2010; ICES, 2010; Carrasco et al., 2012; Longshaw et al., 2013; Batista et al., 2016); and in Argentina (Kroeck and Montes, 2005).

Associated environmental conditions
Depending on the host and geographic location, clinical disease may be associated with temperatures ranging from below 10°C (Cranfield, 1968; per Hine, 1991) to over 30°C (Carnegie et al., 2008). The parasite is frequently observed year-round with only a modest annual prevalence cycle displayed, as in *O. chilensis* (Hine, 1991). In *C. ariakensis*, however, prevalence and clinical disease were found to be sharply higher in the warmer summer and early fall months (Carnegie et al., 2008). *B. exitiosa* displays a preference for euhaline habitats and may be inhibited by salinities below 30 ppt (Bishop et al., 2006; Audemard et al., 2008).

Significance
*Bonamia exitiosa* is acutely pathogenic in some hosts, including *O. chilensis*, *O. puelchana*, and *C. ariakensis* (Dinamani et al., 1987; Burreson et al., 2004; Kroeck and Montes, 2005). It can infect these species at high prevalences and intensities, causing significant mortality. From what has been reported, *B. exitiosa* is somewhat less pathogenic in other
host species. Unambiguous histological evidence of infection of *S. glomerata* from Australia and *O. auporia* from New Zealand is lacking although *B. exitiosa* DNA has been sequenced from both hosts (Carnegie *et al.*, 2014; Hill *et al.*, 2014) and *O. auporia* (as well as *O. stentina*) has been proposed to be synonymous with *O. equestris* (Shilts *et al.*, 2007), which is clearly susceptible. Effects on *C. ariakensis* and *C. virginica* have been focused primarily on young (< 1 year old) seed, with observations exclusively limited to an aquaculture context (Burreson *et al.*, 2004; Bishop *et al.*, 2006; ICES, 2013). Because it is regarded as a significant pathogen, *B. exitiosa* looms as an impediment to fisheries and aquaculture commerce even where it is not acutely pathogenic, as for *O. edulis* in Europe and *C. virginica* in the USA. The significance of new observations is uncertain. The discovery of *B. exitiosa* in *O. edulis* in Europe, for example, may represent improved resolution of parasite diversity (*Bonamia ostreae* also being present) through the application of molecular diagnostics and DNA sequencing. The recent observation in *C. virginica* in North Carolina, USA may represent a temporary host switch under relatively stressful conditions of aquaculture, the parasite never having been observed in *C. virginica* from the region but known to infect *O. equestris* locally. Infection of *C. virginica* in Massachusetts, USA, remote from documented populations of both *B. exitiosa* and *O. equestris*, defies easy explanation.

**Gross clinical signs**

Bonamiosis caused by *B. exitiosa* cannot be diagnosed based on gross signs.

**Control measures and legislation**

Methods for control of *B. exitiosa* are not well established. Care should be taken to avoid introduction of the parasite to *B. exitiosa*-free areas. The parasite may potentially be avoided through selection of culture sites in waters of intermediate salinity (< 25, Audemard *et al.*, 2008) unfavourable to it, although this strategy is not practical for more stenohaline *Ostrea* species like *O. edulis*. The effectiveness and practicality of low-salinity treatment of infected oysters remains to be determined. Infection with *B. exitiosa* is a World Organisation for Animal Health (OIE)-listed disease.

**Diagnostic methods**

The small size of *B. exitiosa* cells (2–4 µm) makes microscopic detection challenging in cases where infection intensity is light, generally necessitating a dual strategy of detection by both microscopic and molecular means. Microscopically, *B. exitiosa* cells can be recognized in both standard histological preparations as well as stained heart or haemolymph smears as primarily uninucleate forms inhabiting the cytoplasm of oyster haemocytes and (to a lesser extent) free in oyster haemolymph. Polymerase chain reaction (PCR) assays specific for *B. exitiosa* have been developed (Carnegie *et al.*, 2008; Ramilo *et al.*, 2013), the latter adaptable for use in a SYBR Green real-time PCR format or multiplexed in conventional PCR format with an assay presented in the same publication for *B. ostreae*. An older conventional assay detecting *B. exitiosa* via PCR-restriction fragment length polymorphism (RFLP, Hine *et al.*, 2001) remains in wide use. Available in situ hybridisation (ISH) assays (Cochennec *et al.*, 2000; Carnegie *et al.*, 2003) remain genus-specific at best. Transmission electron microscopy (TEM) is not a practical tool for *B. exitiosa* diagnosis.

**Key references**

Bonamiosis of oysters caused by Bonamia exitiosa


Histological section of phloxine-tartrazine-stained tissue from a *Bonamia exitiosa*-infected oyster (*Crassostrea ariakensis*) showing parasite cells both intra- and extracellularly in haemal spaces of connective tissues. Bar = 10 microns. (Photo: R. B. Carnegie, VA Institute of Marine Science. Histology courtesy of C. F. Dungan, Maryland Department of Marine Resources, USA).

Author contact details

Ryan B. Carnegie
Virginia Institute of Marine Science
College of William & Mary
P.O. Box 1346
Gloucester Point, Virginia 23062
USA
carnegie@vims.edu