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Aquaculture 253 (2006) 461 – 474
Aquaculture
www.elsevier.com/locate/aqua-online

Presence of spionid worms and other epibionts in Pacific oysters (*Crassostrea gigas*) cultured in Normandy, France

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Received 14 October 2004; received in revised form 16 September 2005; accepted 19 September 2005

Abstract

The presence of mudworms and other epibionts were studied in three batches of Pacific oyster *Crassostrea gigas* from February 2000 to August 2003 at a high productive oyster rearing area in Normandy (France). Spatio-temporal variations of mudworm and epibiont presence were analysed and their impacts on oyster mortality, growth (shell and meat) and condition were assessed. The external shells of the oysters were mainly occupied by barnacles. The proportion of epifauna varied seasonally, showing a peak in autumn for the three oyster batches. The heaviest colonization occurred at the highest areas on the foreshore but there was no obvious relationship between distribution and bathymetry. No significant correlation was detected between epifauna biomass and both oyster growth and condition. Inner shell valves of half-grown (second year of life) and marketable (third year of life) oysters were heavily infested by spionid mudworms whose spatial distribution was significantly correlated with intertidal exposure, the oysters at the highest level being almost free of mudworm tubes and/or blisters. Although it remains unclear how spionid mudworms affect summer mortality of oysters, it was demonstrated that they had a significant negative effect on host growth. Abundant mudworm scars on the inner shell were associated with reduced meat and shell weights, thereby revealing a potential decrease in oyster productivity.

Keywords: *Crassostrea gigas*; Epifauna; *Polydora* worms; Summer mortality; Growth; France

1. Introduction

Oyster farming in the Bay of Veys (Normandy) is characterised by a high trophic richness which promotes rapid shellfish growth (Fleury et al., 2003). The bay contributes an average of 7.5% of total French production with a mean annual production of 9000 tonnes of the Pacific oyster, *Crassostrea gigas* (Thunberg, 1793).

An increase of mortality rate in summer has been observed in the Bay of Veys since 1994 (Goyard, 1996) while a 51% cumulative mortality rate was recorded in 1998 on marketable size oysters (Fleury et al., 1999). Although no single cause seemed to be implicated, summer mortality syndrome is probably a combination of several extrinsic and intrinsic factors. Environmental parameters such as temperature, salinity and oxygen associated with excessive richness in nutrients and gonad maturation have contributed to massive mortalities in other oyster banks (Lipovsky and Kenneth, 1972; Perdue et al., 1981; Andrews, 1982; Maurer et al., 1986;

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doi:10.1016/j.aquaculture.2005.09.018

Soletchnik et al., 1999; Cheney et al., 2000). Our investigations therefore focused on identification of the factors involved in summer mortalities and thence on enhancement of the survival and quality of farmed oysters. In particular the intention was to characterize the impact of external and internal shell epibionts on oyster physiology.

The external shell of oysters is effectively fouled by different species of marine invertebrates that may cause considerable damage to oyster cultures (Arakawa, 1990). Some of these invertebrates are filter feeders and therefore potentially compete with cultivated oysters for phytoplanktonic resources. They can also reduce the water flow through the culture and restrict food availability. Moreover, these organisms can smother the oysters by obstructing the valve opening. Epifaunal species can thus directly affect food availability and consequently, in low trophic condition, can affect the growth and survival of bivalves such as oysters (Osman et al., 1989; Taylor et al., 1997) and scallops (Claereboudt et al., 1994; Lodeiros and Himmelman, 2000).

In addition to external epibionts, the inner surface of the shell can be colonized by burrowing polychaetes (Schleyer, 1991). Prevalence and intensity of such mudworm infestation vary considerably with local conditions. Such infestations vary greatly in density in various basins of the French Atlantic and English Channel coast, as well as within a particular oyster bank (Almeida et al., 1998). With respect to time, the dynamics of infestation are complex, since mudworms can comprise many different species. Mudworms or “polydorid” worms from the Spionidae family comprise a high number of diverse but closely related species which bore into the shell of several molluscan taxa, including oysters, mussels, scallops, abalones or clams (Blake and Evans, 1972; Lauckner, 1983). In the Bay of Veys, five species of burrowing worms were observed in oyster shells (Ruellet, 2004): these included *Polydora ciliata*, *Polydora hoplura*, *Boccardia polybranchia*, *Boccardia semibranchiata* and an unidentified species (*Boccardia* sp.). Infestation is carried out by planktonic larval stages (Blake and Evans, 1972). Newly settled worms can reach full tube length and sexual maturity in a few months and subsequently are capable of rapid colonisation. In the Bay of Veys, *Polydora* sp. and *Boccardia* sp. lifespan generally comprises between 1 and 2 years (Ruellet, 2004). These spionid worms bore into the oyster shell and develop tubes almost immediately inducing the creation of blisters by shell material secretion (conchiolin covered with nacre) to isolate the worm (Kent, 1979; Lauckner, 1983; Almeida et al., 1996). These blisters containing compacted mud may occupy a large proportion of the mantle cavity space and contribute to shell weakening. Worm infestation affects the half-shell presentation and reduces the commercial value of the oysters. Moreover, Lauckner (1983) suggested that a significant reduction of available shell-cavity volume by mud blisters interferes with general physiology of oysters and results in oyster stunting, general weakening, poor condition and increased mortality. Burrowing worms from the genus *Polydora* are suspected to greatly contribute to high oyster mortalities in some shellfish farms. Mass mortalities linked to worm infestation were recorded in scallop stocks from Canada (Bower et al., 1992) and Norway (Mortensen et al., 2000) and in abalones from Western Australia (Westaway and Norriss, 1997) and New Zealand (Lleonart et al., 2003). Thus, infestation by burrowing worms may not only affect oyster quality, but may also influence metabolism and induce mortality. As a consequence, infestation results in a decrease in market value and production.

In the Bay of Veys, little is known about the fouling organisms and the real effect of burrowing worms on oyster physiology. This study therefore aims to assess spatio-temporal variations in the presence of external epibionts and mudworms, and to evaluate their impact on oyster mortality, growth and condition.

2. Material and methods

2.1. Study area and location of sampling sites

The study was carried out in the Bay of Veys on the French coast of the English Channel (Normandy, France), located at the far western Bay of the Seine. This intertidal area includes large oyster leasing grounds (130 ha). Oysters were sampled at five selected stations (Fig. 1), within a farming area which is characterised by a range of physico-chemical conditions. Topography, substratum and hydrodynamic features are summarized for each station in Table 1. The GR1 site (GRandcamp area—the farthest point from the estuary) is less influenced by freshwater than the four other sites, CB (Centre of the Bay), GE1, GE2 and GE3 (3 different sites of the GEfosse area) which are affected by both freshwater and seawater, station GE3 being the highest point on the foreshore. For example, during a period of low rainfall, the lowest salinities were recorded at Gefosse, i.e. 6 ppt compared to Grandcamp where no salinities below 15 ppt were recorded. When rainfall was low, salinity decreased more at Gefosse than at Grandcamp, reaching 21 ppt.