1997

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Journal of Shellfish Research, Vol. 16, No. 2, 519–521, 1997.

EVIDENCE THAT QPX (QUAHOG PARASITE UNKNOWN) IS NOT PRESENT IN HATCHERY-PRODUCED HARD CLAM SEED

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ABSTRACT A protistan parasite known as QPX (Quahog Parasite Unknown) has been recently associated with disease and mortality of adult hard clams, *Mercenaria mercenaria*, from Canada to Virginia. There is concern that the organism may be transported in hatchery-reared seed. Tissue sections of 2,203 seed clams (<1–20 mm) from 13 different hatcheries in six states, collected from 1995 to 1997 and examined by pathologists in three laboratories, failed to show QPX or QPX-like organisms. Further, QPX was not detected in a total of 756 hatchery-produced clams examined during their first year of field growout. From this, we conclude that hatchery-produced seed clams are an unlikely source of QPX organisms.

KEY WORDS: hard clam seed, *Mercenaria mercenaria*, QPX, quahog, disease, parasite, hatchery

INTRODUCTION

A protistan parasite has been recently associated with disease and mortality of wild and cultured hard clams, *Mercenaria mercenaria* (Linnaeus, 1758), from Canada to Virginia (Whyte et al. 1994, Ragone Calvo et al. 1997, Smolowitz and Leavitt 1997, Smolowitz et al. in press). The parasite was first described in clams from the St. Lawrence River, Canada, in the late 1950s and early 1960s (Drinnan and Henderson 1963). It was subsequently found in juvenile and adult clams in a hatchery on Prince Edward Island, Canada, and at that time was given the acronym "QPX" for Quahog Parasite Unknown (Whyte et al. 1994). Morphologically similar organisms have since been found in clams from Massachusetts, New Jersey, and Virginia.

The proper classification of the QPX organism(s) is currently under investigation, and there may be more than one species involved. Whyte et al. (1994) pointed out similarities of the Canadian QPX to members of the Thraustochytriales and Labyrinthulales, which depending on the classification scheme, belong to the phylum Labyrinthomorpha (Pokorny 1985) or to the phylum Labyrinthulomycota (Porter 1990). Although members of these groups are common saprophytic organisms in marine and estuarine environments (Porter 1990), they have also been reported to cause disease in molluscs, especially those held in captivity (Polglase 1980, McLean and Porter 1982, Jones and O'Dor 1983, Bower 1987a).

In one reported disease outbreak, mortalities of up to 100% occurred in nursery-held juvenile abalones, *Haliotis kamtschatkana* (Jonas, 1845), that were heavily parasitized by a Labyrinthulid, *Labyrinthuloides haliotidis* (Bower 1987a). Subsequent investigations (Bower 1987b) showed that *L. haliotidis* could be transmitted directly from abalone to abalone by a flagellated zoospore stage of the parasite.

Hard clam culturists along the East Coast of the United States rely entirely on seed clams produced in hatcheries, which often ship seed to growers in distant regions of the coast. The finding of QPX-like organisms in cultured adult clams, combined with the possibility that they can be transmitted directly between clams, as is the case with *L. haliotidis*, has led to concern that the parasite might have been introduced via hatchery-produced seed and might be further spread in the same way.

Consequently, over the past 2 y, samples of seed clams from hatcheries in seven states (Maine, Massachusetts, New York, New Jersey, Virginia, North Carolina, and South Carolina) have been examined histologically for evidence of QPX, or QPX-like organisms, by our three laboratories. In an effort to provide up-to-date information to seed producers, growers, and resource managers, we present our combined findings in this report.

MATERIALS AND METHODS

Clam seed ranging in size from 1 to 25 mm (mostly <15 mm) shell length and generally no more than a few months old were brought directly to participating laboratories or shipped to them overnight. The smallest clams (1–5 mm) were placed directly into fixative (10% formalin in seawater or Davidson's fixative); the hinges were popped on clams from about 5 to 15 mm, and clams

TABLE 1.

List of hatchery-produced hard clam, *M. mercenaria*, seed samples examined histologically for QPX.

Collection Date	Hatchery Location	Hatchery Code	Shell Length (mm)	Number Examined	Diagnostic Laboratory
5/11/95	MA	A	5–8	50	LAAMP
11/9–27/95	MA	B	4–12	158	LAAMP
6/6/96	MA	A	5–6	150	LAAMP
6/13/96	NJ	C	11–16	23	LAAMP
6/21/96	ME → MA*	D	3–5	150	LAAMP
6/21/96	MA	E	≤2	75	LAAMP
7/24/96	NJ	C	5–8	150	LAAMP
7/24/96	MA	B	1–2	25	LAAMP
8/2/96	NJ → MA*	F	4–10	150	LAAMP
8/28/96	NJ	F	10–14	116	LAAMP
9/13/96	MA	A	15–20	50	LAAMP
10/16/96	MA	B	1–3	50	LAAMP
7/11/97	MA	A	3–5	50	LAAMP
8/28/97	MA	A	12–16	52	LAAMP
8/28/97	NJ	F	14–16	54	LAAMP
8/15/95	NJ	G	4–10	80	HSRL
10/19/95	NY	H	6–12	80	HSRL
10/22/95	NJ	G	6–12	240	HSRL
5/1/96	MA	I	2	100	HSRL
1/28/97	NY	J	5–14	50	HSRL
9/25/97	NC	K	7–9	50	HSRL
9/25/97	VA → NJ*	L	7–9	50	HSRL
10/6/97	NJ	C	10–13	50	HSRL
2/20/97	VA	M	<1	200	VIMS
Total				2,203	

Samples came directly from the hatchery/nursery, except for three samples (*) that were held briefly in nurseries in different states before sampling. Each hatchery was assigned a letter code (A-M) to differentiate among them. LAAMP, Laboratory for Aquatic Animal Medicine and Pathology; HSRL, Haskin Shellfish Research Laboratory; VIMS, Virginia Institute of Marine Science. None of the clams was diagnosed with QPX.

were placed into fixative. In both cases, the shells were allowed to decalcify in the fixative. Larger clams were shucked, and the meats were fixed. Clams 1–12 mm were embedded whole in paraffin; larger individuals were sectioned first. Tissue sections were mounted on slides, stained, and examined microscopically. A total of 2,203 seed clams directly from hatcheries were examined in this manner between May 1995 and October 1997 (Table 1). Only two samples had been held in filtered (1–50 μm pore size) water before examination; the rest had been held in upwellers or raceways supplied with unfiltered seawater. An additional 756 hatchery-produced clams in their first year of field growout were examined in the same manner (Table 2).

TABLE 2.

List of hatchery-produced hard clam, *M. mercenaria*, seed samples examined for QPX during first year of field growout.

Collection Date	Hatchery Location	Growout Location	Growout Period (mo)	Shell Length (mm)	Number Examined	Diagnostic Laboratory
6/6&27/96	MA	MA	7	6–12	136	LAAMP
4/24/96	NY	NY	6	10–12	100	HSRL
4/12/96	NJ	NJ	6	6–8	120	HSRL
5/27/97	NJ	NJ	8	20–25	50	HSRL
5/15/96	VA	FL	<6	4–10	60	VIMS
10/24/96	ME	SC	<6	8–15	60	VIMS
11/20/96	VA	VA	9	5–15	60	VIMS
5/13/97	VA	SC	3	<5	60	VIMS
5/22/97	VA	VA	6	7–8	25	VIMS
5/22/97	VA	VA	5	9–13	25	VIMS
10/1/97	SC	FL	<6	12–16	60	VIMS
Total					756	

LAAMP, Laboratory for Aquatic Animal Medicine and Pathology; HSRL, Haskin Shellfish Research Laboratory; VIMS, Virginia Institute of Marine Science. QPX was not detected in any of the clams.

RESULTS AND DISCUSSION

No QPX-like organism was found in any of the 2,203 clams originating directly from hatcheries. We cannot discount the possibility that infection frequency was so low that we did not detect parasitized individuals in our samples or that our diagnostic methods missed some very light infections; however, the large number of clams that we examined makes this highly unlikely. Further, the scope of our investigation—encompassing 13 hatcheries in six states, seed clams of varying size and age, collections over 2 y, and examination by pathologists in three different laboratories—also lends support to the contention that hatcheries are not the source of QPX. In the late 1980s and early 1990s, six to eight samples of 50 seed clams each, from hatcheries in Massachusetts and New Jersey, were examined histologically without detection of any microorganism resembling QPX (R. Hillman, Battelle Ocean Sciences, pers. comm. 1997).

The evidence that seed clams coming directly from hatcheries do not contain QPX-like organisms is further supported by histological examination of hatchery-produced clams diagnosed within a year of placement in field growout locations (Table 2). No QPX-like organisms were found in any of the 756 clams originating from hatcheries in six states and examined after periods ranging from 3 to 9 mo in the field. In fact, all findings of QPX-like organisms in hard clams under culture in the United States have been in adults, typically 1.5–2 y or older (Ragone Calvo et al. 1997, Smolowitz et al. in press). Smolowitz and Leavitt (1997) monitored the acquisition of QPX infections in clams after they had been placed on infected leases and reported that none was detected until clams had been in the field for at least 1 y.

We believe that the most reasonable interpretation of the available data is that hard clams become parasitized with QPX-like organisms during field growout, not in hatcheries. Whether these organisms are facultative or opportunistic pathogens that invade clams already stressed by poor growing conditions is currently under investigation. Meanwhile, we hope that this report provides reassurance to growers, hatchery operators, and resource managers that hatchery seed is an unlikely source of QPX-like parasites in hard clams.

ACKNOWLEDGMENTS

We thank the many hard clam seed producers who provided seed clams for diagnosis and Juanita Walker and Rita Crockett, who performed histology at Virginia Institute of Marine Science (VIMS). The work reported in this publication was supported in part by the Northeastern Regional Aquaculture Center at the University of Massachusetts Dartmouth, through Grants No. #92-38500-7142 and 96-38500-3032 (to R. Smolowitz) and 93-38500-8391 (to J.N. Kraeuter), from the Cooperative State Research, Education, and Extension Service of the United States Department of Agriculture. This is Publication No. 97-21 of the Institute of Marine and Coastal Sciences at Rutgers and VIMS contribution No. 2099.

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