

U.S. HOUSE OF REPRESENTATIVES
COMMITTEE ON NATURAL RESOURCES
SUBCOMMITTEE ON WATER AND POWER

Hearing on:

*THE SILENT INVASION: FINDING SOLUTIONS TO MINIMIZE THE IMPACTS
OF INVASIVE QUAGGA MUSSELS ON WATER RATES,
WATER INFRASTRUCTURE AND THE ENVIRONMENT*

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Chairwoman Napolitano and members of the Subcommittee, I am Denise Mayer, Senior Research Scientist at the New York State Museum's Field Research Laboratory. Originally from the shores of Lake Superior in northern Wisconsin, I have a long history in the formal and informal study of sensitive aquatic ecosystems and their susceptibility to invasive species, and I have been involved in microbial and ecological research for almost 20 years. I am honored to be here today to provide information about a green technology for the management of quagga and zebra mussels that shows promise to help protect sensitive industries and ecosystems from these fouling invasive mussels.

One of the goals of the NYSM is to make information about the ecology of New York State available to the public and to protect biodiversity through applied scientific research. Industries with raw-water dependent infrastructures are at risk to fouling by mussels and are interested in ecologically friendly alternatives to the broad spectrum biocides currently required to manage mussel infestations in their pipes. Due to its history in biopesticide development, the NYSM's Field Research Laboratory, under the direction of Dr. Daniel Molloy, was approached by the power industries in New York (a research consortium called the Empire State Electric Energy Corporation (ESEERCO)) in the early 1990's hoping that he might discover a highly effective biological control agent that could reduce the use of the polluting broad-spectrum biocides they were forced to use for mussel control due to a lack of safer alternatives (http://sgnis.org/publicat/papers/jsr17_1.pdf). His NYSM laboratory examined the biocontrol potential of the natural enemies of these mussels (parasites and predators) and also evaluated bacteria that contained novel byproducts with pesticidal properties. His laboratory's screening trials of more than 700 bacterial strains did successfully identify a North American bacterium, strain CL145A of *Pseudomonas fluorescens*, that was highly lethal to zebra and quagga mussels.

Since its discovery, his research team at the NYSM, of which I am the lead scientist, has been developing *Pf*-CL145A into an effective and environmentally benign alternative to chemical control for the management of zebra and quagga mussels for use in industrial water systems. Over 3 million dollars in research funds have been awarded to our NYSM laboratory by agencies in NY State (ESEERCO, NY Power Authority, NY Sea Grant, NYS Energy Research and Development Authority, NYS Department of Environmental Conservation) and federal agencies (U.S. Department of Energy's National Energy Technology Laboratory, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, National Science Foundation, U.S. Bureau of Reclamation) for the development of this product. Without the foresight of these funding agencies to find alternatives to polluting biocides, the development of this product would not have been possible. Among the key findings of our research to date are:

- The mode of action of *Pf*-CL145A is toxin related as opposed to infection. Applications are as effective whether the bacterial cells are alive or dead. Thus, to reduce the risk of proliferation and ecological impact, killed cell formulations are applied.
- Because quagga and zebra mussels naturally filter feed on bacteria in water, they readily ingest *Pf*-CL145A cells, and the toxin kills by destruction of their digestive gland. This is in contrast to most chemical treatments which are sensed by the mussels causing them to stop feeding and thereby requiring extended treatment periods.
- The bacterial product is effective across a wide range of biotic and abiotic factors. We have characterized the following variables: water temperature, oxygenation, velocity, turbidity and chemistry (pH and hardness), mussel density, species (quagga and zebra), size, life stage (larval, juvenile and adult).
- The toxicity of the bacterial product is highly specific to quagga and zebra mussels. At dosages that produce high mussel mortality, no bacteria-induced mortality has been observed among any of the nontarget species tested, including fish, ciliates, daphnids and native bivalves.
- Mammalian toxicological studies predict human safety when working with this product.

More detailed information about *Pf*-CL145A is available in the document that I have also submitted as part of my written testimony to the Subcommittee.

Until recently our research focused entirely on industrial applications, i.e., controlling mussels in pipes. After the expansion of the quagga mussel's range to the West, however, there has been considerable interest among state and federal agencies as to its potential usefulness in the control of mussels in open waters, like rivers and lakes. With this interest, we began assessing the effectiveness of *Pf*-CL145A against mussel larvae (i.e., veligers) and have demonstrated their sensitivity to the toxic bacterium. Just over one year ago, when quagga mussels were first discovered in Lake Mead, near the Hoover Dam, the management of the State of Nevada's Lake Mead Fish Hatchery allowed us to conduct a closed system laboratory trial to demonstrate the effectiveness of *Pf*-CL145A at killing quagga mussels from within their facility. Recently the U.S. Bureau of Reclamation has allied with us in a partnership that includes Marrone Organic Innovations (MOI), our commercial partner, to assess the effectiveness of this bacterial product to manage populations of quagga mussels in lakes and reservoirs as well as within closed pipe systems. The U.S. Environmental Protection Agency, as well as regulatory agencies in Arizona, California and Nevada, have been working closely with us and MOI to obtain the permits necessary for experimental field trials and eventual product registration. At the same time, individual states, including Nevada, Arizona and California, have expressed interest in teaming with us to expedite field trials at scales not requiring an experimental use permit (i.e., less than 2 acres) this summer. We would be pleased to form additional partnerships this year with state, federal and private agencies interested in assessing *Pf*-CL145A's effectiveness in controlling quagga and zebra mussels under field conditions. I welcome interested parties to contact me directly if you're interested in participating in field trials out West.

Pf-CL145A is unique in its effectiveness and environmental safety for mussel control and it stands as the only non-chemical control method being developed that could potentially be used in both raw-water infrastructures and open waters with minimal ecological impact. Once formulated to maximize its effectiveness in open-water conditions, the use of this management tool could help slow the spread and impact of quagga and zebra mussels particularly in the Western States where the infestation is still in its early stages. The timing of the availability of this management tool could prove to be critical to preservation of sensitive ecosystems if the mussel invasions are detected early, when we believe *Pf*-CL145A could be most effective. It is in this regard that we feel an urgency to expedite the final phases of R&D on this bacterial control method. When mussels invaded the Central and Eastern U.S., no such environmentally safe method existed to slow their spread, but now we believe that such a tool potentially does exist and field trials are urgently needed to assess the impact of *Pf*-CL145A treatments in open waters.

In conclusion, I'd like to thank the Subcommittee and staff for inviting me here today and express my appreciation to many supporters of this project, including the U.S. Department of Energy, Marrone Organic Innovations, the National Science Foundation, the U.S. Fish and Wildlife Service, the U.S. Bureau of Reclamation and well as the US Environmental Protection Agency. We look forward to continuing to work with them and others as we make further improvements in developing bacterial formulations for effective mitigation of quagga and zebra mussels. I'll be happy to answer any questions that you may have.