An introduced pathogenic yeast may have initiated the crash of the Strait of Georgia *Neocalanus plumchrus* and Cherry Point herring

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Introduction

Gardner reported in 1976 and 1977 that the Strait of Georgia *Neocalanus plumchrus* population had gone into steep decline in 1971 while populations of smaller copepods increased. He predicted declines in important fish populations due to the greater energy needed to acquire equal nutrition from the smaller copepods as from *N. plumchrus*. Whatever caused the crash of the Strait of Georgia *N. plumchrus* may have also contributed to the steep decline in the Cherry Point herring from 1973 to 1982. A literature search revealed that a disease may have been introduced into the Strait of Georgia which was a factor in the decline of the *N. plumchrus*.

Results

Scattergood (1960) documented the many attempts to introduce American lobster to the Pacific Coast of North America. 233 adult lobsters were released into Puget Sound and off the mouth of the Columbia River in 1874, 1879, 1888, and 1899. California waters received transplants of 104,000 larval and 355 adult lobsters at the same time. Efforts to transplant American lobster to the Pacific Coast continued and intensified from 1906 to 1917. 24,572 adult lobsters were planted in Puget Sound and 1,532 in Yaquina Bay. None of these lobsters or any offspring were recovered subsequent to transplantation. However, several adult American lobsters transplanted to Prince Rupert in 1954 (possibly 1955 or 1956) were recovered two years later. One was taken 20 miles away from the release point.

Ghelardi (1967) reported that the dozens of failed attempts by the United States and Canada to introduce American lobster to the Pacific Coast inspired the Fisheries Research Board of Canada to release lobsters in 1965 into confined circumstances where they could be studied in Fatty Basin on the west side of Vancouver Island. Departure Bay near Nanaimo and adjacent to the main basin of the Strait of Georgia received caged lobsters at the same time for comparison.

Only 96 of the184 live adult lobsters caught in 1965 in eastern Canada for this purpose survived a week in quarantine. The survivors were then shipped to the Biological Station at Nanaimo. 22 lobsters were placed in cages in Fatty Basin and 16 lobsters in Departure Bay. The other 58 lobsters were held in tanks at the Biological Station and used to replace dead lobsters in the Departure Bay cages.

17 lobsters died in Departure Bay while only 3 died in Fatty Basin. None of the dead caged lobsters could be assessed for disease due to a lack of preservation. 32 of the 58 lobsters held in tanks at the Biological Station died and 8 were confirmed to be infected with *Aerococcus viridans*, the agent of a fatal blood disease. Diseases and mortalities were thought to be enhanced by crowded conditions (7 to 15 lobsters per 12 ft^2) in the tanks. Each lobster when originally caught had its claws immobilized with wooden plugs which also encourage infections.

Seki and Fulton in 1968 found 5% of zooplankton collected at depths greater than 200 meters at Station 1 (between the southern tip of Lasqueti Island and Vancouver Island) in the Strait of Georgia to be infected with *Metschnikowia* sp., a yeast pathogen of crustaceans. The sea floor at the time was littered with *N. plumchrus* exoskeletons. *Metschnikowia* cells were only common in water samples collected above 20 meters in depth suggesting that infected zooplankton must have carried the yeast to depth. *N. plumchrus* possibly carried *Metschnikowia* down to depth when entering its annual diapause.

Seki and Hardon in 1969 found *Metschnikowia* on a rock crab (*Cancer productus*) from Fatty Basin. Even though the yeast was not found on lobsters from the experimental introduction, only carapaces were sampled and the pathogen is known to infect intramuscular tissue causing Seki and Hardon to conclude that the lobsters may also have been infected with *Metschnikowia*.

Conclusions

The information presented here is not proof that *Metschnikowia* caused the crash of the Strait of Georgia's *N. plumchrus*. Even if a factor, it was only one of many possible factors. The next known potentially harmful event in the Strait of Georgia was a major oil spill in 1972 (Bellingham Herald, June 5 and 6). Carls *et al* (2006) demonstrated that *N. plumchrus* picks up and concentrates both dissolved and particulate oil while feeding. They proposed sampling these copepods as a means to monitor for oil pollution. *N. plumchrus* would pick up other pollutants in the same way.

Large scale environmental factors are also important. Mackas *et al* (2013) documented associations between various climate/oceanographic changes and the Strait of Georgia *N. plumchrus*. These changes appear to have resulted in a timing mismatch between *N. plumchrus* emergence to graze in shallow water and the Strait of Georgia annual phytoplankton bloom. Another mismatch was seen between *N. plumchrus* emergence and the fish depending upon this lipid-rich food source to emerge at predictable times and places within the Strait of Georgia. Such mismatches usually have negative population consequences.

It is impossible to know every anthropogenic or natural event which may have affected the Strait of Georgia *N. plumchrus* and Cherry Point herring. All we know for sure is that forty years have passed and both populations remain in decline. We must learn to be more observant at all levels and to be more careful in our decisions.

In Ghelardi's 1967 progress report on the attempt to introduce American lobster, he said:

> "There are, potentially, two detrimental effects that could result from the introduction: a population explosion by lobsters that might eliminate natural animals and plants; introduction of new pest parasites harmful to resident species. A thorough, quantitative assessment of the probability associated with each of these is theoretically desirable but logistically impossible at this time…"

If so, the attempts to introduce lobster to the West Coast should not have been made.

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