

NON-INDIGENOUS AQUATIC SPECIES OF CONCERN FOR ALASKA

Fact Sheet 13

Foraminiferan *Trochammina hadai*

BIOLOGY & PHYSIOLOGY

Physical Description: Foraminiferans are single cell amoeba-like microorganisms with shells made of calcium carbonate. In general, a foraminiferan is a unicellular organism, characterized by long, fine protrusions (pseudopodia) extending far away from their cytoplasmic body. In its early life stages, the shell contains a single chamber. New chambers are added in a characteristic linear, spiral, or concentric series as the organism grows. Some shells reach several inches in diameter, but most species are less than a millimeter in diameter. Long, branching extensions of the cell (pseudopodia) reach from openings in the shell and fuse together to form a net in which planktonic organisms are trapped. The net may cover an area 10 times the diameter of the shell. Foraminiferans may be red, brown, or white in color.



Photo by: Ohio State University

Nutrition Requirements: Foraminiferans have a broad food preference. They may eat live food such as bacteria, unicellular algae, especially diatoms, other protozoa, small anthropods, and small sea urchins. They may also eat material such as dead organisms, organic-rich grains including fecal pellets, detritus, and colloidal organic molecules.

Reproduction: Foraminiferans exhibit both sexual and asexual reproduction. Studies conducted on the reproductive activities of this specific foraminiferan showed that sexual reproduction occurred only in spring whereas asexual reproduction occurred in autumn. During sexual reproduction, gametes (eggs and sperm) from different individuals are released into the water. The sperm will fertilize the egg to form the zygote (fertilized egg). The zygote then develops into a mature adult. Asexual reproduction begins as the foraminiferan builds a protective cyst of mineral grains and debris around itself. This is accomplished by the pseudopodia (a temporary cellular extension used in moving and feeding) actively moving material into position and cementing it into a rigid cyst wall. One or two hours after cyst formation, the cytoplasm within the foraminiferan begins to differentiate into many individual gamonts (gamete-producing form of an organism that is sexually differentiated). The gamonts then produce the eggs and sperm that will unite within the same foraminiferan and form the zygotes. The zygotes are then released into the water where they will mature into individual foraminiferans. The time required for reproduction varies considerably among individuals, but is always less than 24 hours (usually about 6 hours) from the time that cyst building becomes noticeable until the time the young are dispersed.

Lifecycle Stages: The life cycle of foraminiferans is biphasic, meaning that during their annual life cycle they exhibit two morphological forms.

Habitat: A few foraminiferans live in fresh or brackish water, but most live at all depths in marine environments. They are found in the first couple of centimeters of the sediment. They prefer environments that are very stressed. This specific foraminiferan thrives in saline waters of 17.5-30 ppt (parts per thousand) but can be found in waters with salinities as low as 12-15 ppt. This species tolerates water temperatures from 52-66° F. It is more abundant on muddy rather than sandy substrates, and thrives in estuaries year-round with saturated oxygen conditions. The abundance of foraminiferans typically increases as the levels of organic matter in the sediment increases. It has

been observed that this foraminiferan is dominant in foraminiferan assemblages in the most contaminated brackish water locations, especially in sites with heavy metal contamination. Some studies have shown that a related species, *Trochammina pacifica*, increases significantly in highly organic sediments surrounding the Orange County, California ocean sewer outfall. Other studies similarly showed that *T. pacifica* was 2 to 1,600 times more abundant than usual in the vicinity of the Los Angeles city sewage outfall.

DISPERSAL POTENTIAL

Historical and Current Introduction/Spread: This specific foraminiferan's earliest record in North America is from sediment collected in Puget Sound, Washington in 1971. Sediment samples show that this foraminiferan was most likely introduced in San Francisco Bay sometime between 1981 and 1983. It may have first been recorded in Prince William Sound in 1989 where it is currently established. However, sediment samples collected from low intertidal to shallow subtidal zones throughout Prince William Sound during 1998-1999 did not contain this specific foraminiferan, so the extent of this population in the Prince William Sound area remains unclear. It can now be found in marine sediment from San Diego to Alaska. It is likely that this foraminiferan's native distribution is the Northwest Pacific, including Japan. It should be noted that this foraminiferan's exact origin is uncertain; it is possible that its original distribution could include parts of the West Coast of North America. There are three possibilities for the origins of this foraminiferan at sites along western North America: (1) it may be native to sites both north and south of San Francisco Bay, but not to San Francisco Bay itself; (2) it may initially have had a boreal (extreme) Pacific distribution, ranging as a native species from Japan northward through Siberia to North American shores and southward to some point north of San Francisco Bay, and been recently introduced by human activities or carried by currents to sites south of that point; or (3) it may be native to Asian shores and introduced to all North American sites where it is now found.

Dispersal Methods: In general, foraminiferans can be transported in sediment associated with oyster farming as well as ship hull fouling, anchor mud, in ballast water, or in sediment from ballast tanks. A study on Prince William Sound tanker ballast confirmed that this foraminiferan was present in eleven of thirty samples.

IMPACTS AND CONTROL

General Impacts: Although it is still too early to fully quantify the impact of this foraminiferan on estuary ecosystems, a study conducted in San Francisco Bay revealed that it dominated nearly one-third of the Foraminiferan assemblages, indicating that this type of Foraminiferan may be capable of replacing native Foraminiferans.

Management Information: There are no known control measures for foraminiferans once they are established. The best control measure for this species is preventive, such as ballast water management and treatment. Controlling organic discharges into the marine environment can also help control populations.

Key Notes: In general, foraminiferans are eaten by a wide variety of predators such as copepods, planktonic larvae, crabs, worms, scaphopods, shrimp, gastropods, fish, and other foraminifers. Foraminiferans are so plentiful in oceans that, as they die, they settle to the bottom, form massive deposits, and harden into limestone rock.