Passage Three

Beluga Whales in the St. Lawrence River

At first, the scientists turned their attention to the most striking disorder – cancer. The incidence of cancer in belugas is twice as high as in humans and higher than in horses and cats. Restricting the comparison to gastrointestinal organs, those most affected in whales, makes this comparison even more striking. In the latter comparison, the only animals that exceed whales were sheep in Australia and New Zealand. The high disease rate in the sheep populations has been attributed to carcinogenic herbicides. The sheep graze in pastures contaminated with carcinogenic chemicals. This observation eventually provided a model that applied to whales because sediments in portions of the St. Lawrence contain an extremely potent carcinogen that collects in invertebrates. Although able to detect the carcinogen in belugas, the scientists were not certain how it entered the animals' systems until they discovered that, in addition to eating fish, belugas dig into sediments to feed on bottom-dwelling invertebrates. This seemed like a good model and likely explanation for how a specific, potent carcinogen entered the belugas.

In the end, however, the cancer data were confounding. Exposure to a certain carcinogen usually harms a specific tissue, but in the belugas, a variety of organs were affected. So, the investigations moved to organohalogens, the chemicals that were most abundant in the whales. Other research has demonstrated that, in many animals, organohalogens impede the activity of killer cells, the immune cells that ordinarily destroy malignant tumor cells. When given to experimental animals in embryonic, fetal, and early postnatal stages, these chemicals caused defects in the nervous, endocrine, and reproductive systems. In addition, other research indicated that organohalogens stunted the production of immune cells. This line of research led to investigations that

- Examined blood samples from contaminated whales to determine the levels of organo-halogens in the plasma and the numbers and responses of immune cells, and
- Determined the minimum levels at which the ill effects of organohalogens arise.

As a result of these investigations, the biologists determined that beluga whales were in fact more contaminated than expected. The researchers found the observation puzzling because larger animals typically have lower levels of toxins. There are two reasons that larger animals have lower levels of toxins: 1) smaller whales require more food per pound of body weight than do larger whales, and 2) some larger whales consume base-level plankton while other smaller whales such as the harbor porpoise consume fish that are higher in the food chain, where organo-halogens accrete. Application of the model developed in this line of research provided an explanation. The belugas feed on eels, which have high levels of MIREX (a chemical produced in a plant near Lake Ontario), and adult eels migrate to the Atlantic through the beluga habitat. During the course of 15 years of eating migrating eels, the beluga whales would have taken in the amounts of MIREX found in dead belugas and half the amounts of other chemicals such a PCBs and DDT. The investigations continued and the evidence was helping scientists form cause-effect explanations. But as the senior scientist indicated, "At this juncture I felt like a naïve detective who had been trying to figure out how packages move between cities by searching highway vehicles at random. I got nowhere until I chanced on a mail truck" (p.63).

In this statement the scientist was referring to an alternative explanation. The investigators noticed that organohalogen levels were often higher in very young animals, which contradicted another common explanation – toxins accumulate during the animals' lifetime. Also, they found that adult females were consistently less contaminated than the males. These observations suggested the explanation that the females passed significant amount of chemicals on to their

calves. When the team examined several females that had died shortly after giving birth, they found evidence for this explanation. The milk provided the evidence. The suckling calf ingests food that is far more contaminated than its mother's food. In ecological terms, the calves feed at a higher echelon in the food chain where the toxins have been concentrated. Every new wave of calves begins life with higher levels of toxins than those of their mothers. They then take in fish that also contain higher levels of toxins each year. So, each new generation begins at a less advantageous position than prior generations.

The scientists proposed an answer to the original question – What explains the lack of increase of the beluga population? All the evidence indicates that the belugas have failed to increase in number due to the long-term exposure to a complex mixture of toxic chemicals.

How does the investigation of the beluga whales illustrate scientific inquiry?

Identify specific places in the passages that illustrate one of the following aspects of scientific inquiry from the National Science Education Standards (NSES).

Understandings About Scientific Inquiry

- ✓ Different kinds of questions suggest different kinds of scientific investigations.
- ✓ Current scientific knowledge and understanding guide scientific investigations.
- ✓ Mathematics is important in all aspects of scientific inquiry.
- ✓ Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.
- ✓ Scientific explanations emphasize evidence, have logically consistent arguments, and use scientific principles, models, and theories.
- ✓ Science advances through legitimate skepticism.
- ✓ Scientific investigations sometimes result in new ideas and phenomena for study.