

## Infections endangering wild aquatic animals

*How can we help all these stranded dolphins?*



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## A child-centric microbiology education framework

### Infections endangering wild aquatic animals

#### Storyline

What are the reasons for recurrent mass mortalities of dolphins and seals? Are medical interventions to aquatic mammals sustainable? How can we help to avoid plague-like infection outbreaks in these species?

#### Infections endangering wild aquatic animals: the Microbiology

1. ***Animal plagues are dramatic events for the public.*** Animal plagues are generally perceived as devastating infectious diseases of domesticated animals where they are of great economic and public health concern. In natural habitats and in particular in aquatic habitats, plagues remain mostly unnoticed as the dying animals often disappear in the vastness of the oceans. However, if such epidemics happen inshore and dying animals are detected in masses on beaches, the news rapidly spreads across the globe and the public becomes horrified with the articles and pictures.

2. ***Identification of the causative agents and reasons for outbreaks can be difficult.*** Analysis of the causes of such events is often cumbersome and requires intensive studies, first on the etiological agent that caused the mass mortality, and secondly on the reasons of the sudden appearance of the epidemics. Very often, the etiological agents found are genetically related to known viruses of plagues in domesticated animals or humans. The reason for their sudden spread or jumping host species, however, often remains unresolved. To clarify these aspects requires comprehensive and interdisciplinary studies on the behavior of the affected animals and the possible changes of their natural habitat.

3. ***Example: Endangered dolphins.*** In summer 2013, bottlenose dolphins (*Tursiops truncatus*) off the American East Coast were suffering the worst outbreak of an infectious disease caused by a morbillivirus. The epidemic was initially detected on the coast of New York State from where it spread southwards to the coast of Florida. It resulted in the stranding and death of about 1500 dolphins.

a. Dolphins can get infected by morbillivirus through inhalation of aerosols containing the virus, or by direct contact with other infected dolphins. In addition to the respiratory tract, the virus finds its entry via eyes, mouth, urogenital tract and wounds in the skin. The virus then affects mainly the lungs, leading to breathing difficulties and pneumonia. The animals are stressed and act abnormally, one of the possible reasons for stranding.

b. The virus belongs to a family that includes many highly contagious pathogens, such as the human measles virus, the human mumps virus and the distemper virus of dogs. The virus also weakens the dolphin's immune system, so they often suffer from secondary infections by fungi or bacteria. Because some of these secondary pathogens can also be dangerous to humans and their pets, people are advised to keep their distance from the dead animals on the beach. On the other hand, according to current knowledge, the morbillivirus that has been circulating among bottlenose dolphins does not infect humans.

c. Researchers and veterinarians cannot stop such epidemics, and this is unfortunately the case for most of the disease events occurring in free-ranging animals. At best, they hope to gain an understanding of the origin, and ideally to acquire information that could help to implement management of the affected hosts. So far, it is unclear why the outbreak had come about and it is possible new outbreaks will occur in the future. A particularity of the

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outbreak on the American East Coast was that the disease affected mostly young animals. It was speculated that the older animals that had survived a similar epidemic 20 years earlier were naturally immune to the 2013 outbreak. The hope is that the dolphins that survived gained lifelong immunity to the pathogen.

d. But why did the 2013 epidemic occur and why was it so severe? Researchers assume that environmental factors such as heavy metal pollution and changes in water temperature may have contributed to the outbreak by weakening the innate immunity of those animals that were not immune or had acquired only a low adaptive immunity. Vaccinating wild dolphins is not possible for practical reasons and is strictly discouraged or forbidden in many countries. Much more meaningful is to protect the habitat of the dolphins, by implementing the measures necessary to avoid water pollution and warming of the oceans. This will significantly reduce the susceptibility of dolphins to infectious diseases and is essential for their survival, and that of most other wild animals.

e. It should be emphasized that the environment has a critical influence on the already complex host-pathogen interactions, and can play a significant role in disease outcome. Accordingly, the environment is probably the element which we, as humans, can influence in diverse ways. The understanding of this aspect and its exploitation to develop a long-term strategy is probably among the best approaches to reduce these disease outbreaks and for the conservation of these paradigmatic species.

4. **Example: recurring mass extinctions of harbor seals.** In 2002, newspapers and TV news networks around the globe reported a tremendous mass extinction of harbor seals (*Phoca vitulina*) in Northern Europe, in particular on the coasts of Germany. Hundreds of volunteers from animal welfare organizations tried to help save the seals, but in vain. The disease symptoms were coughing, shortness of breath, fever and general weakness, which are typical of phocine distemper virus. The distemper virus epidemic resulted in the deaths of more than 30,000 harbor seals, and was a repeat of another severe epidemic 14 years earlier which resulted in over 18,000 dead seals.

a. Interestingly, both epidemics were first detected on the Danish Island of Anholt in the middle of Kattegat, which is home to a marine animal observation and research station. From there the disease spread to adjacent seal colonies. However, also more distant and unlinked outbreak foci were detected in the Irish Sea and in the Dutch Wadden Sea. This observation was important to understand the outbreaks.

b. Harbor seals are known to be sedentary and the sudden outbreaks in unlinked places indicated the role of a vector species involved in disease transmission. Another seal, the grey seal which often mixes with harbor seals was assumed to be the carrier that spread the phocine distemper virus. Grey seals infected with the virus seem to show much milder symptoms. In harbor seals, distemper can lead to death within two weeks.

c. Phocine distemper virus strongly resembles canine distemper virus. It weakens the animals' immune system and makes them susceptible to secondary infections like pneumonia. The virus is not dangerous for humans. Nevertheless, humans and their pet animals, in particular dogs, should keep distance from diseased seals in order to avoid dissemination of the disease.

d. Scientists wondered how the two extremely severe epidemics with an interval of 14 years without other major outbreaks could have happened. One possibility is that, after the first epidemic decimated the colonies of harbor seals so strongly, for long time their population density was too low to allow efficient transmission/support an epidemic. Furthermore, the surviving animals from the first epidemic may have acquired immunity.

e. Another possibility is that pollutants such as lead, mercury and cadmium which enter the North Sea via rivers, also increase the susceptibility to infections. Furthermore, due to the pollution and heavy exploitation of the oceans by humans, the seals are forced to migrate to

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the remaining less polluted places where they live in highly dense colonies, thus increasing transmission and the risk of epidemics.

f. There is, however, a vaccine against phocine distemper virus that is used at times in seals in captivity. However, vaccinating thousands of seals in the wild is considered impractical and at odds with current wildlife conservation practices. The experts hope to gain precise knowledge about the cause of seal mortality in order to be able to propose adequate measures to the authorities.

5. **Conclusions.** Aquatic animals, in particular dolphins and seals, often inspire strong emotional feelings in humans, especially children. And in spite of their lifestyles and habitats, which are very unlike those of humans, they seem to be able to interact with humans when in captivity, partial confinement or unconfined in inshore locations. Severe epidemics in wild animals like dolphins and seals are relatively rarely reported since they are only observed when the diseased animals appear in places like sea shores where they encounter humans. However, when it happens, the news rapidly spreads around the globe and induces animal welfare organizations and many members of the public to try to help the suffering animals. However, such actions, although well intentioned, are unfortunately of little help to the animals and paradoxically may cause more harm than good to the surviving population.

More useful is a broad interdisciplinary scientific approach, aimed at understanding the various microbiological and environmental parameters that led to the disastrous outbreaks, and finding sustainable measures and policies to reduce manmade activities that could be behind such disasters. Communication to the wider public of the underlying causes of the epidemics is of paramount importance to raise consciousness and practices that safeguard the habitats of wild animal species.

### The Evidence Base, Further Reading and Teaching Aids

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