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Lead shot at Larnaca salt lake – assessment and restoration activities

Myroula Hadjichristoforou
Department of Fisheries and Marine Research, Cyprus

In February 2003 the death of 52 flamingos in the area of the shooting club on the shores of the Larnaca Salt Lake lead to an investigation as to the causes of the incident. It was ascertained that the death of the birds was caused by the presence of lead shot in their gut system and that they displayed lead poisoning symptoms. Up to 80 lead shot were found in the gut of birds. Further investigations showed that in the immediate area of the shooting club, the concentration of lead shot in the sediments of the lake reached 98,000 lead pellets per square metre in the more affected areas.

The history

The Larnaca Salt Lake complex was declared as a protected area by a decision of the Council of Ministers in 1997. In 2001 the main Larnaca Salt Lake was declared as a Ramsar Site, the first such site in Cyprus.

The shooting club was set up on the shores of the Lake in 1979. In 1997 following a study by the Department of Fisheries and Marine Research in 1995, which showed very high levels of lead in the sediments of the lake in that area, the Council of Ministers decided that the operation of the club was to be terminated and that it would move elsewhere. This decision was taken within the overall management plan of the salt lakes of 1997. Due to problems in finding a new location the club remained there, until the deaths of the Flamingos in 2003 pressed for immediate action.

In February 2003 following a debate in the House of Representatives on the issue it was decided that the Shooting Club was to terminate its operations immediately. It was also decided that habitat restoration was to be undertaken urgently but that it should be preceded by an environmental study of the related parameters and of the restoration methods to be used. This was undertaken by the Department of Fisheries and Marine Research. The study was submitted to and approved by the Management Committee of the Larnaca Salt Lake protected area.

On the ecology of the lake

The main Salt Lake is the saltiest of the lakes in the area. It usually dries out in summer. The basis of the food chain there is *Dunaliella salina* on which *Artemia salina* feeds. In winters with a lot of rain *Branchinella spinosa, which predominates in the neighbouring lakes, as well as* some Ostracods are also found in the main lake. The number of flamingo overwintering in the lake and feeding on the shrimps, is usually about 1000-2000, though in a good winter there may be 5-7000 flamingos overwintering in the lake.

Methodology and summary of results

Sampling of the lake bottom was undertaken with a corer which sampled to a depth of 12 cm. Sampling extended to 300m from the shooting range. The largest concentration of lead shot was found at a distance between 100-150m from the club, peaking at about 98,000 lead shot per m^2, though the range where lead shot was found extended from 50 to 200m. It was found that the pellets were mainly in the top 5 cm of the sediment, with only a few between 5-8 cm and none lower down (Fig 1).

Sediment analyses also showed concentrations of 3,826 mg/kg of lead in the sediment, compared to about 30 mg/kg in other areas of the lake. In the 1995 study 1,316 mg/kg of lead was found in the shooting club area and about 25mg/kg elsewhere.

Why the flamingo died in 2003 and not in earlier years

The reasons for the deaths of the flamingo occurred in 2003 and not in previous years were:

a. The high rainfall in 2003 covered a wider than normal area, which meant that the flamingo had access to the area contaminated with lead shot, near the shooting club, for feeding.

b. The high rainfall in 2002 led to water remaining in the lake over the preceding summer period, upsetting the usual ecological cycles and limiting the quantity of Artemia in the lake. This in turn changed the feeding pattern of the flamingo which started looking for food by stirring the sediment with their feet and ingesting lead shot in the feeding process.

Restoration methodology and actions

The restoration method chosen was the removal of the top 10 cm of sediment in the area in which the lead shot was found. An area of 550m by 200m was cleaned up this way. A bulldozer was used. The clean up operation was undertaken in August/September 2003 when the lake dried up and conditions were optimal. The contaminated material was removed to an old quarry selected for the purpose by the Geological Survey Department, to ensure that no pollution or other problems were created.

The restoration operations were carried out in three phases, all supervised by the DFMR:

- Removal of the broken target discs and piles of empty cartridges (August 2003)
- Clean up operations for the lead shot loaded sediments (August/September 2003)
- Demolition and removal of the buildings and other infrastructure of the shooting club (October 2004)

The restoration operation is considered to be very successful as the area has reverted back to near normality and the mortality of flamingo in 2004 has been low, though the lake was flooded to 2003 levels.

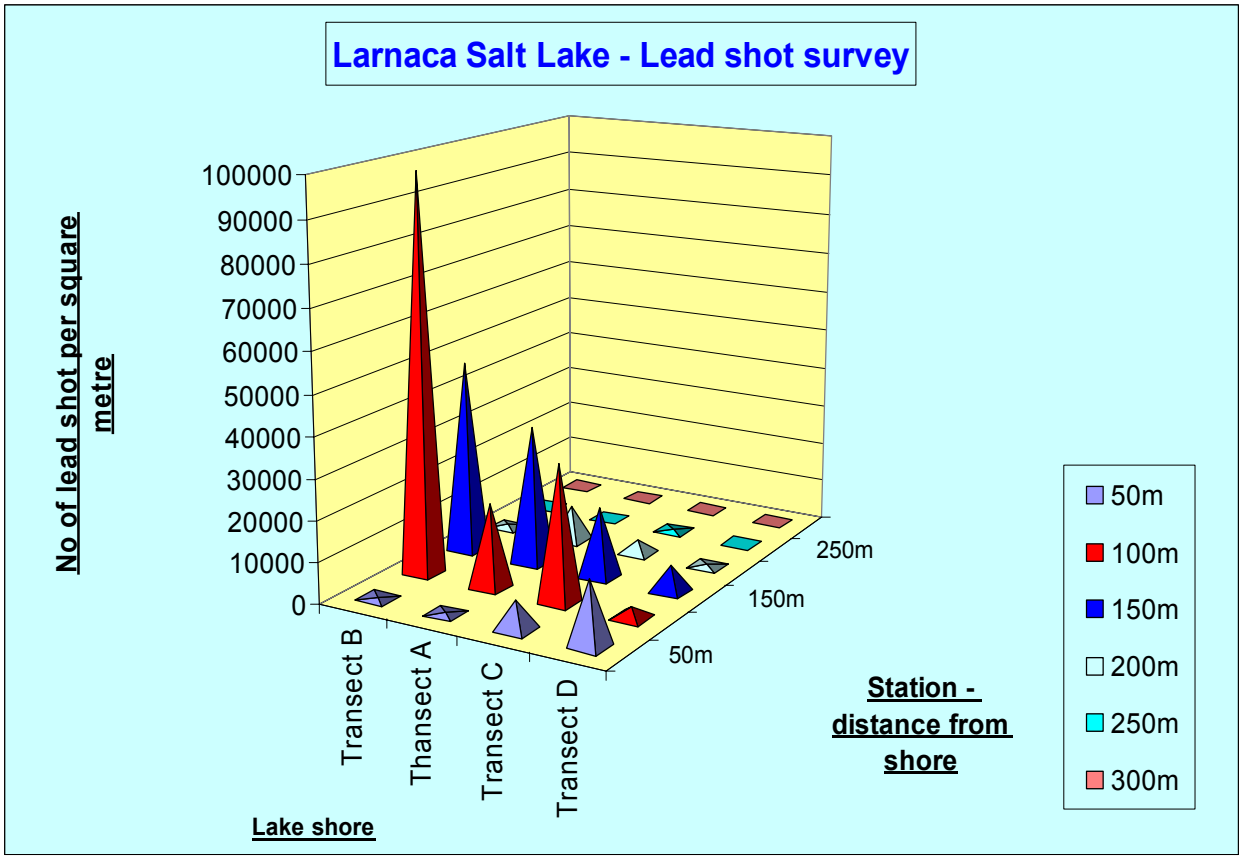
Larnaca Salt Lake - Lead shot survey
No of lead shot per square metre
100000
90000
80000
70000
60000
50000
40000
30000
20000
10000
0
Transect B
Thansect A
Transect C
Transect D
Lake shore
50m
150m
250m
Station - distance from shore
50m
100m
150m
200m
250m
300m

Fig 1