



पशु रोग शोध एवं निदान केन्द्र
भारतीय पशुचिकित्सा अनुसंधान संस्थान

इज्जतनगर-243 122 बरेली (उ०प्र०) भारत

Centre for Animal Disease Research and Diagnosis

An ISO 9001 : 2000 Certified Centre

INDIAN VETERINARY RESEARCH INSTITUTE

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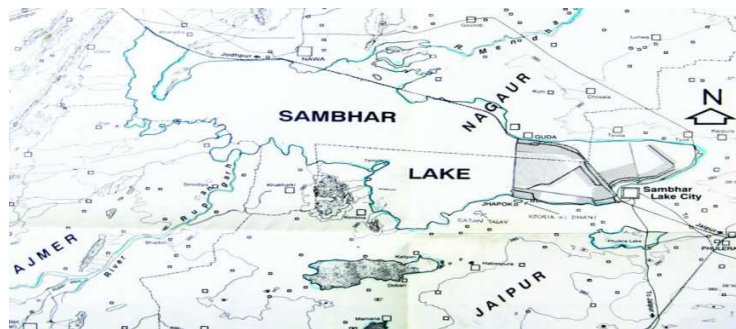
Date: 21.11.2019

To,
Director,
Directorate of Animal Husbandry,
Pashudhan Bhawan,
Lalkothi,
Jaipur, 302015

Investigation of mortality in the migratory birds of Sambhar lake, Jaipur, Rajasthan

Details of the lake:

- Sambhar Lake (26°52'–27°02'N 74°54'–75°14'E), situated in the Nagaur, Jaipur and Ajmer districts of Rajasthan and spread over 240 km², is India's largest inland saline wetland. It has been recognised by Government of India as a wetland of International importance and has been accordingly designated a Ramsar Site. (Source: CCF, Jaipur, Rajasthan).
- Sambhar Lake has a catchment area spread over 5,700 km². The playa has a maximum depth of 3 m with average depth not exceeding 0.16 m. The lake basin is 22.5 km long while its width ranges from 3.2 to 11.2 km. The lakebed (360 m alt.) is almost flat with a slope of 10 cm per km. The lake was divided into two unequal parts by a 5.16 km long embankment erected in 1924 between the settlements of Jhapok in the south and Gudha in the north. The western part of the lake covering about 113 km² has almost no disturbance and is a natural continuous sheet of water. On the other hand, the eastern part of the lake, covering 77 km², is heavily used for salt extraction and comprises a mosaic of canals and salt pans (Sangha, 2009).



(Image source: Singha, 2009)

- **Source of the water:** Four seasonal streams—Mendha, Rupangarh, Kharian and Khandel—besides numerous rivulets and surface runoff, feed the lake . (Source: CCF, Jaipur, Rajasthan; Sangha, 2009).).
- **Salinity:** With the onset of rains, the lake starts filling gradually and the water is almost fresh, with salinity less than 2 ppm. The salinity of the lake, however, increases through the winter due to evaporation and salt-encrustation of the lakebed. Salinity rises sharply during spring or early summer when salt crystallisation starts (Sangha, 2009). Report attached for water testing done on 13.11.2019 (Source: JD (AH), Jaipur). It was very clear that the salt levels **are well below 2ppm (Report attached)**

Sambhar Salts Ltd. Sambhar Lake									
Sambhar Salts Test Laboratory									
Analysis Report of Lake Brine sample received through Director verterinary dated 13-11-2019									
*Tested on Wet basis									
*Date of Analysis 14-11-2019									
S.N.	Lab Code	Description	Density @ Be	Sodium Chloride as NaCl %	Alkalinity as Na ₂ CO ₃ %	Sodium Sulphate Na ₂ SO ₄ %	Calcium as Ca %	Magnesium as Mg %	Water Insoluble %
1	2928	20 Mts. (Back side Ratan talab)	4	2.84	0.15	0.30	0.006	0.007	0.28
2	2929	40 Mts.	2	1.58	0.10	0.15	0.004	0.0036	—
3	2930	60 Mts.	2	1.58	0.11	0.13	0.004	0.0036	—
4	2931	80 Mts.	2	1.58	0.11	0.14	0.004	0.0036	—
5	2932	100 Mts.	2	2.21	0.10	0.15	0.004	0.0036	—
6	2933	120 Mts.	2	1.58	0.11	0.14	0.004	0.0036	—
7	2934	140 Mts.	2	1.58	0.10	0.18	0.006	0.0036	—
8	2935	160 Mts.	2	1.58	0.11	0.12	0.004	0.0036	—
9	2936	180 Mts.	2	1.89	0.10	0.11	0.006	0.0036	—
10	2937	200 Mts.	2	1.58	0.11	0.15	0.004	0.0036	—

This Report is for infromation to verterinary department only and not for other use

Incharge (BSP/GSR) *15/11*

ICISSD
15/11/19

Bhojani
Jr. Mgr. (Tech.)
(GSR)

- **Recent rain:** It was enquired from the local people about the rain this year; it was found that there was severe rain this year from 8th July 2019 to August end.

CENTRAL LABORATORY
RAJASTHAN STATE POLLUTION CONTROL BOARD
 Water sample analysis results for samples collected from Sambhar Lakes on 12.11.2019

5. No.	Point of sample Collection	Parameter							
		pH	Total Suspended Solids	chemical oxygen demand	fluoride	Dissolved oxygen	Total Dissolved Solids	Total Alkalinity	Conductivity at 25°C micro mhos/cm
5.	Surface water quality criteria for Propagation of wild life, fisheries.	6.5-8.5				> 4			1000 Max
5.	Indian Standard, Drinking Water Specification, IS 10500 : 2012 (Permissible Limit in the absence of alternate source)	6.5 - 8.5			1.5		2000	600	
1	South Edge of Sambhar lake - Dam area, Opposite of Shakanbhar Mata Temple, Sambhar Lake, Sambhar	9.84	127	311	3.52	1.7	20190	616	23900
2	South Edge Towards East (mid side) of Sambhar lake - Dam area, Opposite of Shakanbhar Mata Temple, Sambhar Lake, Sambhar	9.48	262	265	3.19	2.2	18574	596	21500
3	East Edge of Sambhar lake - Dam Area, Behind Jhapok Dam opposite of Shakanbhar Mata Temple, Sambhar Lake, Sambhar	9.65	91	327	3.32	3	18222	584	22100
4	Water sample of Sambhar lake - Dam Area having dense algal growth (One of food for birds)	7.45		14790	1.34	NT			
5	Towards west side of Sambhar lake - Dam area near Shakanbhar Mata Temple, Sambhar Lake, Sambhar	9.14	9738	249	3.5	0.5	26612	840	31000
6	Towards East side of Sambhar lake - Dam area near Shakanbhar Mata Temple, Sambhar Lake, Sambhar	9.21	932	296	3.13	0.8	19638	632	24200
7	Jhapok Dam Near Jhapok Kyar (Salt Pan), Sambhar Lake, Sambhar	9.83	196	358	4.66	0.3	23808	1088	27700
8	Nayi Kyar, Near Sambhar P S Plant, Sambhar Lake, Sambhar	9.26	180	202	3.98	2.4	7194	552	11780

Result
awaited

(R. K. Sharma)
 Chief Scientific Officer
 RSPCB, Jaipur

Observations from other characteristics of the water:

The pH of the water ranged between 7.4- 9.84. Water levels were fluctuating throughout the year. The locals reported that due to good monsoon this year **water level has reached the lake beds significantly after 20 years**. Temperature of the water was about 25 °C. No farming practices were in the vicinity. However, several salt panning industries are seen in the banks. There was no algal bloom and no raw sewage discharges. There was no pesticide run off (Source: CCF, Jaipur, Rajasthan).

Sparse reports from locals that every year few birds die but goes unnoticed. Food sources of birds such as fishes and crabs were not noticed, however, numerous molluscs and insects were noticed in the initial phases of death. Algae growth in the water was observed. (Source: CCF, Jaipur, Rajasthan).

No high power grids, wind turbines and tall buildings were noticed. However, numerous bore wells have been installed in the banks to collect brine underwater and for making salts.

Details of the birds in the lake:

There were several migratory birds falling under two major categories viz. water fowls and shore birds were seen. Resident birds were also recorded. Migratory birds are mainly from Siberia, Russia, China and Himalayas. These birds followed Asia Pacific migration route. Migratory birds include Northern Shovelers, Kentish Plovers, common Teals, common Sandpipers etc (Source WTI). Resident birds such as Ruff, Pied Avocets, Whistling ducks, Coots, Greater and lesser Flamingos are in the lake (Source WTI). Northern shovelers, Kentish plovers, Common Teals, Common Sandpipers, Ruff, Pied avocets, Whistling Ducks, and Coots are either omnivorous or insectivorous while Greater and lesser Flamingos feed on algae (Source WTI).

Affected birds include mostly omnivorous and insectivorous birds are affected involving both water fowls and shore birds. However, Flamingos, land birds (crows, kites, domestic chickens in nearby villages) were not affected. Birds were found dead all over the lake and its premises (lake beds and water dried areas). Dead birds could be recovered from feeding area, loafing area and roosting area. Migration has stopped now and fresh incumbents are yet to arrive like Barn headed geese and pelicans. No domestic animals/ birds were present in the lake area. No domestic birds were dead. There is migration every year and this year there is significant arrival of migratory birds in the lake.

Studies on mortality associated attributes:

The first report was on 10/11/2019 in the area marked as circle in red color. The birds could be recovered all along the banks in the subsequent days (Blue lines). Note: **The birds in the fresh water lake (FW) did not have any mortality** (Source: CCF, Rajasthan). The person reported that the carcass recovered on 10/11/19 had severe maggot infestation.



Trend of Dead Carcass Retrieval and Birds Rescued: (Source: SVO SDDL, Jaipur)

Date	Sites Approached	No. of Dead Birds Received	No. of Birds Rescued	Birds died after Rescue
11.11.2019	Sambhar	716	-	
12.11.2019	Sambhar	1622	25	4
13.11.2019	Sambhar	1992	10	4
14.11.2019	Sambhar	538	15	10
15.11.2019	Sambhar, Nawan	3265	150	50
16.11.2019	Sambhar, Nawan	2696	181	32
17.11.2019	Sambhar, Nawan	5665	128	27
18.11.2019	Sambhar, Nawan	1028	91	141
	Total	17522	600	268

Clinical Signs exhibited by ailing birds

All the birds across age groups and both the sex were affected. Ailing Birds were in lateral and ventral recumbency. Birds were afebrile and were gasping for breath evidenced by open mouth breathing. Soiling of vent with severe watery whitish to greenish diarrhea. Both legs and wings showed flaccid paralysis. Drooping of necks were evident and the birds were unable to lift their neck. Drooping of third eyelid was evident. There was no perching reflex, no flight reflex, pupillary reflex. The course of illness is about 2 days.

Treatment given and response to treatment

Multiple rescue areas were created and the birds were given treatment by the state veterinarians and Wild Trust of India (WTI). The birds were given parenteral injections of Betamethasone, Neurobion, oxytetracycline and Atropine. The birds were given fresh feed and water. The birds responded well to treatment in 24 to 48 hrs depending upon the severity.

Post mortem examination (16/11/19 at ICAR-IVRI):

Four birds, water samples (2) received from state disease diagnostic lab (Jaipur).

Species examined: Northern Shoveler (1), Black Winged Stilt (1), Common Sandpiper(1), Plover(1).

Gross findings recorded:

- The condition of carcass was good.
- The rigor mortis has passed. Soiling of vent region was observed.
- Upon deskinning the muscles, keel bone and subcutaneous fat were normal in appearance. No abnormal discharges were found in the nostrils.
- Internally, all the organs appeared normal. The Gizzard had less feed content mixed with small stone grits. The intestines had sparse amount of greenish mucus contents.
- Cerebral blood vessels showed mild congestion.

Histopathological examination:

- Pronounced vascular changes were evident in all the visceral organs including brain.
- Other associated findings recorded were lower nephron nephrosis, diffuse Gliosis, perivascular infiltration in the liver.

Details of samples collected and processed: Intestinal contents and Heart blood Liver and gizzard contents, water samples, Brain and spleen

Postmortem examination conducted at Veterinary Hospital, Nagaur (18/11/19).

Species: Northern shoveler

Gross findings recorded:

The condition of carcass was good. Soiling of vent region was observed. Upon deskinning the muscles, keel bone and subcutaneous fat were normal in appearance. No abnormal discharges were found in the nostrils. Internally, all the organs appeared normal. The Gizzard had less feed content mixed with small stone grits. The intestines had sparse amount of greenish mucus contents. Cerebral blood vessels showed mild congestion.

Samples collected: Visceral samples in Formalin, Brain and spleen

Samples collected from the field: Dead birds (5), serum from ailing birds, maggots from the dead birds, maggots from the dead birds water samples.

Maggots identification: *Calliphora* spp (3rd instar).

Postmortem examination (20/11/19 at ICAR-IVRI):

Species examined: Northern Shoveler (2), Black winged stilt (2), common Sandpiper(1).

Gross findings recorded:

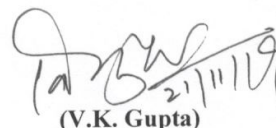
The condition of carcass was good. The rigor mortis has passed. Soiling of vent region was observed. Upon deskinning the muscles, keel bone and subcutaneous fat were normal in appearance. No abnormal discharges were found in the nostrils. Internally, all the organs appeared normal. The Gizzard

was empty. The intestines had sparse amount of greenish mucus contents. Cerebral blood vessels showed mild congestion.

Maggots collected at the site, serum samples collected from affected birds, small intestine contents and gizzard contents from the dead birds were used for diagnosis. Presence of botulinum toxin from the samples was demonstrated by mouse lethality assay.

Diagnosis and Interpretation:

- **Diagnosis:** Based on epidemiological and laboratory investigations, the cause of mortality in migratory birds is Avian Botulism caused by *Clostridium botulinum*.
- **Interpretation: Factors favoring growth of *Clostridium botulinum***
 - Low salinity level
 - Temperature was $> 25^{\circ}\text{C}$
 - pH was between 7 to 9
 - Dissolved oxygen level was below 4
 - Chemical oxygen demand was high
 - Presence of crustaceans, invertebrates and planktons
 - Presence of maggot infested carcasses in the lake and its premises
 - Heavy rains in the month of July and August resulted in filling of lake and there was formation of new marshy areas (reported after 20 years).
 - The salinity of the water must have been less due to heavy downpour which would be a conducive environment for the proliferation of crustaceans, invertebrates and planktons.
 - The crustaceans, invertebrates and planktons harbor *C. botulinum* in their body.
 - Upon receding of water levels there must be mild increase in the salinity suboxic levels which must have led to the death of crustaceans, invertebrates and planktons.
 - Upon death, it is reported that *C. botulinum* multiplies inside the dead crustaceans, invertebrates and planktons, there is accumulation of toxins.
 - After migration of birds, there was death in the insectivorous and omnivorous eating birds only. There were no deaths in the herbivorous birds. After death of the birds, the carcass was infested with maggots and they are known to bio-accumulate botulinum toxins.
 - Initial dead birds that were recovered on 10/11/19 were also infested with maggots of 3rd instar stage *Calliphora* species, which clearly indicates that the birds must have died 10-14 days earlier to 10/11/19.
 - The death in water birds is mainly because of drowning and the dead carcasses were visible immediately after the water started receding.
 - The fresh birds that feed on these maggots have also succumbed to botulism thus establishing a maggot carcass vicious cycle.



(V.K. Gupta)

Joint Director (CADRAD)