

# LIMNOLOGICAL STUDIES OF THE SALT LAKES IN MONGOLIA ARE IMPORTANT FOR REHABILITATION PROJECTS OF THE ARAL SEA

The Second International Conference on the Aral Sea  
in St. Petersburg

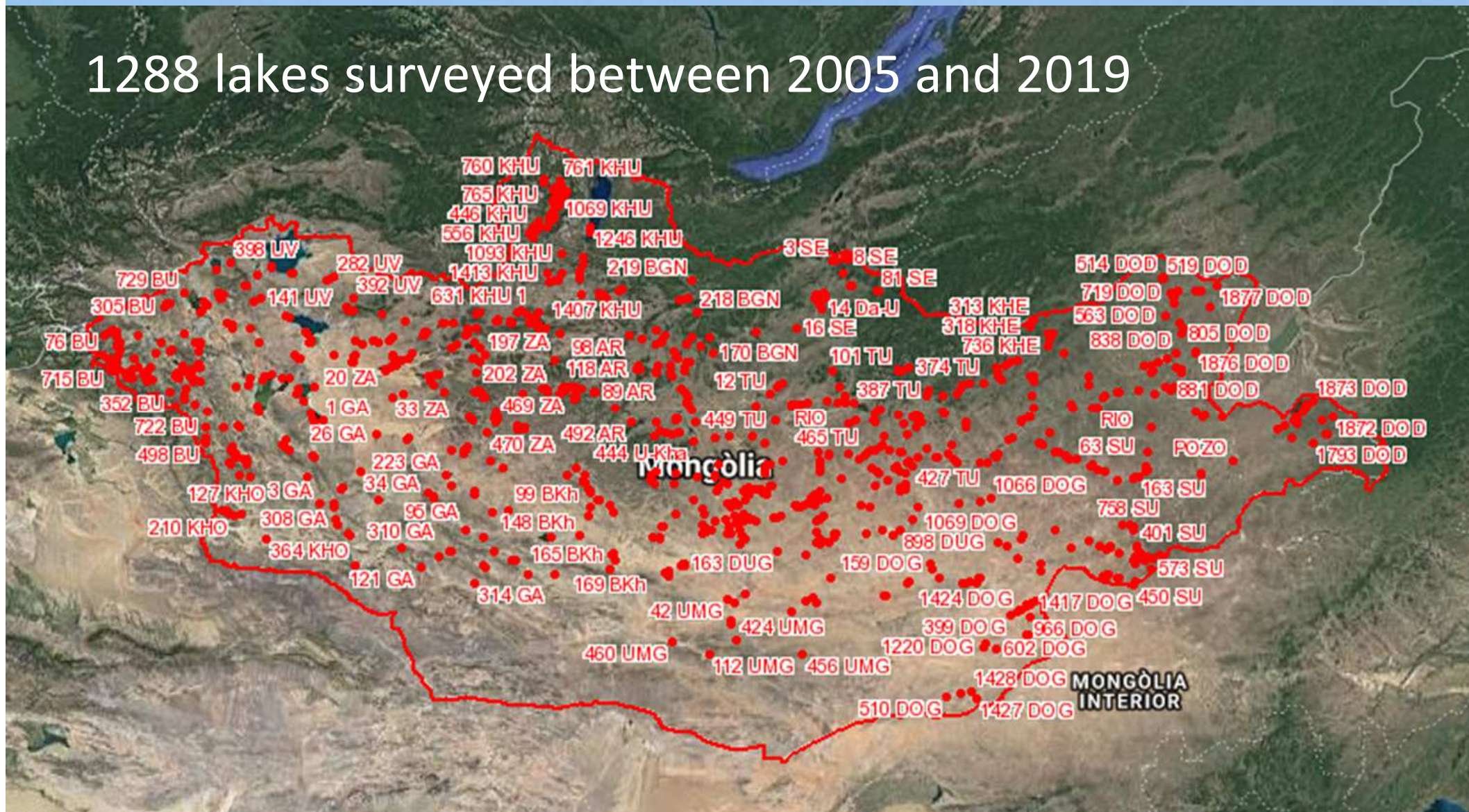
Zoological Institute of the Russian Academy of Sciences  
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Despite the low rainfall, there are over 10,000 lakes in Mongolia, which include some of the largest in Eurasia

1288 lakes surveyed between 2005 and 2019



# TYPES OF LAKES IN MONGOLIA

1. LARGE PERMANENT FRESH WATER LAKES



2. SMALLER PERMANENT OR SEMI PERMANENT FRESHWATER LAKES. WATER TURBIDITY NOT DUE TO INORGANIC SUSPENDED PARTICLES



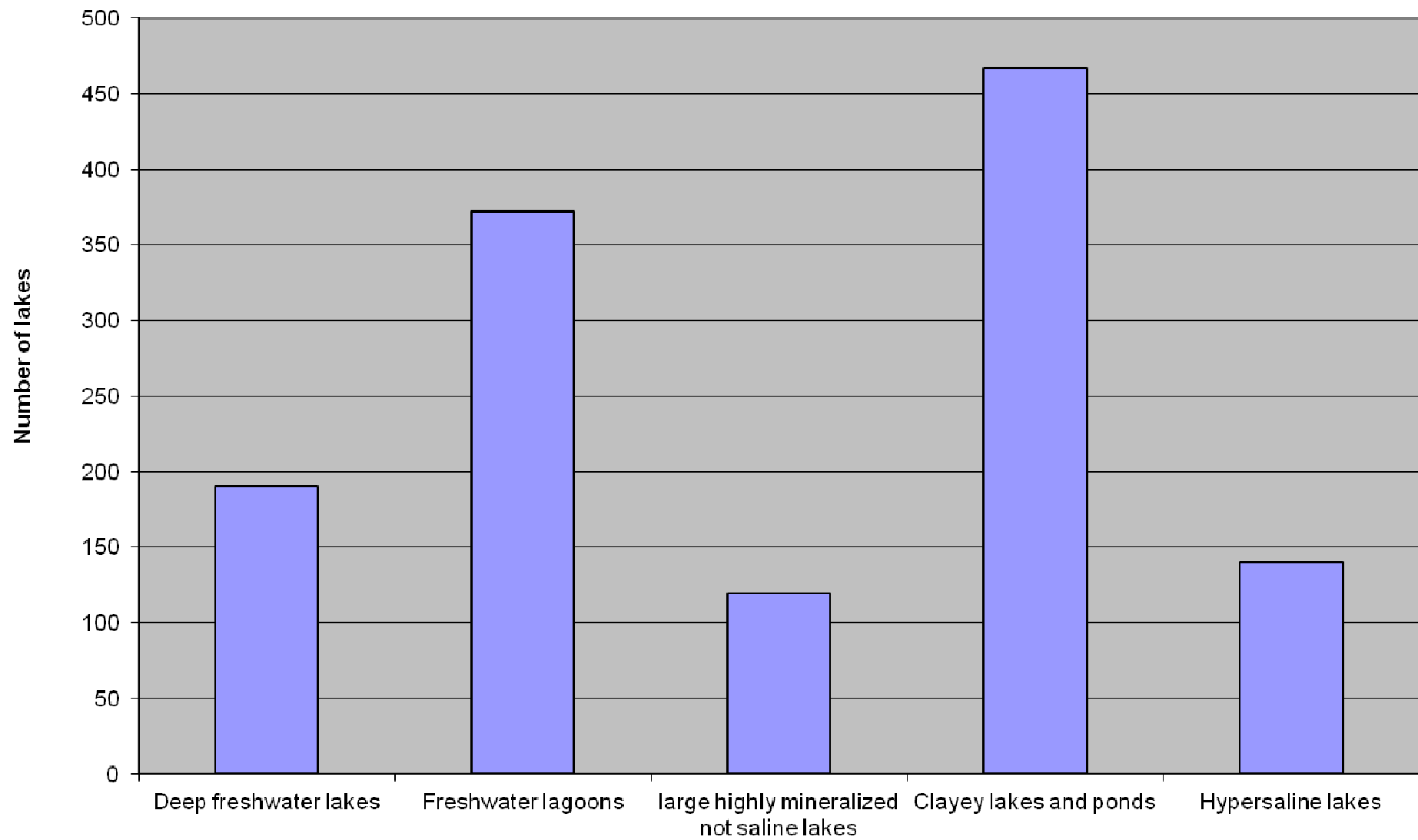
3. LARGE PERMANENT LAKES WITH HIGHLY MINERALIZED, AND EVEN SALINE (NOT HYPERSALINE) WATERS



4. SHALLOW LAKES AND LAGOONS BOTH PERMANENT OR TEMPORAL, WITH SLIGHTLY TO HIGHLY MINERALIZED WATERS TURBID BY SUSPENDED INORGANIC PARTICLES.

5. HYPERSALINE LAKES





# TYPE 1

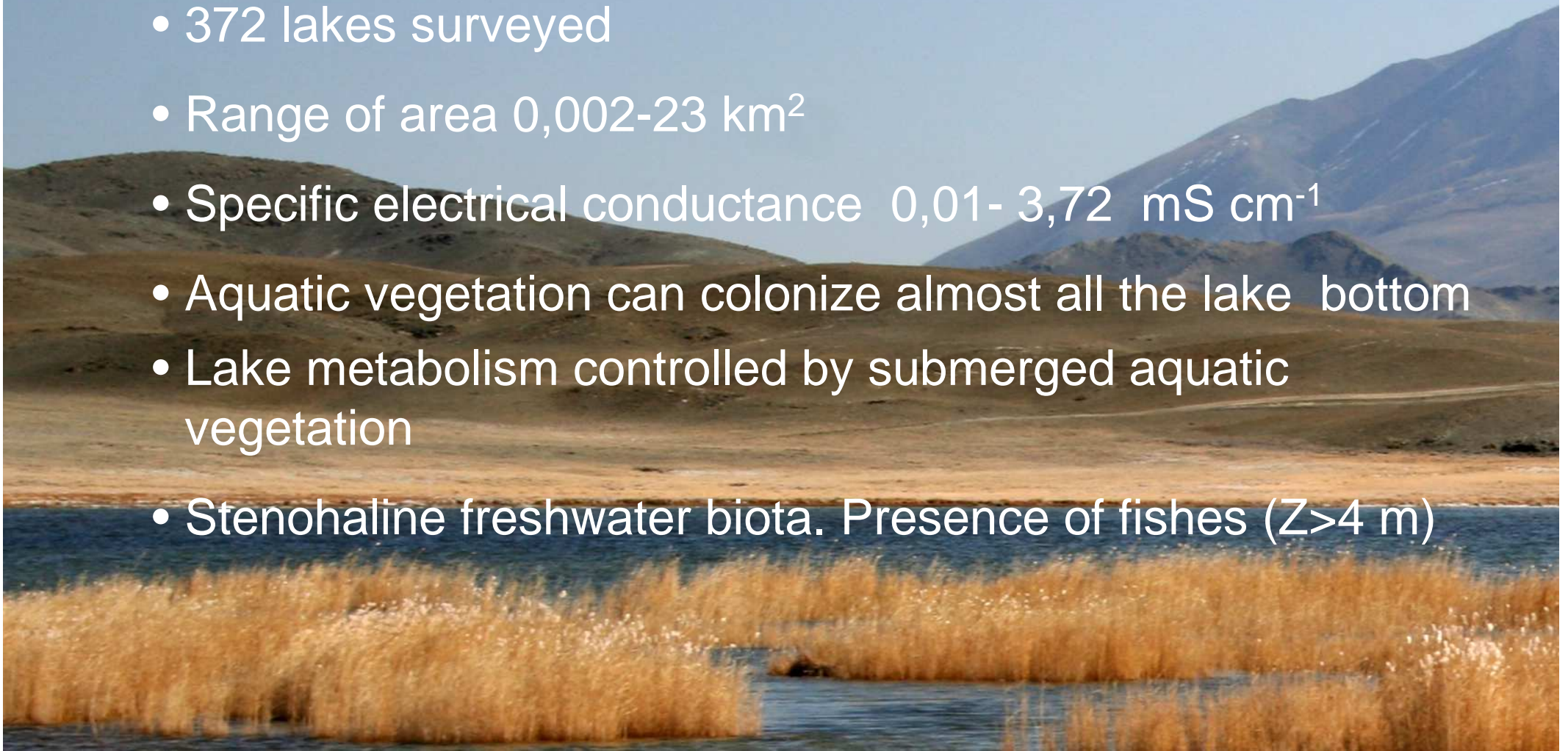
## LARGE PERMANENT FRESH WATER LAKES

- 190 lakes surveyed
- Range of area 0,01 – 2.863 km<sup>2</sup>
- Lake maximum depth greater than cannot be colonized by submerged aquatic vegetation
- Specific electrical conductance 0,01-3,72 mS cm<sup>-1</sup>
- Lake metabolism controlled by plankton (trophic status)
- Stenohaline freshwater biota. Presence of fishes

## TYPE 2

### SMALLER PERMANENT OR SEMI PERMANENT FRESHWATER LAKES. WATER TURBIDITY NOT DUE TO INORGANIC SUSPENDED PARTICLES

- 372 lakes surveyed
- Range of area 0,002-23 km<sup>2</sup>
- Specific electrical conductance 0,01- 3,72 mS cm<sup>-1</sup>
- Aquatic vegetation can colonize almost all the lake bottom
- Lake metabolism controlled by submerged aquatic vegetation
- Stenohaline freshwater biota. Presence of fishes (Z>4 m)



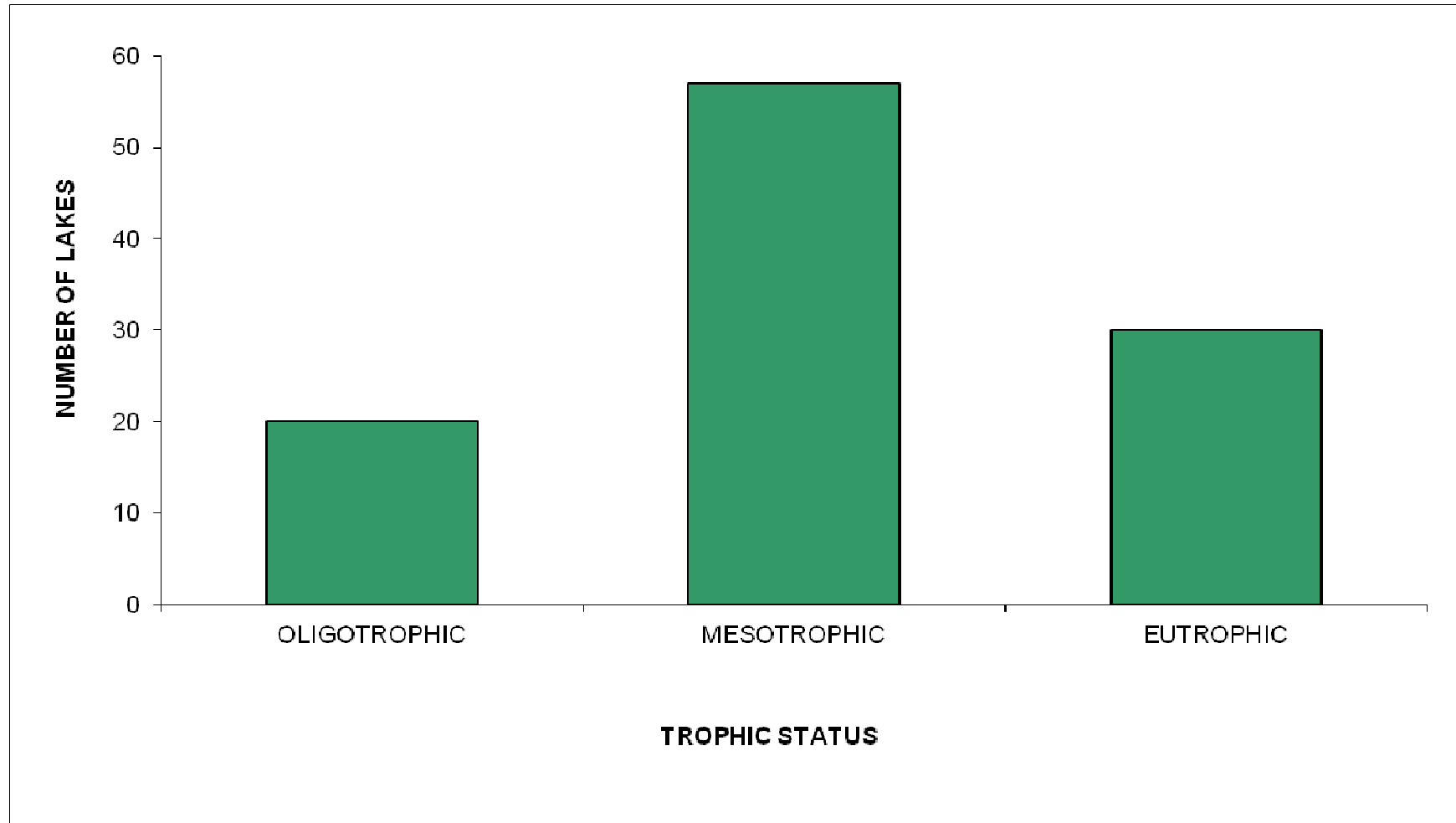
# TYPE 3

## PERMANENT LARGE LAKES AND LAGOONS WITH HIGHLY MINERALIZED, AND EVEN SALINE (NOT HYPERHALINE) WATERS

- 119 lakes surveyed
- Range of area 0,023- 3.670 km<sup>2</sup>
- Specific electrical conductance 4,3 – 43,70 mS cm<sup>-1</sup>
- Euryhaline biota. Presence of fishes in large lakes



## TYPE 3 LAKES TROPHIC STATUS





## TYPE 4

**SHALLOW LAKES AND LAGOONS BOTH PERMANENT OR TEMPORAL,  
WITH SLIGHTLY TO HIGHLY MINERALIZED WATERS TURBID BY  
SUSPENDED INORGANIC PARTICLES.**

- 467 lakes surveyed
- Range of area 0,006-122 km<sup>2</sup>
- Specific electrical conductance 0,13 – 52,1 mS cm<sup>-1</sup>
- Turbidity does not allow submerged macrophyte growth
- Lake metabolism heterotrophic
- Euryhaline biota. No fishes

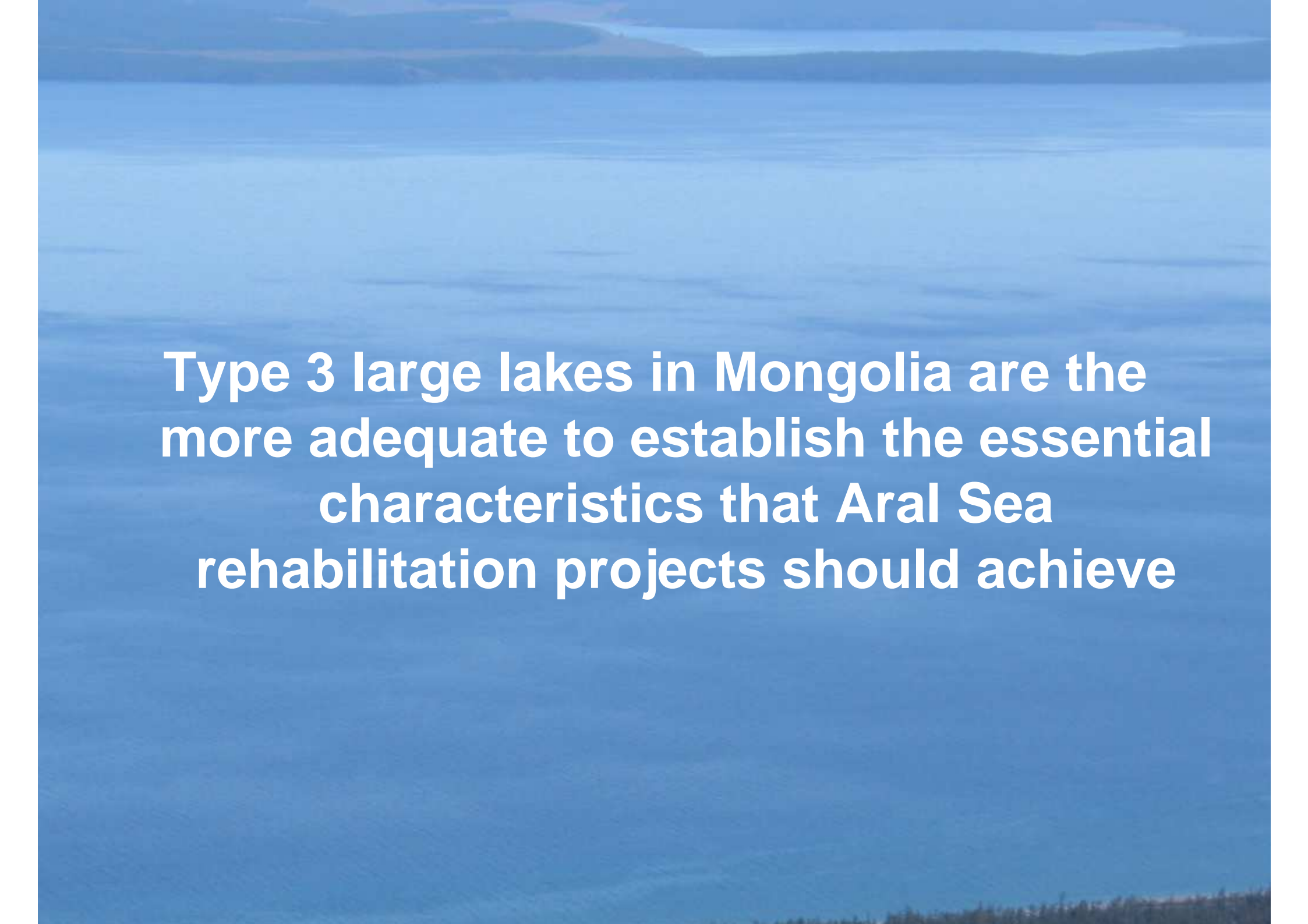




# TYPE 5

## HYPERSALINE LAKES

- 140 lakes surveyed
- Range of area 0,009 – 24 km<sup>2</sup>
- Specific electrical conductance 43,5 - 809 mS cm<sup>-1</sup>
- Stenohaline athalassic saline biota



**Type 3 large lakes in Mongolia are the more adequate to establish the essential characteristics that Aral Sea rehabilitation projects should achieve**



Khandagaytu  
Хандагайты

Davst  
Давст

Tesiin gol  
Тэсийн гол

Tes  
Тэс

Uvs Nuur  
Увс Нуур

Ulaangom  
Улаангом

Uvs nuur: 3670 km<sup>2</sup>; 17,8 mS cm<sup>-1</sup>; 15 ‰



Uvs nuur

Naranbulag  
Наранбулаг

Tsagaan  
Цагаан

Khyargas Lake  
Хяргас Нуур

Khyargas Lake  
Хяргас  
Нуур БЦГ


Airag Lake  
Айраг Нуур

Zavkhan  
Завхан

**Khyargas nuur 1407 km<sup>2</sup>; 9,5 mS cm<sup>-1</sup>**



Khyargas nuur

A satellite map showing a large, dark green lake (Durgun Lake) in the center, surrounded by a light brown, arid landscape. The lake has a long, narrow inlet extending towards the top left. There are several smaller, irregularly shaped green patches scattered across the brown terrain, likely representing smaller water bodies or wetlands. The text 'Durgun Lake' and 'Дөргөн Нуур' is overlaid on the lake in white. At the bottom, there is a white text box containing the lake's area and conductivity.


Durgun Lake  
Дөргөн Нуур

**Durgun nuur 347 km<sup>2</sup>; 6,3 mS cm<sup>-1</sup>**





**Durgun nuur**

A satellite map showing a large, dark blue lake in a mountainous region. The lake is outlined in yellow. The surrounding terrain is brown and rocky, with some smaller water bodies and streams visible. The text 'Buun Tsagaan nuur' is written in white at the bottom of the image, and 'Buun Tsagaan nuur' is written in blue on the lake itself.

Buun Tsagaan nuur  
Бөөнцагаан Нуур

**Buun Tsagaan nuur 286 km<sup>2</sup>; 4,5 mS cm<sup>-1</sup>**



**Buun Tsagaan nuur**

A satellite map showing a large, dark blue lake in a mountainous region. The lake is surrounded by brown and grey terrain with visible ridges and valleys. A yellow line outlines the lake's perimeter. The text 'Uureg Lake' and 'Үүрэг Нуур' is overlaid on the lake.

Uureg Lake  
Үүрэг Нуур

**Uureg nuur 265 km<sup>2</sup> ; 8,6 mS cm<sup>-1</sup>**



**Uureg nuur**



Telmen nuur 194 km<sup>2</sup> ; 7,4 mS cm<sup>-1</sup>



Telmen nuur



**Sangiin Dalai nuur 188 km<sup>2</sup> ; 5,2 mS cm<sup>-1</sup>**





**Sangiin Dalai nuur**

A satellite map showing a large, irregularly shaped lake in the center. The lake is a dark green color, indicating water. The surrounding land is a mix of brown and tan, suggesting a dry or semi-arid environment. There are some smaller, lighter-colored areas that could be islands or peninsulas. The text 'Airag Lake' and 'Айраг Нуур' is overlaid on the lake. At the bottom, there is a white text box with the lake's area and conductivity.

Airag Lake  
Айраг Нуур

Airag nuur 186 km<sup>2</sup> ; 5,8 mS cm<sup>-1</sup>



Airag nuur



Orong Lake

Orong nuur 121 km<sup>2</sup> ; 5,7 mS cm<sup>-1</sup>



Orog nuur



Khoh nuur 106 km<sup>2</sup> ; 3.3 mS cm<sup>-1</sup>

A brown camel with two humps stands on a sandy beach with sparse green vegetation. In the background, there is a large body of water, likely a lake or sea, with several white birds flying in the sky above. The sky is overcast with grey clouds.

Khoh nuur



Shaazgai Lake  
Шаазгай Нуур

82 UV

Shaazgai nuur 15 km<sup>2</sup>; 8,3 mS cm<sup>-1</sup>





Shaazgai nuur



**Doroo tsagaan nuur 10.23 km<sup>2</sup>; 13 mS cm<sup>-1</sup>; 12 ‰**



**Doroo tsagaan nuur**

# Meiobenthic branchiopoda and copepoda in large permanent lakes and lagoons with highly mineralized, and even saline (not hypersaline) waters

## BRANCHIOPODA

*Leptodora kindtii*  
*Diaphanosoma mongolianum*  
*Diaphanosoma lacustris*  
*Daphnia carinata*  
*Daphnia magna*  
*Daphnia gr. pulex*  
*Daphnia gr. longispina*  
*Daphnia longispina turbinata*  
*Daphnia galeata*  
*Ceriodaphnia reticulata*  
*Moina mongolica*  
*Moina brachiata*  
*Moina micrura*  
*Moina gr. belli*  
*Moina macrocopus*  
*Macrothrix gr. hirsuticornis*  
*Macrothrix rosea*  
*Macrothrix laticornis*  
*Bosmina longirostris*  
*Bosmina fatalis*  
*Chydorus sphaericus*  
*Coronatella rectangula*  
*Alona costata*  
*Alona flossneri*  
*Oxurella tenuicaudis*  
*Monospilus dispar*

## COPEPODA

*Arctodiaptomus gr. wierzjeskii*  
*Arctodiaptomus rectispinosus*  
*Arctodiaptomus alpinus*  
*Arctodiaptomus niethammeri akatovae*  
*Cyclops strenuus*  
*Cyclops furcifer*  
*Megacyclops gigas*  
*Megacyclops cf magnus*  
*Acanthocyclops sp*  
*Eucyclops serrulatus*  
*Eucyclops speratus*  
*Ectocyclops phaleratus*  
*Metacyclops minutus*  
*Metacyclops gracilis*  
*Thermocyclops cf. dumonti*  
*Mesocyclops leuckarti*

# CONCLUSIONS

**Mongolian saline but not hypersaline lakes are useful for rehabilitation projects of the Aral Sea due to :**

- **Their limnological characteristics are similar to those of the Aral Sea around the sixties**
- **They are pristine since human uses are very limited in their basins (low population, no agriculture, livestock extensive and with low density)**

**Both commented points give to these lakes the category of reference systems to evaluate the ecological status of the rehabilitation projects according to their physicochemical and biological indicators.**



**THANKS FOR YOUR ATTENTION**

**The Western Large Aral Sea, October 2019**