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

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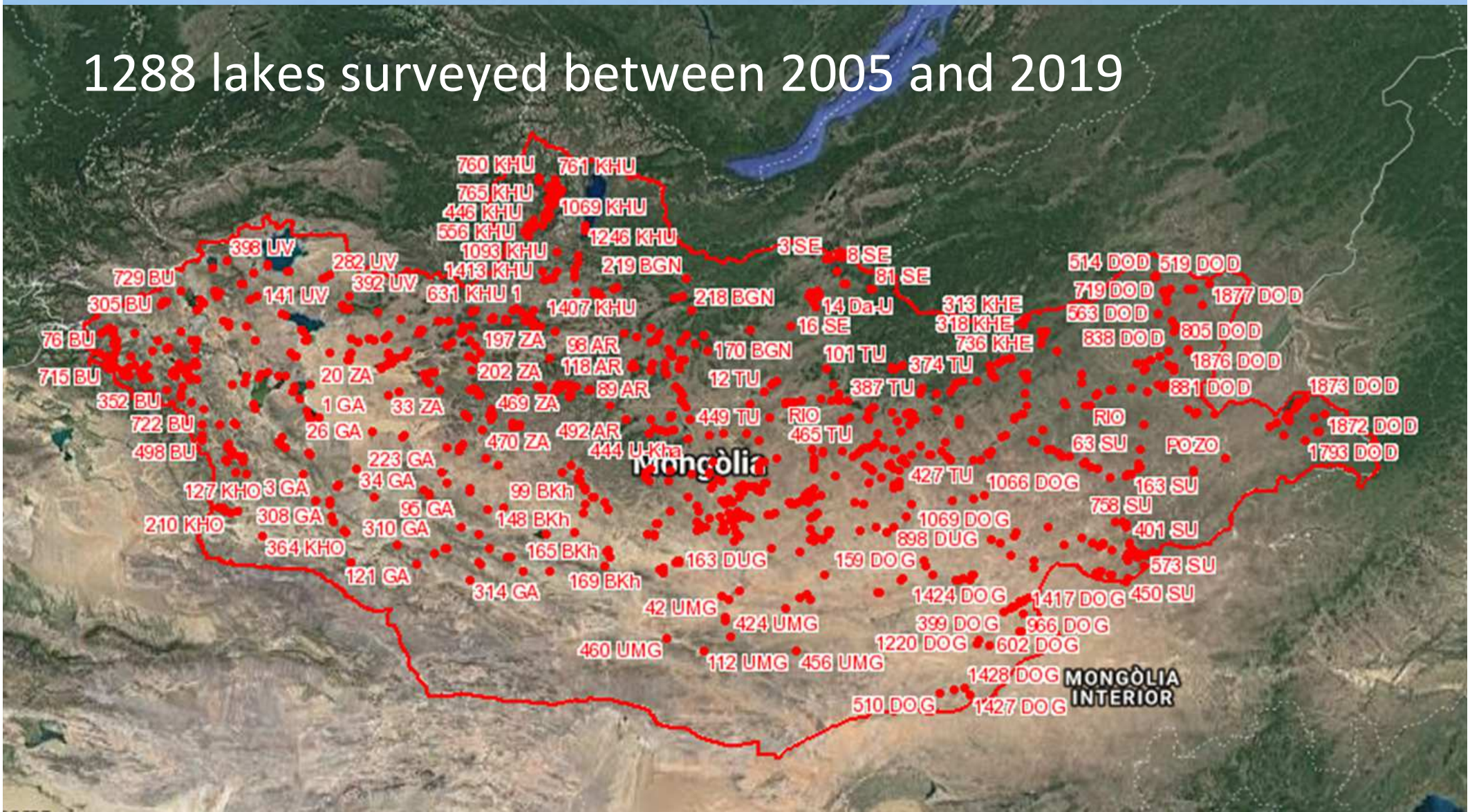
Despite the low rainfall, there are over 10,000 lakes in Mongolia, which include some of the largest in Eurasia



TYPES OF LAKES IN MONGOLIA

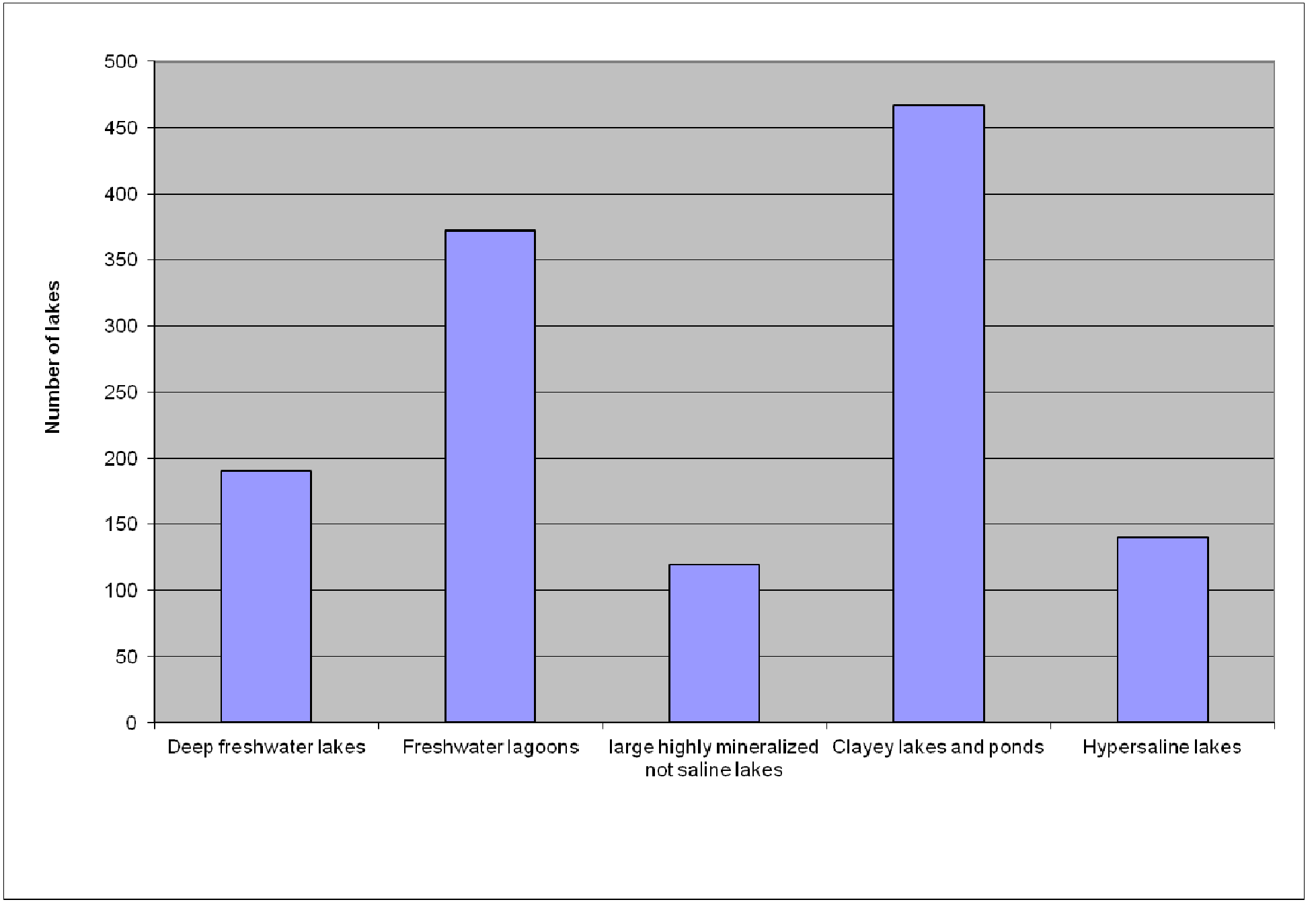
1. LARGE PERMANENT FRESH WATER LAKES

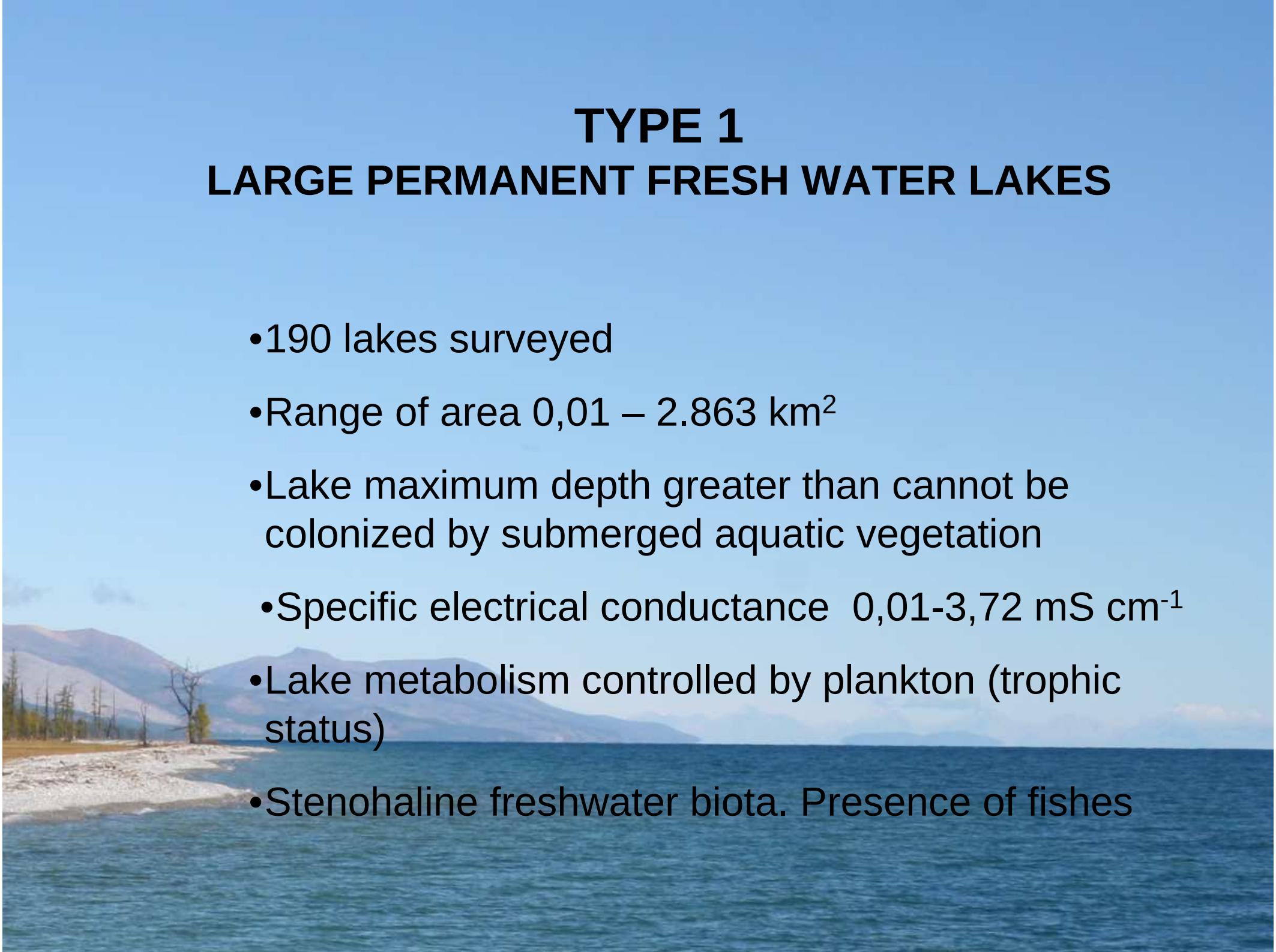
2. SMALLER PERMANENT OR SEMI PERMANENT FRESHWATER LAKES. WATER TURBIDITY NOT DUE TO INORGANIC SUSPENDED PARTICLES

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.

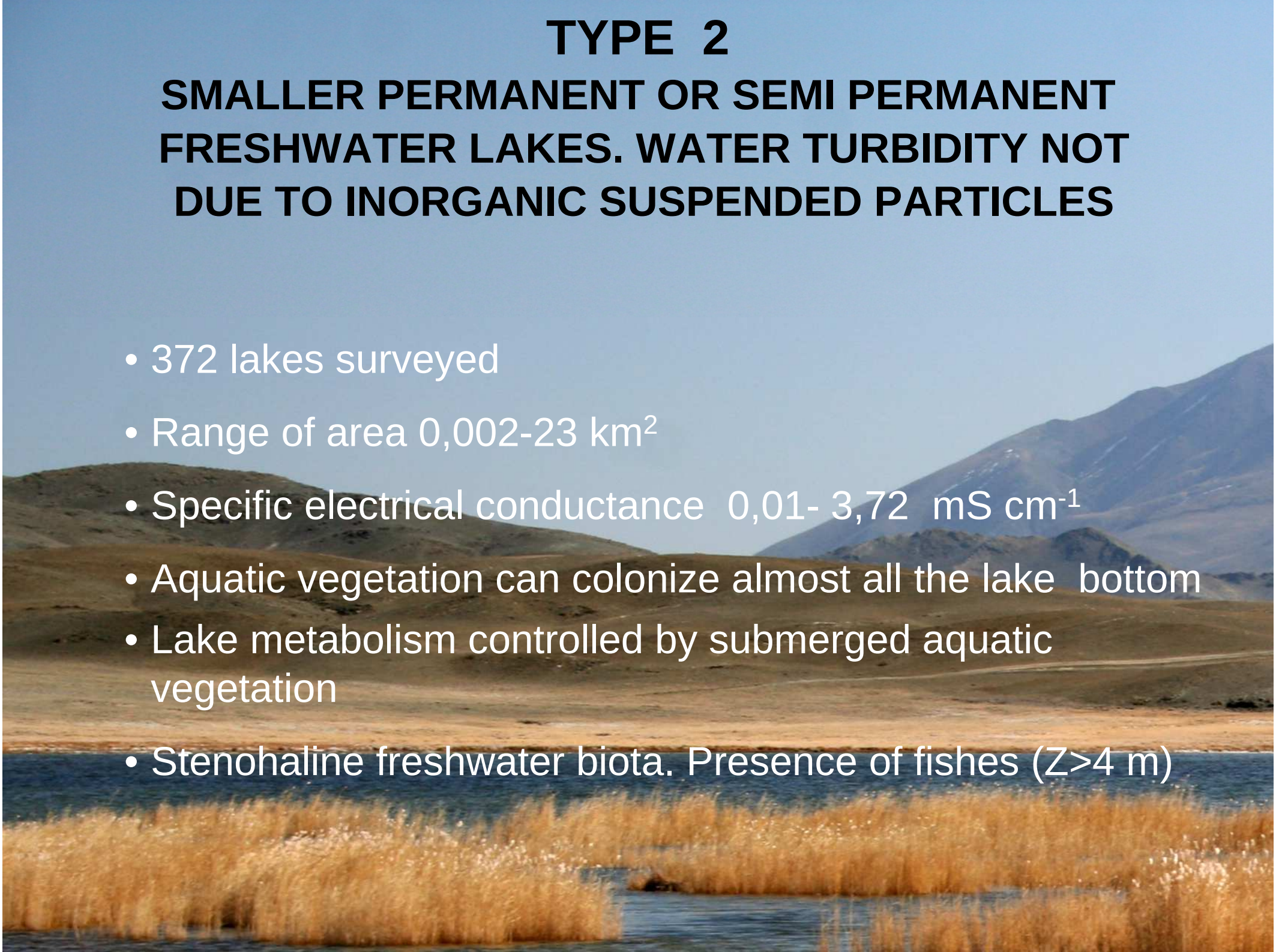
5. HYPERSALINE LAKES


Number of lakes
500
450
400
350
300
250
200
150
100
50
0
Deep freshwater lakes
Freshwater lagoons
large highly mineralized not saline lakes
Clayey lakes and ponds
Hypersaline lakes



TYPE 1
LARGE PERMANENT FRESH WATER LAKES

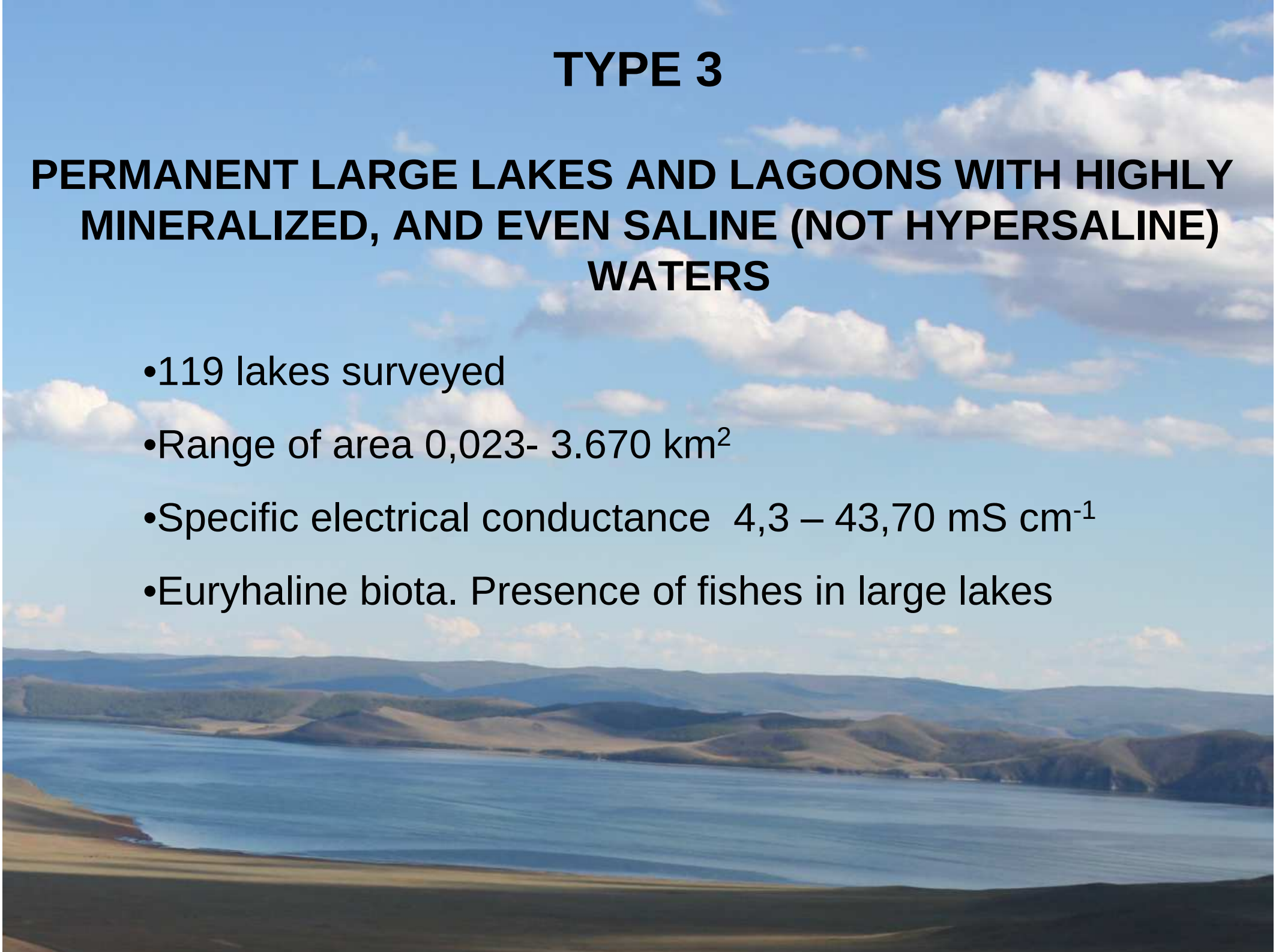
- 190 lakes surveyed
- Range of area 0,01 – 2.863 km^2
- Lake maximum depth greater than cannot be colonized by submerged aquatic vegetation
- Specific electrical conductance 0,01-3,72 mS cm^{-1}
- Lake metabolism controlled by plankton (trophic status)
- Stenohaline freshwater biota. Presence of fishes



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^2
- Specific electrical conductance 0,01- 3,72 mS cm^{-1}
- 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)

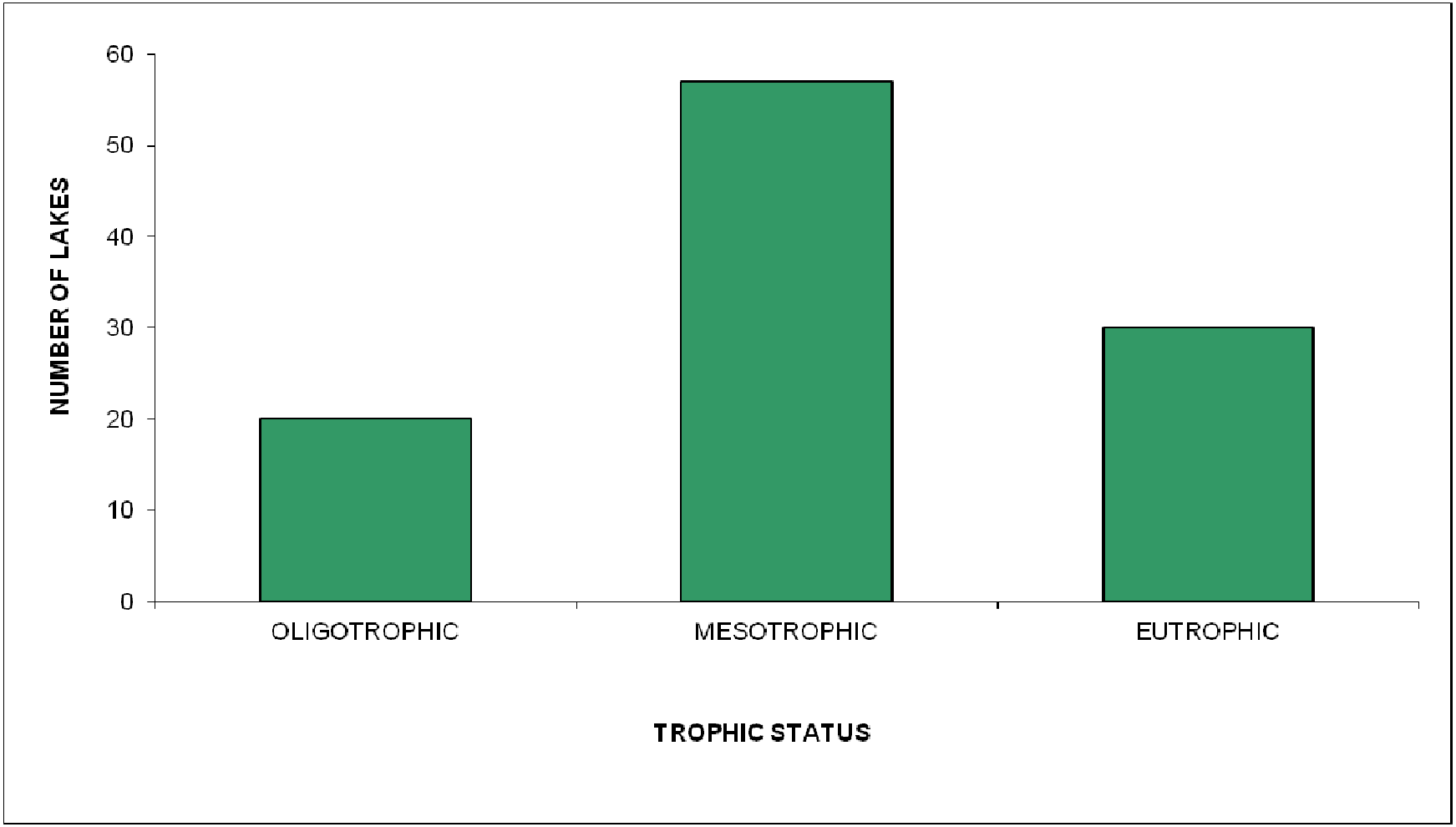


TYPE 3

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

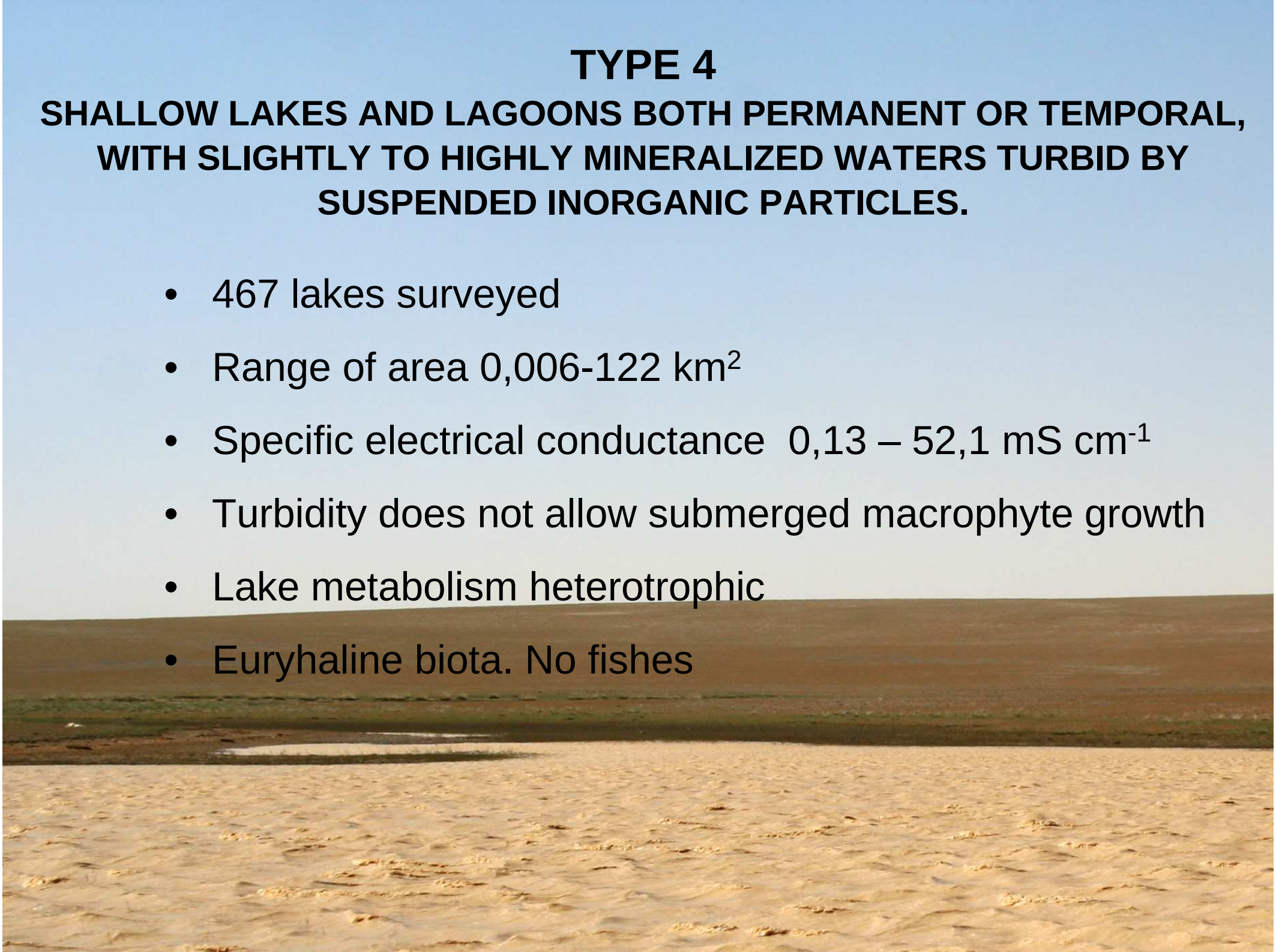
- 119 lakes surveyed
- Range of area 0,023- 3.670 km^2
- Specific electrical conductance 4,3 – 43,70 mS cm^{-1}
- Euryhaline biota. Presence of fishes in large lakes

TYPE 3 LAKES TROPHIC STATUS

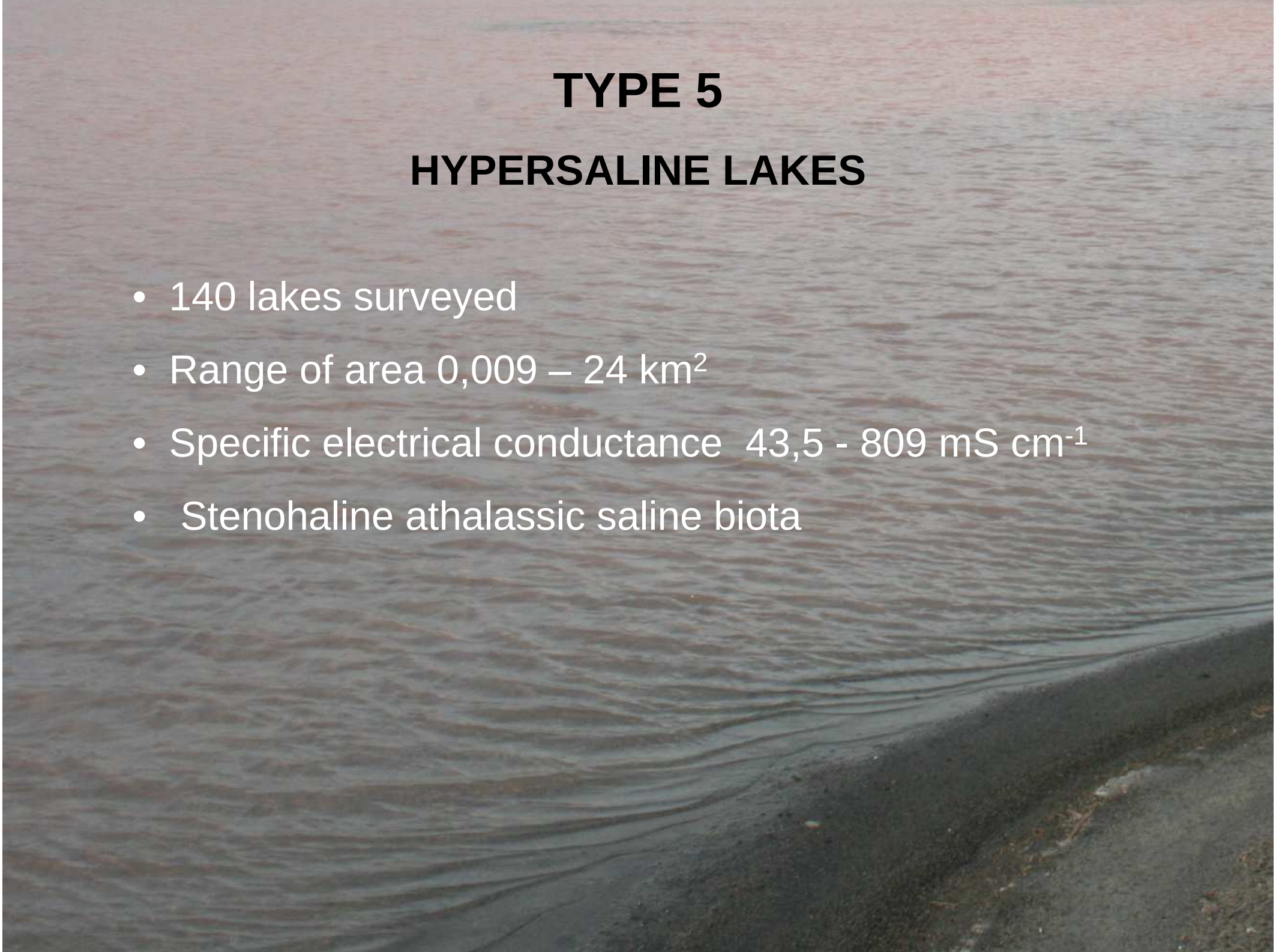


TYPE 4

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



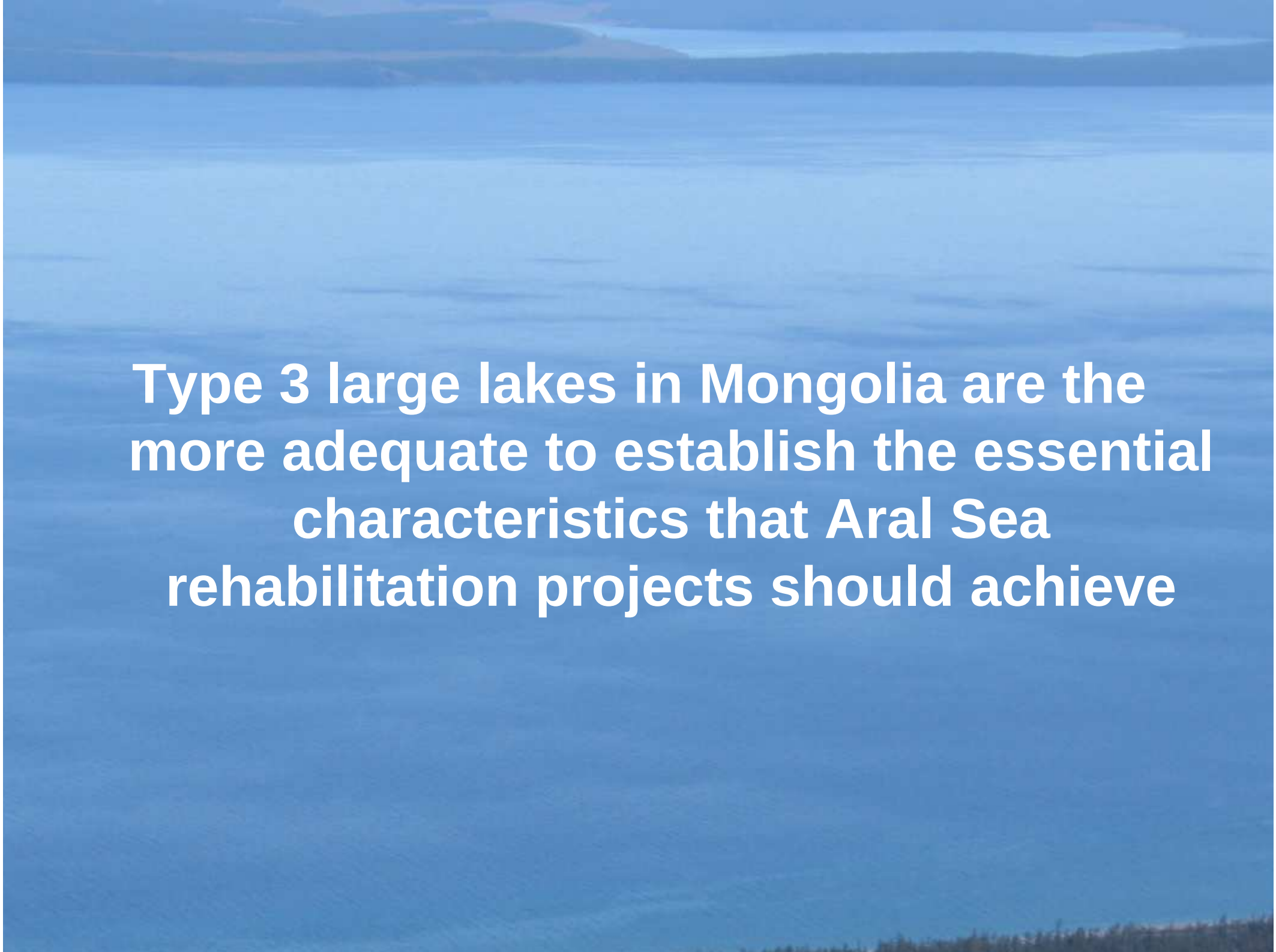
- 467 lakes surveyed
- Range of area 0,006-122 km^2
- Specific electrical conductance 0,13 – 52,1 mS cm^{-1}
- Turbidity does not allow submerged macrophyte growth
- Lake metabolism heterotrophic
- Euryhaline biota. No fishes



TYPE 5

HYPERSALINE LAKES

- 140 lakes surveyed
- Range of area 0,009 – 24 km^2
- Specific electrical conductance 43,5 - 809 mS cm^{-1}
- 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

Uvs nuur: 3670 km^2; 17,8 mS cm^{-1}; 15 $^0/_{00}$

Uvs nuur

Khyargas nuur 1407 km^2; 9,5 mS cm^{-1}

Khyargas nuur

Durgun nuur 347 km^2; 6,3 mS cm^{-1}

Durgun nuur

Buun Tsagaan nuur 286 km^2 ; 4,5 mS cm^{-1}

Buun Tsagaan nuur

Uureg nuur 265 km^2 ; 8,6 mS cm^{-1}

Uureg nuur

Telmen nuur 194 km^2 ; 7,4 mS cm^{-1}

Telmen nuur

Sangiin Dalai nuur 188 km^2 ; 5,2 $mS\ cm^{-1}$

Sangiin Dalai nuur

Airag nuur 186 km^2 ; 5,8 mS cm^{-1}

Airag nuur

Orog nuur 121 km^2 ; 5,7 mS cm^{-1}

Orog nuur

Khoh nuur 106 km² ; 3.3 mS cm⁻¹

Khoh nuur

Shaazgai nuur 15 km^2; 8,3 mS cm^{-1}

Shaazgai nuur

Doroo tsagaan nuur 10.23 km^2; 13 mS cm^{-1}; 12 $^0/_{00}$

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