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# Restoration of the Northern Aral Sea with the help of Kokaral dike

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This presentation is dedicated to the memory of

T. Kira (Japan)

K. Salykov (Kazakhstan)

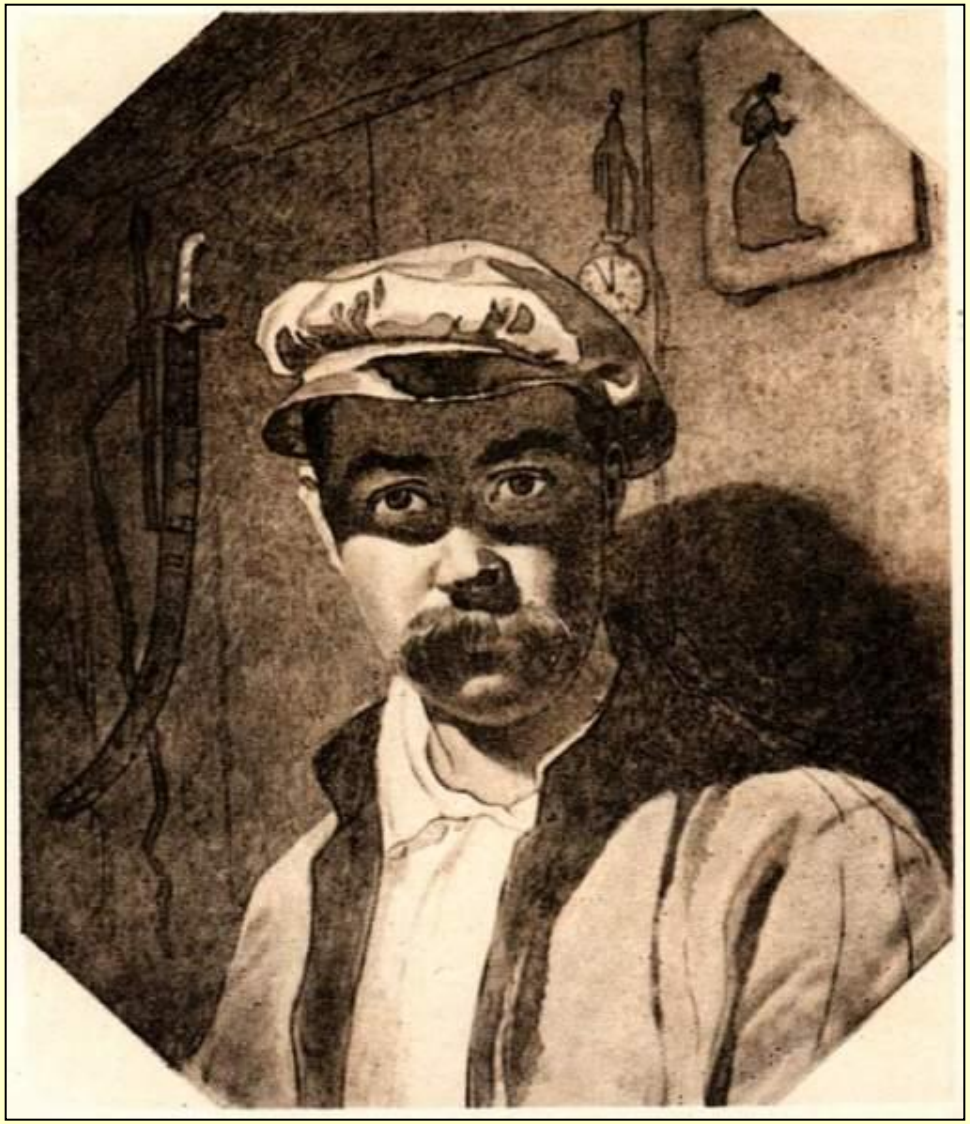
N. Vorontzov (Russia)

G. White (USA)

W. Willams (Australia)

who are together with us did the first diagnostic study for the Aral Sea under umbrella of UNEP (February 1989 – September 1992).

A.I. Butakov



T.G. Shevchenko
(self-portrait, 1849-1850)


Commonwealth of Independent States - Central Asian States
RUSSIA
KAZAKHSTAN
MONGOLIA
CHINA
KYRGYZSTAN
TAJIKISTAN
UZBEKISTAN
TURKMENISTAN
IRAN
AFGHANISTAN
PAKISTAN
INDIA
AZERBAIJAN
Catchment area of the Aral Sea is about 1.8 million km²
ARAL SEA BASIN
Aral Sea
Caspian Sea
Lake Balkhash
Volga-Don Canal
Nizhniy Novgorod
Perm'
Tobol'sk
Achinsk
Krasnoyarsk
Tomsk
Kemerovo
Abakan
Novosibirsk
Barabinsk
Novokuznetsk
Barnaul
Yekaterinburg
Tyumen'
Chelyabinsk
Kurgan
Ufa
Izhevsk
Kazan'
Naberezhnyye Chelny
Saransk
Ul'yanovsk
Penza
Tambov
Kuznetsk
Tol'yatti
Samara
Saratov
Volgograd
Orenburg
Orsk
Petropavl
Troitsk
Pavlodar
Oskemen
Aqtöbe
Arqalyq
Qaraghandy
Embi
Maqat
Atyraū
Astrakhan
Shalqar
Zhezqazghan
Aral
Beyneu
Aqtau
Makhachkala
Leninsk
Qyzylorda
Saryshaghan
Balqash
Aqtoghay
Ayagoz
Taldyqorghan
Ürümqi
Almaty
Shū
Zhambyl
Bishkek
Kara-Kul
Naryn
Shymkent
Tashkent
Namangan
Osh
Ferghona
Kashi
Nukus
Dashhowuz
Urganch
Türkmenbashi (Krasnowodsk)
Nebitdag
Gyzylarbat
Nawoiy
Jizzakh
Bukhoro
Samarqand
Qarshi
Chärjew
Ashgabat
Mary
Garagum Kanaly
Termiz
Dushanbe
Qürghonteppa
Khorugh
Mashad
Gushgy (Kushka)
Scale 1:16,500,000
Lambert Conformal Conic Projection, standard parallels 47°N and 62°N
0 300 Kilometers
0 300 Miles
Indian claim
Chinese line of control
Boundary representation is not necessarily authoritative.
802384 (R00030) 5-95

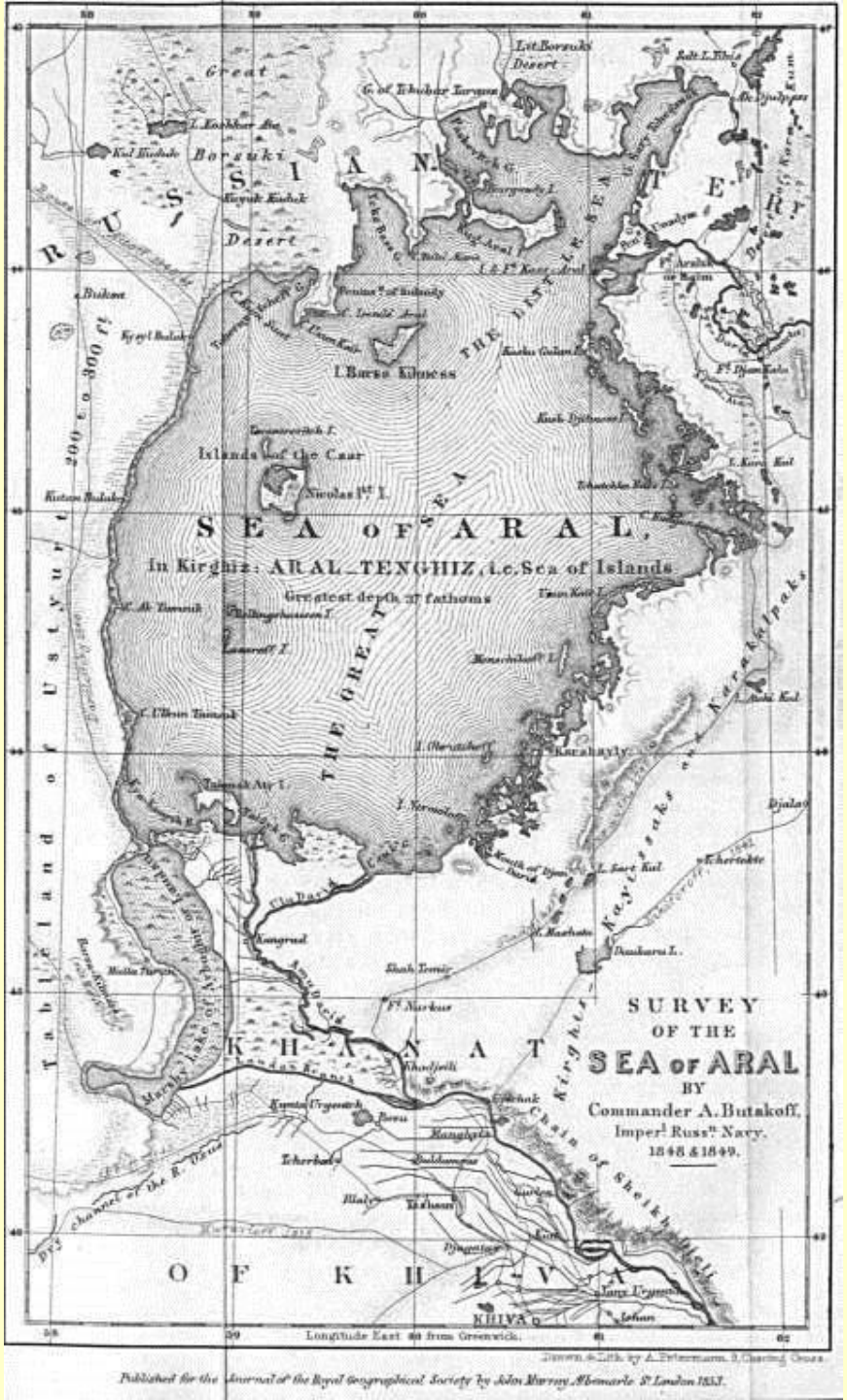
**The Aral Sea was the 4th largest lake in the world according to surface in 1960 (comparative areas below in km²)**



**The Aral Sea map made by A.I. Butakov expedition materials in 1848-1849**

# Parameters of the Aral Sea in the beginning of 20th century

- Area 67499 $km^2$
  Large Aral 61381 $km^2$
  Small Aral 6118 $km^2$
- Volume 1089 $km^3$
  Large Aral 1007 $km^3$
  Small Aral 82 $km^3$
- Level +53.4 m
- Maximal depth 69 m
- Salinity about 10 g/l
- The Aral Sea was inhabited by about 20 species of fishes and about 200 species of free-living invertebrates




**In the Aral Sea there was the following number of aboriginal free-living animals:**

**Fishes – 20**
**Coelenterata – 1**
**Turbellaria – 12**
**Rotatoria – 58**
**Oligochaeta – 10**
**Cladocera – 14**
**Copepoda – 7**
**Harpacticoida – 15**
**Ostracoda – 11**
**Malacostraca – 1**
**Hydracarina – 7**
**Bivalvia – 9**
**Gastropoda – 3**
**TOTAL: 160**

**Protozoa and some other small Metazoa are not included.**


**Between the middle of the 19th century and 1961 shape and salinity of the Aral Sea practically didn't change. We must note, however, that due to intended and accidental introductions, that started in the 1920s, the number of free-living animals grew substantially.**

**In the Aral Sea appeared:**

**Fishes – 17**

**Mysidacea – 5**

**Decapoda – 2**

**Copepoda – 1**

**Polychaeta – 1**

**Bivalvia - 1**

**TOTAL: 27**


***Abra*** **and** ***Nereis*** **introduced by man are of great importance for flounder nutrition.**


**Crab** ***Rithropanopeus*** **was introduced accidentally**

# Since 1960 the Aral Sea has steadily shrunk and shallowed owing overwhelmingly to irrigation withdrawals from its influent rivers (Amu Dar'ya and Syr Dar'ya)



**September, 2009: Aral area – 8410 km$^2$ (13%), volume – 85 km$^3$ (7.5%);**
**the Large Aral – 4922 km$^2$ (8%), 58 km$^3$ (6%), salinity >100 g/l;**
**the Small Aral – 3487 km$^2$ (57%), 27 km$^3$ (33%), salinity 10-14 g/l.**

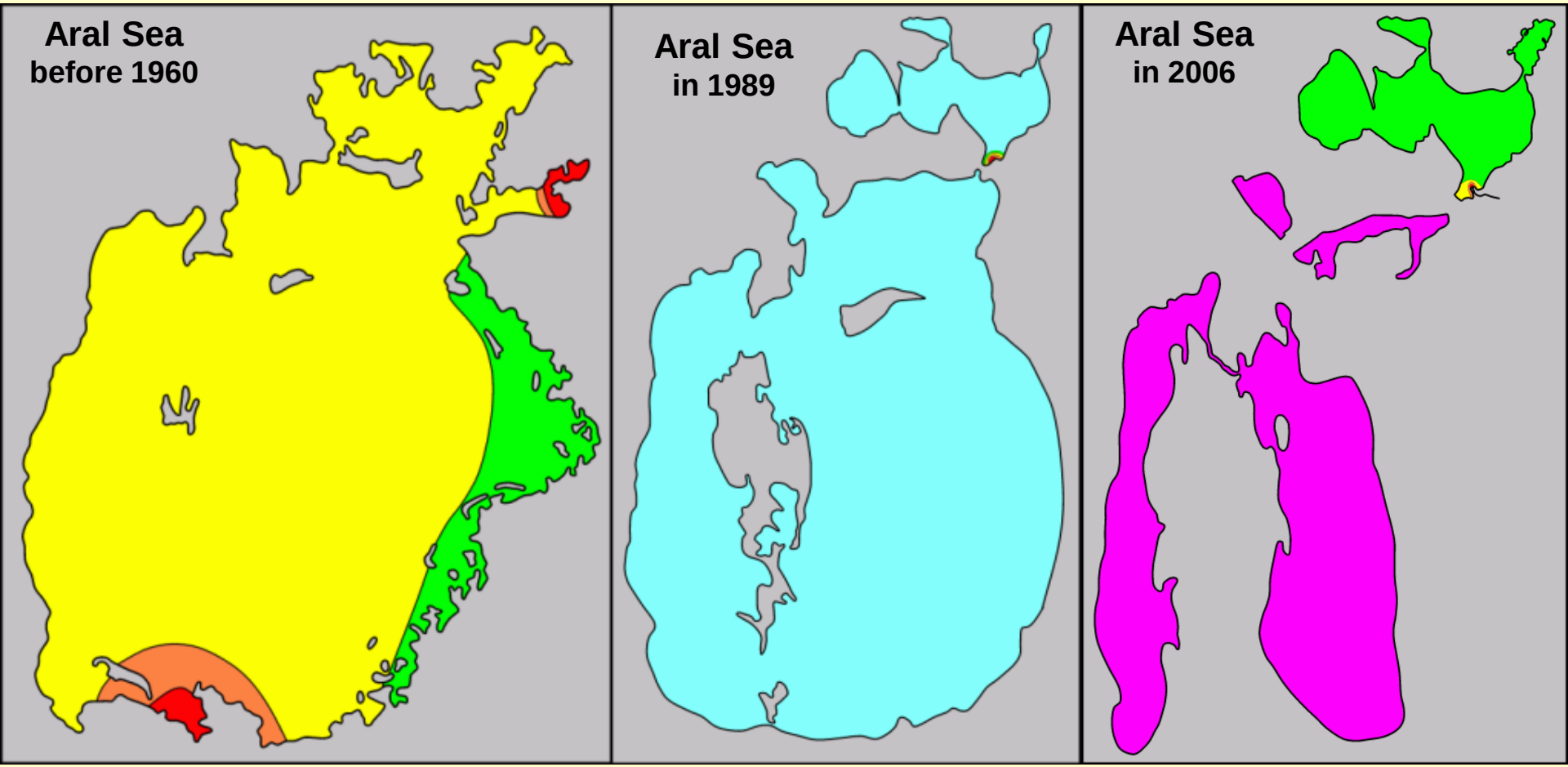
# *IRRIGATION DEVELOPMENT IN ARAL SEA BASIN*


**MAJOR IRRIGATION COMPLEXES IN THE ARAL SEA BASIN**

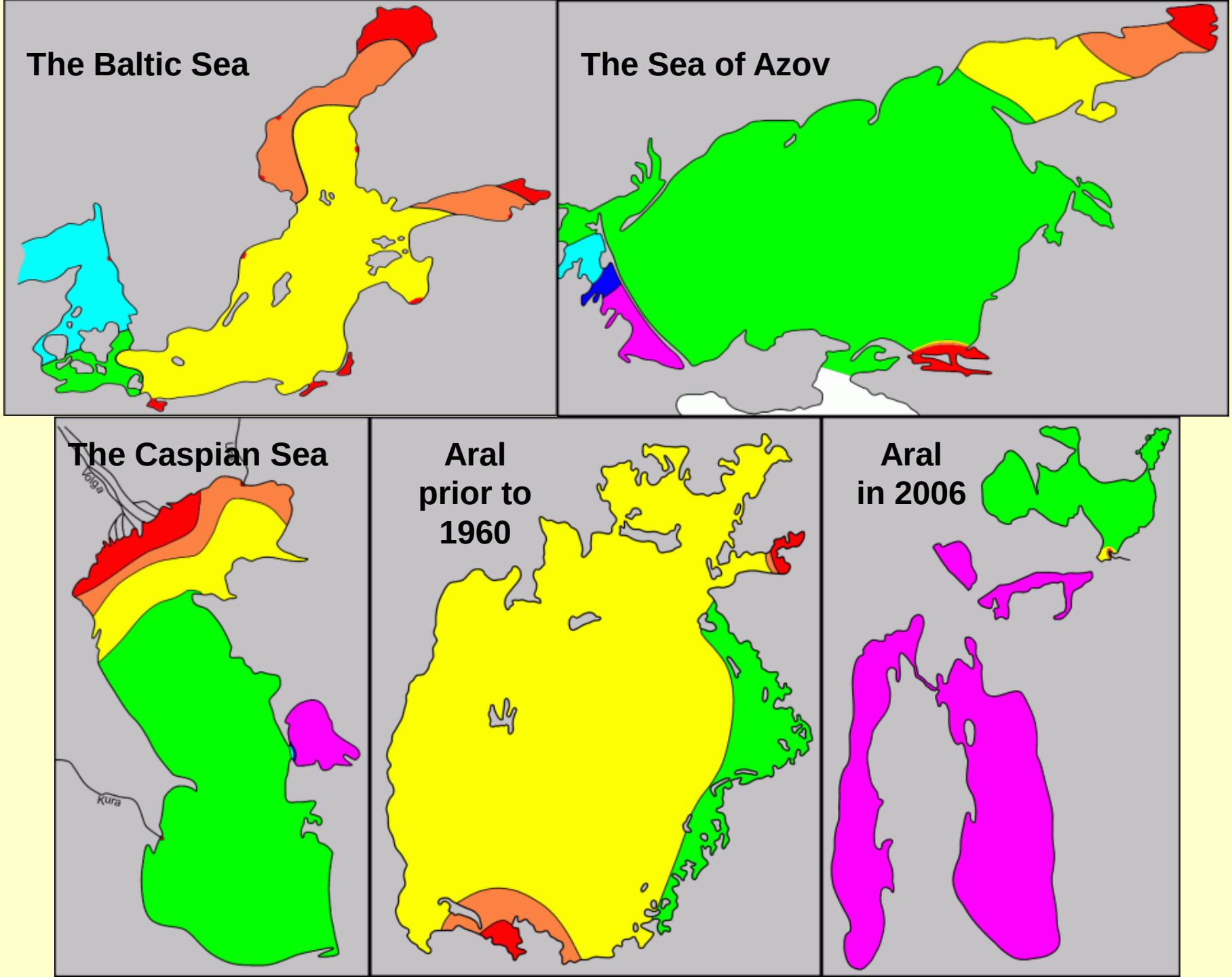
main irrigation zones in the Aral Sea Basin

proposed Siberia-Aral Sea Canal

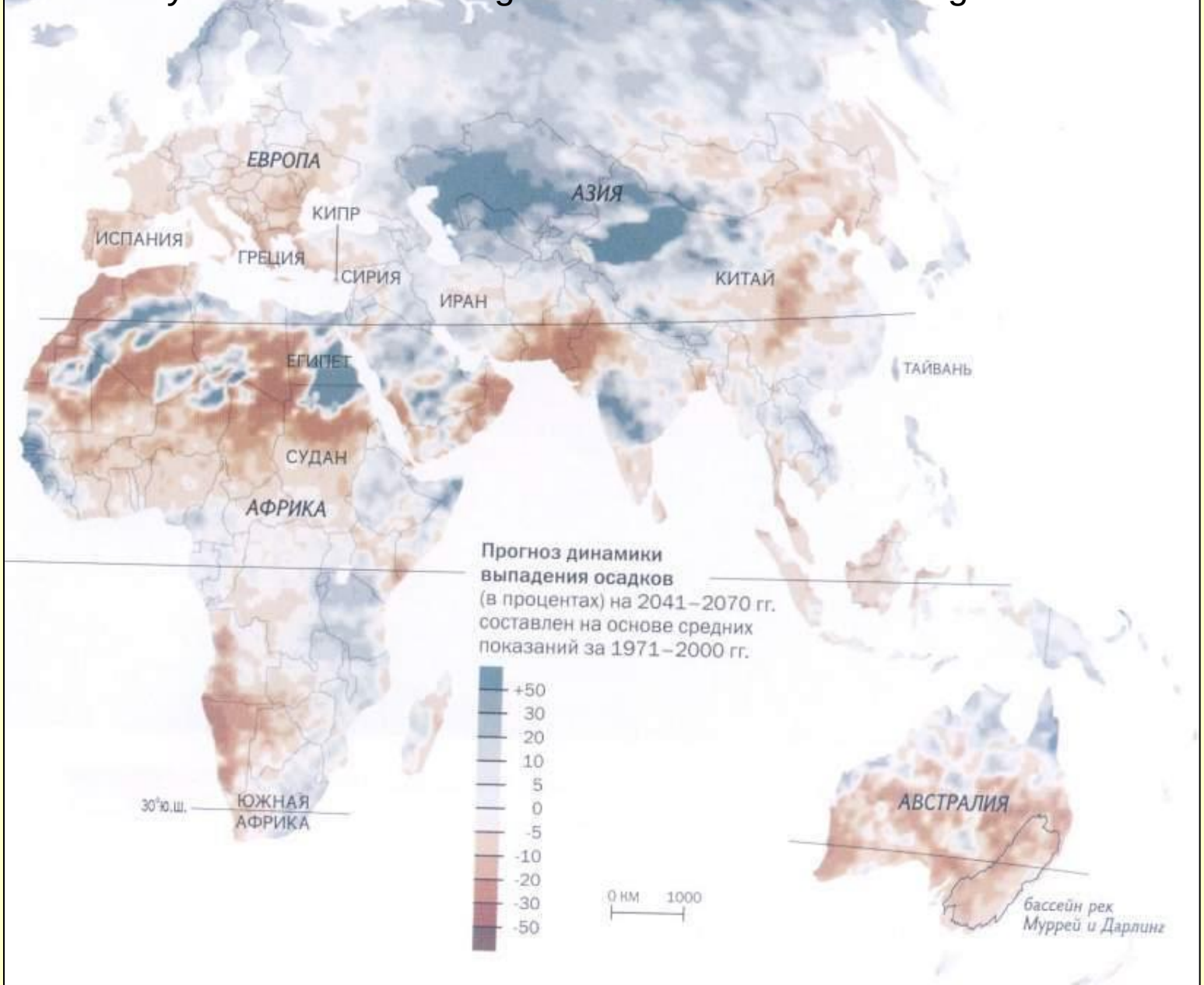
1. Kara-Kum Canal
2. Amu Dar'ya Delta
3. Amu-Bukhara Canal
4. Zeravshan Valley
5. Karshi Steppe
6. Middle Amu Dar'ya
7. Surkhandar'ya Valley
8. Golodnaya Steppe
9. Fergana Valley
10. Middle Syr Dar'ya
11. Kzyl-Orda Canal
12. Syr Dar'ya Delta




- Freshwater ecosystems
- Transitional freshwater-brackishwater ecosystems
- Brackishwater ecosystems
- Transitional brackishwater-marine ecosystems
- Marine ecosystems
- Hyperhaline ecosystems


The Baltic Sea
The Sea of Azov
The Caspian Sea
Volga
Kura
Aral
prior to
1960
Aral
in 2006

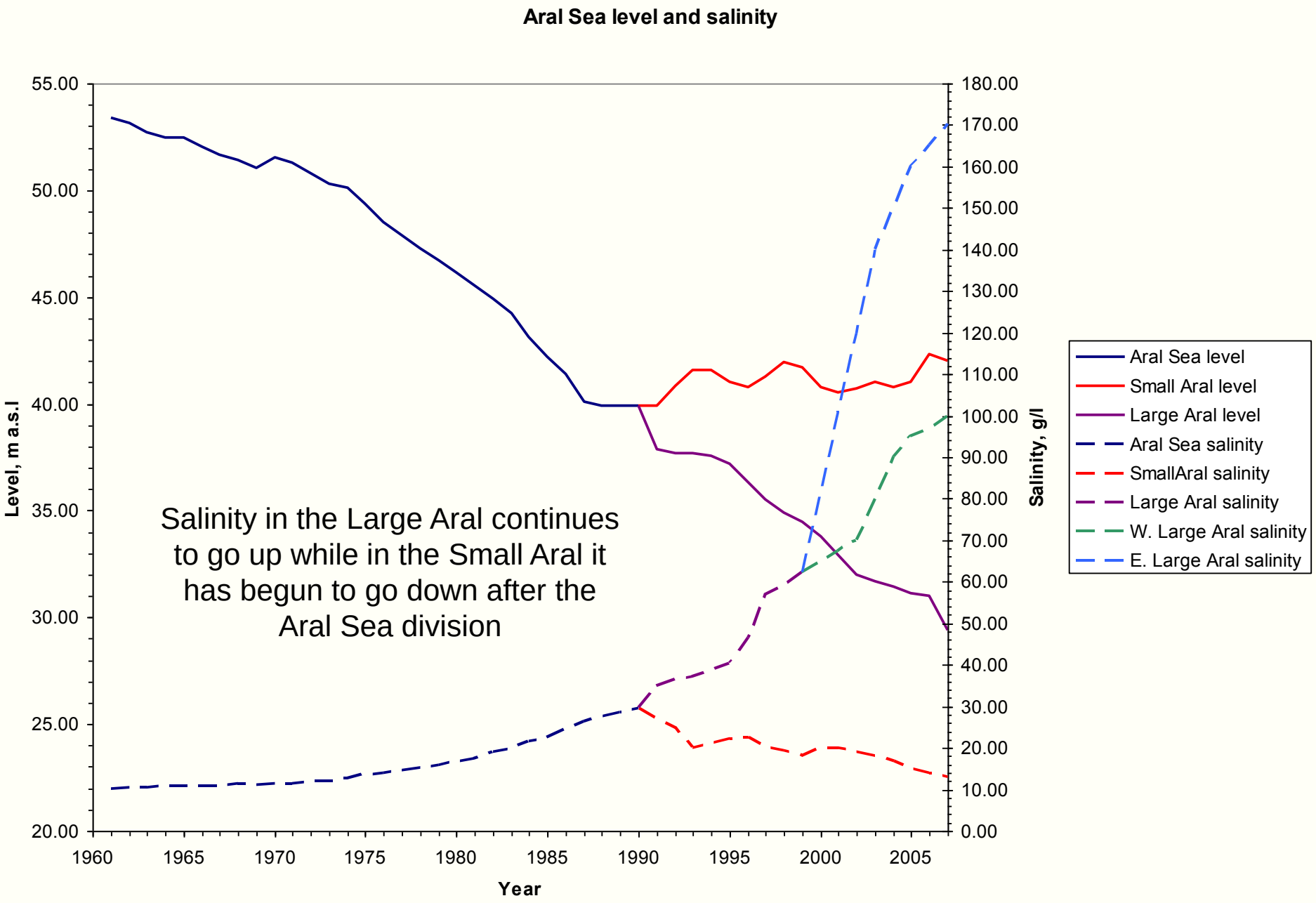
Due to the Global Warming precipitations in 2041-2070 will increase up to 50%. Melting of mounting ice caps that is feeding Syr Darya and Amu Darya are still increasing due to the Global Warming.



# In the end of 1980's, when the level dropped by about 13 m and reached about +40 m, the Aral Sea divided into the Large and Small Aral


**Area 40000 km$^2$ (60% from 1960)**
**Volume 333 km$^3$ (33% from 1960)**
**Salinity 30 g/l (10 g/l in 1960)**

**In autumn 1987 – spring 1989 Aral Sea divided into 2 lakes: Small (Northern) Aral and Large (Southern) Aral. In both lakes salinity increased and could survive practically the same number of free-living animals.**


Aral Sea level and salinity
Level, m a.s.l
Salinity, g/l
Year
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
180.00
170.00
160.00
150.00
140.00
130.00
120.00
110.00
100.00
90.00
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
Salinity in the Large Aral continues to go up while in the Small Aral it has begun to go down after the Aral Sea division
Aral Sea level
Small Aral level
Large Aral level
Aral Sea salinity
SmallAral salinity
Large Aral salinity
W. Large Aral salinity
E. Large Aral salinity

**There are 4 main ways of conservation and rehabilitation of Aral Sea and its ecosystems that was first discussed in Geneva (September 1992 - UNEP meeting)**

1. **Conservation and rehabilitation of Small Aral**
2. **Conservation and rehabilitation of Large Aral**
3. **Conservation and rehabilitation of delta and deltaic water bodies of Syr Darya**
4. **Conservation and rehabilitation of delta and deltaic water bodies of Amu Darya**

# Concept to Partially Preserve Small and Large Aral Seas
## (proposed by Lvovich and Tsigelnaya, updated and modified by P. Micklin)

### Small Aral Sea

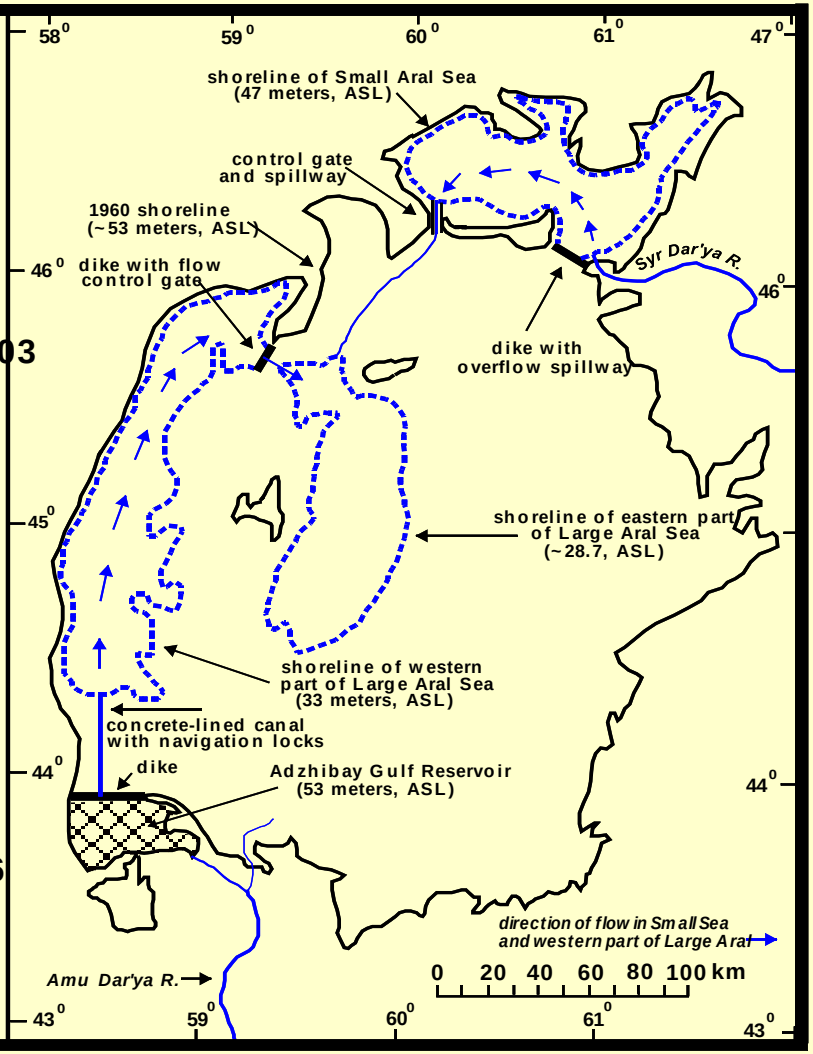
level 47 m, area 4310 km2, vol. 46.5 km3, river inflow 4.5 km3, outflow toward L. Aral 1.4 km3, salinity 7.6 g/l (?), start date for project - 2004

### Large Aral Sea

Western Sea: level 33 m, area 6203 km2, vol. 85 km3, river inflow 7.35 km3, outflow to E. Aral 3.05 km3, salinity 45 g/l, (21 g/l by 2050), start date - 2007

Eastern Sea: level 28.7 m, area 5710 km2, vol 21 km3, inflow from W. Aral 2.95 km3, inflow from Small Aral 1.03 km3, salinity 362 g/l (?)

Adzhibay Gulf Reservoir: level 53 m, area 1147 km2, vol. 6.23 km3, inflow from Amu Dar'ya 8.26 km3, outflow to W. Aral 7.35 km3, salinity ~2g/l




Another option would be to give more water to the Eastern Large Aral from Small Aral via Berg strait and from Amudarya river via Akdarya river bed. Level of Western Large Aral Sea might be maintainable using ground water flow from Amudarya delta and Ustjurt plateau.

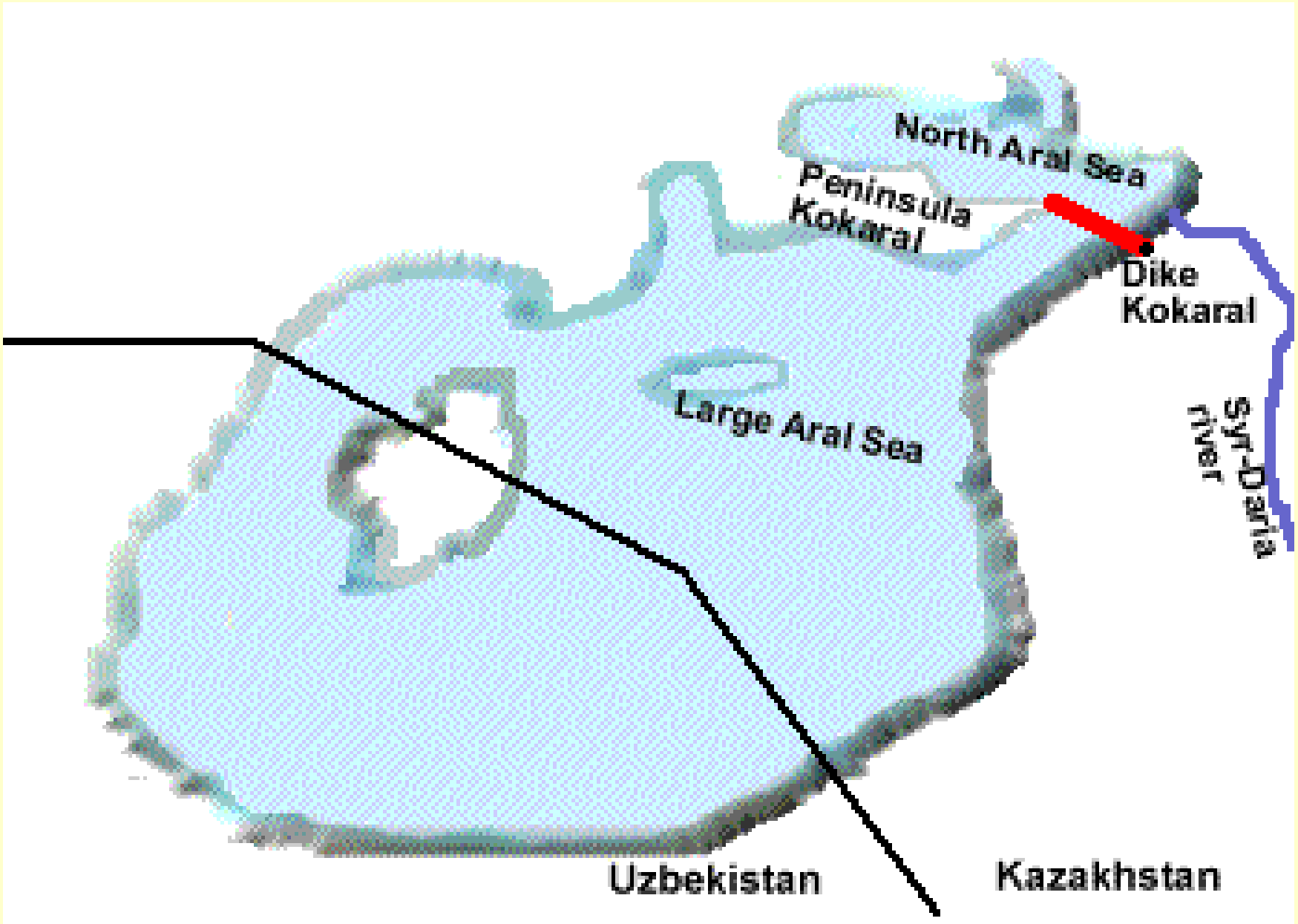
# Way 1.
# Conservation and rehabilitation of Small Aral and its ecosystems

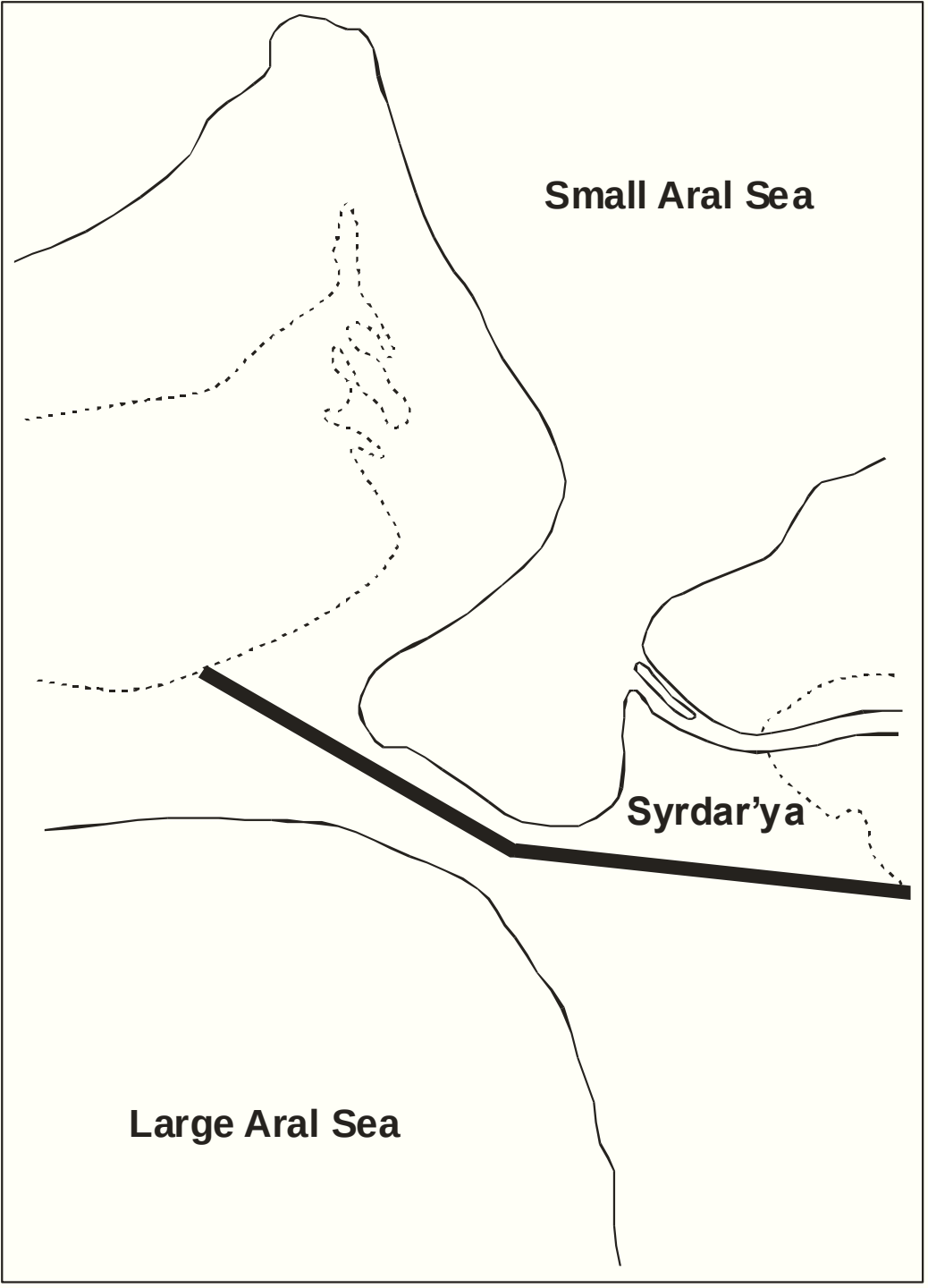
**Discharge of water from Small Aral occurs primarily in Spring-early Summer high flow period on Syr Dar'ya. Since August 2005 outflow is controlled by a discharge structure (gates) in the dike.**



**SMALL ARAL AND NORTH PART OF LARGE ARAL**
**(Showing effect of Spring/early summer "high flow" and later Summer "low flow" of Syr Dar'ya)**

# Dike in Berg strait is preserving Small (Northern) Aral and rehabilitating its biodiversity.

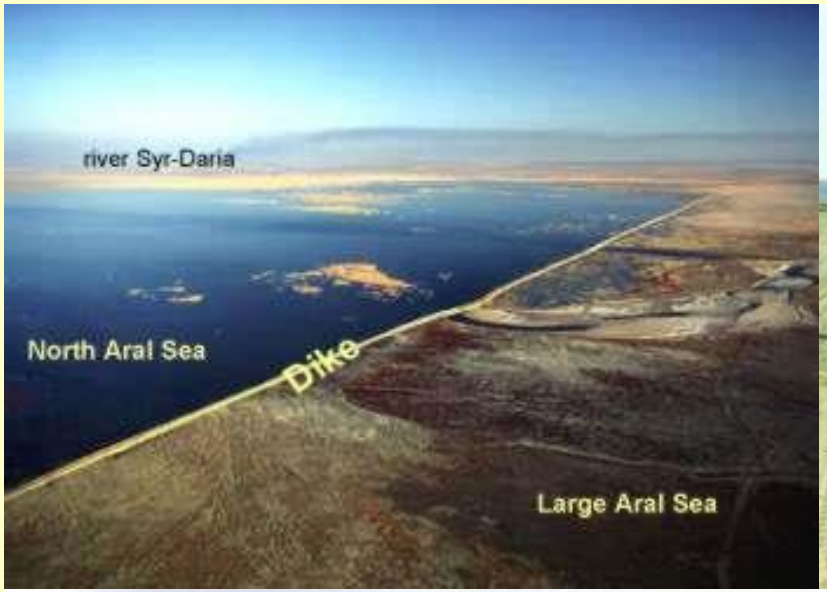





**Dike in Berg strait is preserving Small (Northern) Aral and rehabilitating its biodiversity.**

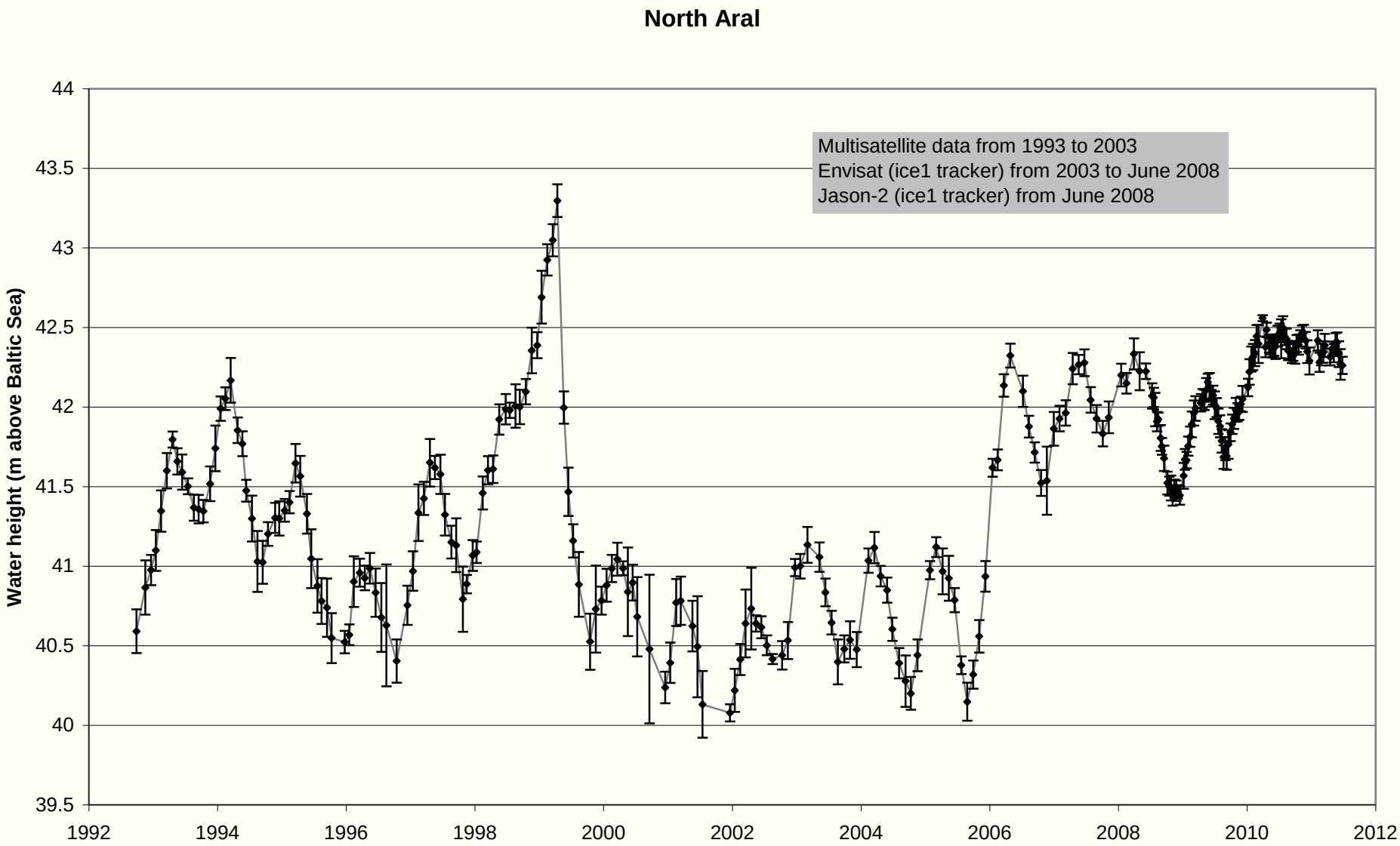
By: Aladin N.V., Plotnikov I.S., Potts W.T.W., 1995. The Aral Sea desiccation and possible ways of rehabilitation and conservation of its North part // Int. J. Environmetrics. Vol. 6: 17-29.

# The first dam was built by our proposal in August 1992.




# In April 1999, when the Small Aral Sea level increased more than by 3 m and reached +43.5 m, the dam broke.

## (data below are from satellite altimetry courtesy of Jean-Francois Cretaux)



# Berg's strait before (left) and (after) the dike collapse

April 14, 1999

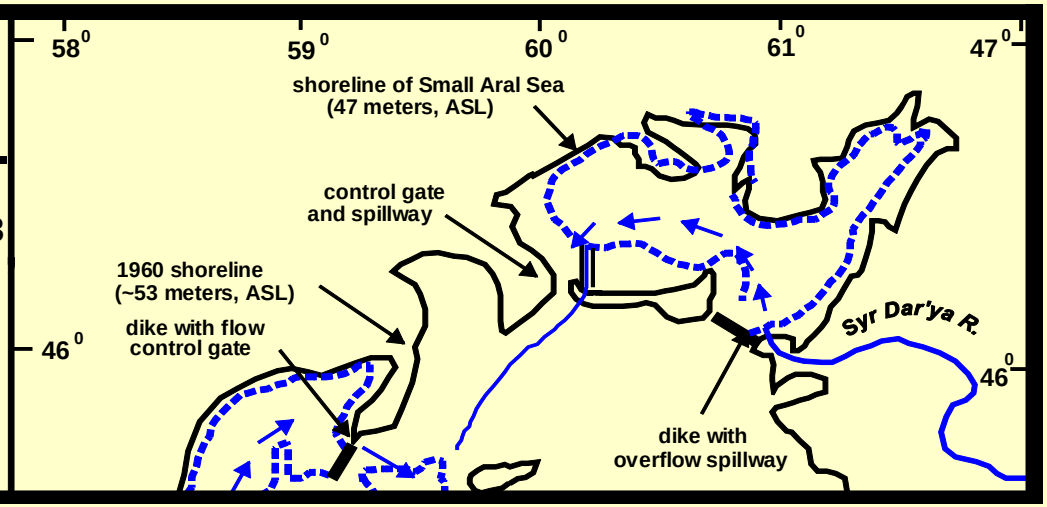

April 30, 1999

Source: USGS Global Visualization Viewer, Landsat 4-5 TM (http://glovis.usgs.gov/ImgViewer/Java2ImgViewer.html)

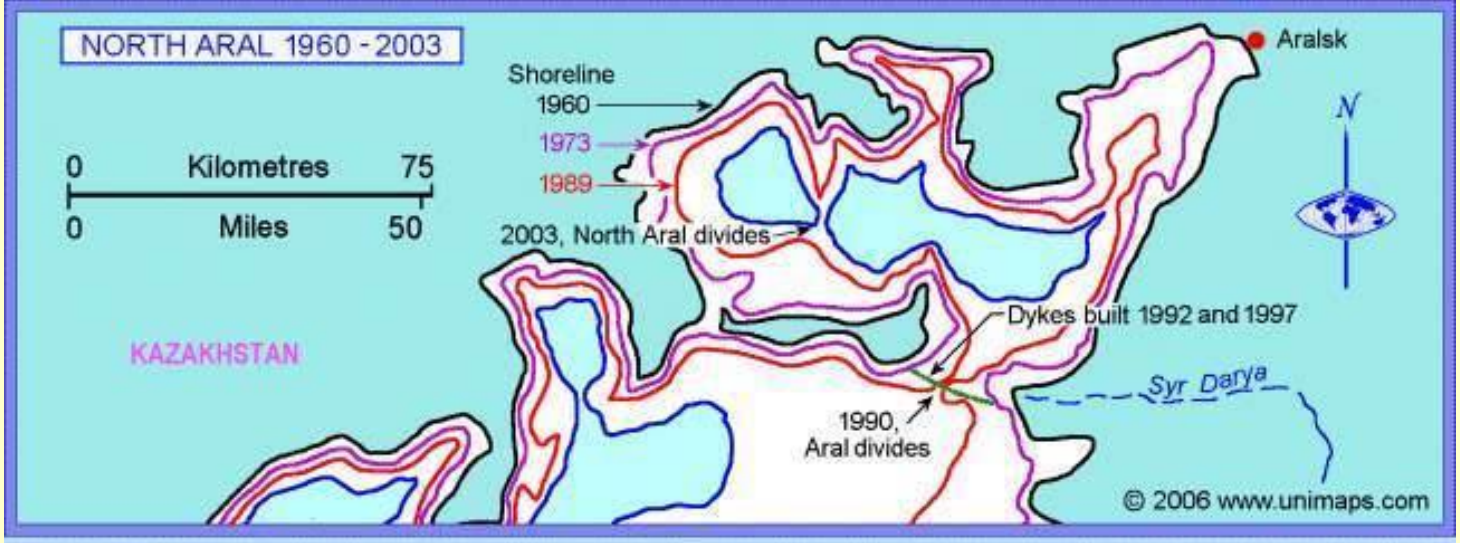
# Russian company “Zarubezhvodstroy” made new dike in Berg strait. It was completed in autumn 2005.

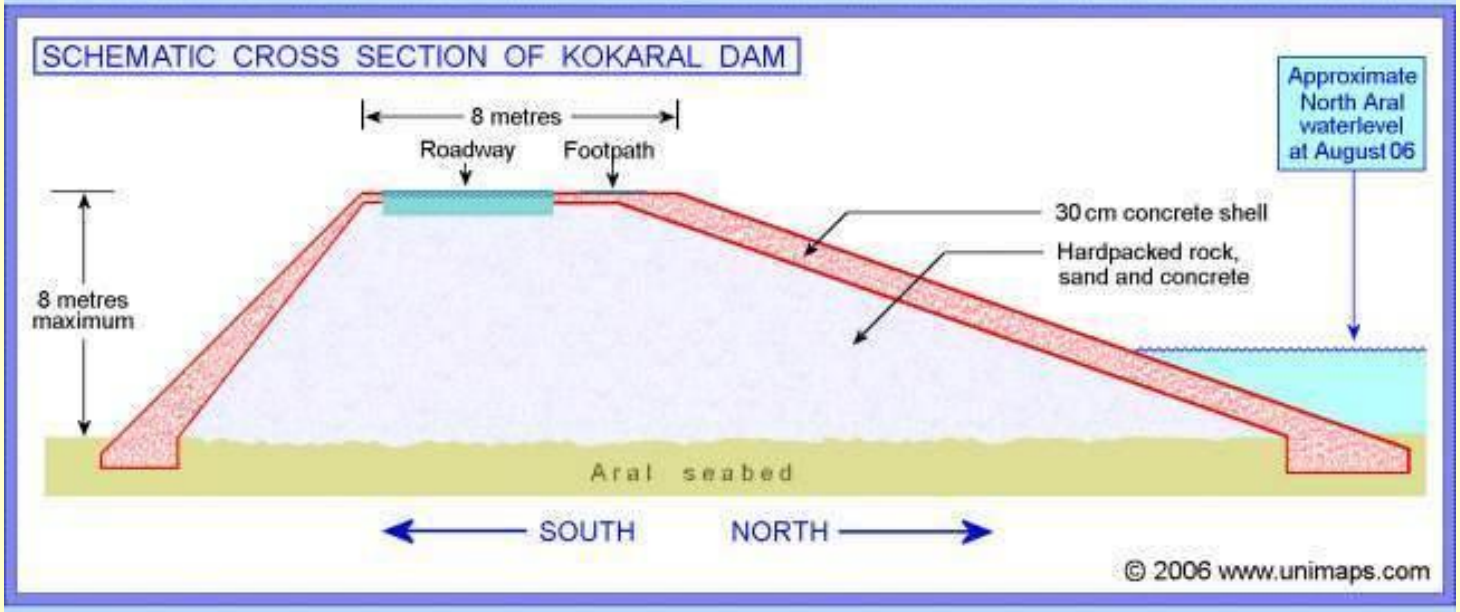
**Small Aral Sea**

**level 47 m, area 4310 km$^2$, vol. 46.5 km$^3$, river inflow 4.5 km$^3$, outflow toward L. Aral 1.4 km$^3$, salinity 7.6 g/l (?), start date for project - 2004**




**Unfortunately level of Small Aral reached only +42-43 m but not 47 m as it is shown above. Discharge from Small Aral to Large Aral is not through former Auzy-Kokaral strait, but via former Berg strait. Salinity of Small Aral is 11-14 g/l.**


NORTH ARAL 1960 - 2003
Shoreline
1960
1973
1989
2003, North Aral divides
0 Kilometres 75
0 Miles 50
KAZAKHSTAN
Aralsk
N
Dykes built 1992 and 1997
Syr Darya
1990,
Aral divides
© 2006 www.unimaps.com


SCHEMATIC CROSS SECTION OF KOKARAL DAM
8 metres
Roadway
Footpath
Approximate
North Aral
waterlevel
at August 06
30 cm concrete shell
Hardpacked rock,
sand and concrete
8 metres
maximum
Aral seabed
SOUTH
NORTH
© 2006 www.unimaps.com


CROSS SECTION OF KOKARAL DAM SHOWING TRUE FRONTAL SLOPE ratio 1:36
Dam
Aral seabed
© 2006 www.unimaps.com

# New Kok-Aral dike built by Russian company “ZARUBEZHVODSTROY”

# Spillway of new dike in the Berg strait in September 2006 (photo by L.Kuznetsov)

# Spillway of new dike in the Berg strait in September 2007

# Small Aral sea before new dike construction

# This boat was far from the sea in September 2005

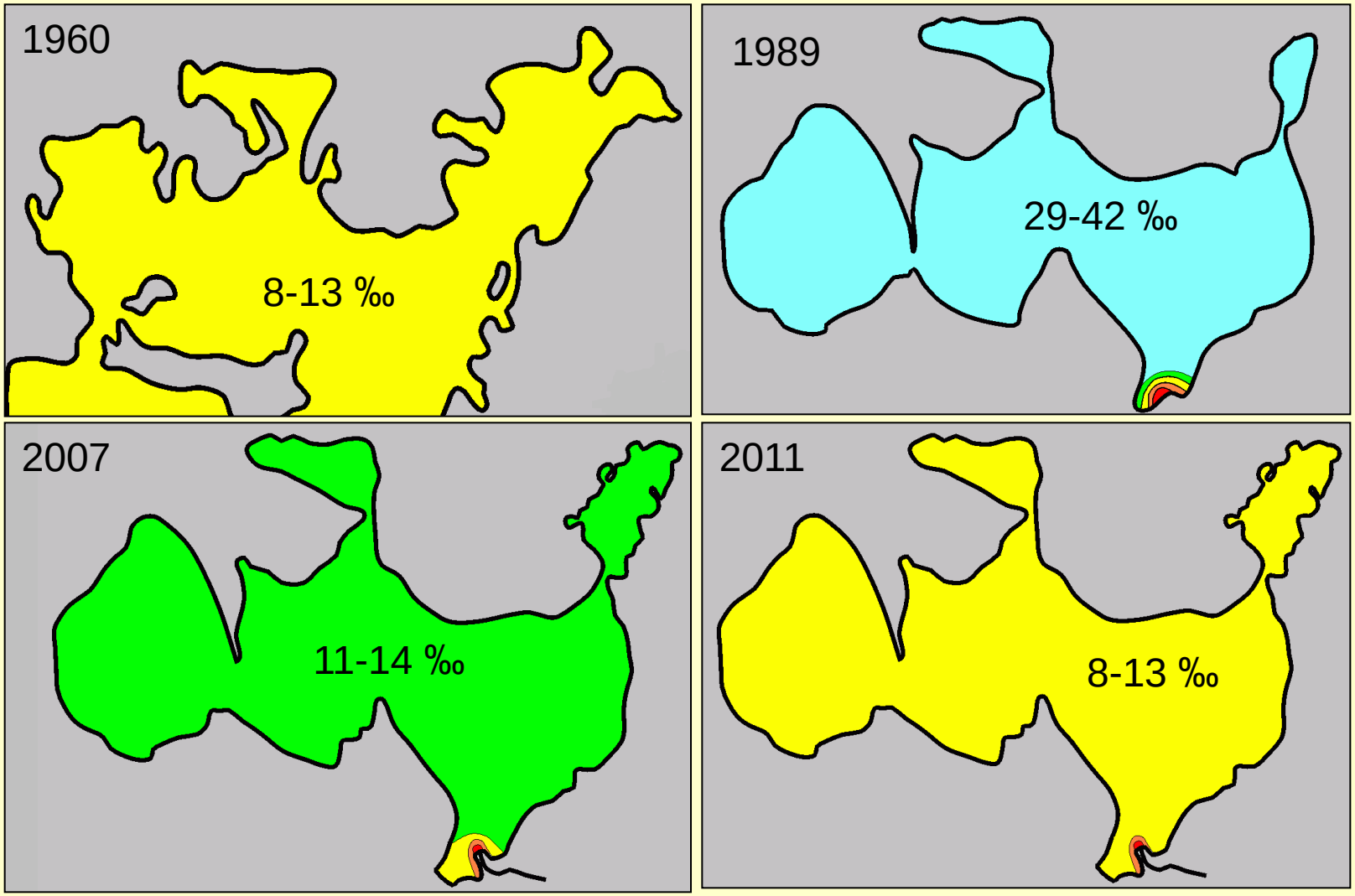
# Small Aral sea after new dike construction

**Owing to level rise of the Small Aral the same boat was mostly under water by September 2007**

**Owing to some level drop of the Small Aral the same boat is standing exactly at the shoreline by September 2011**

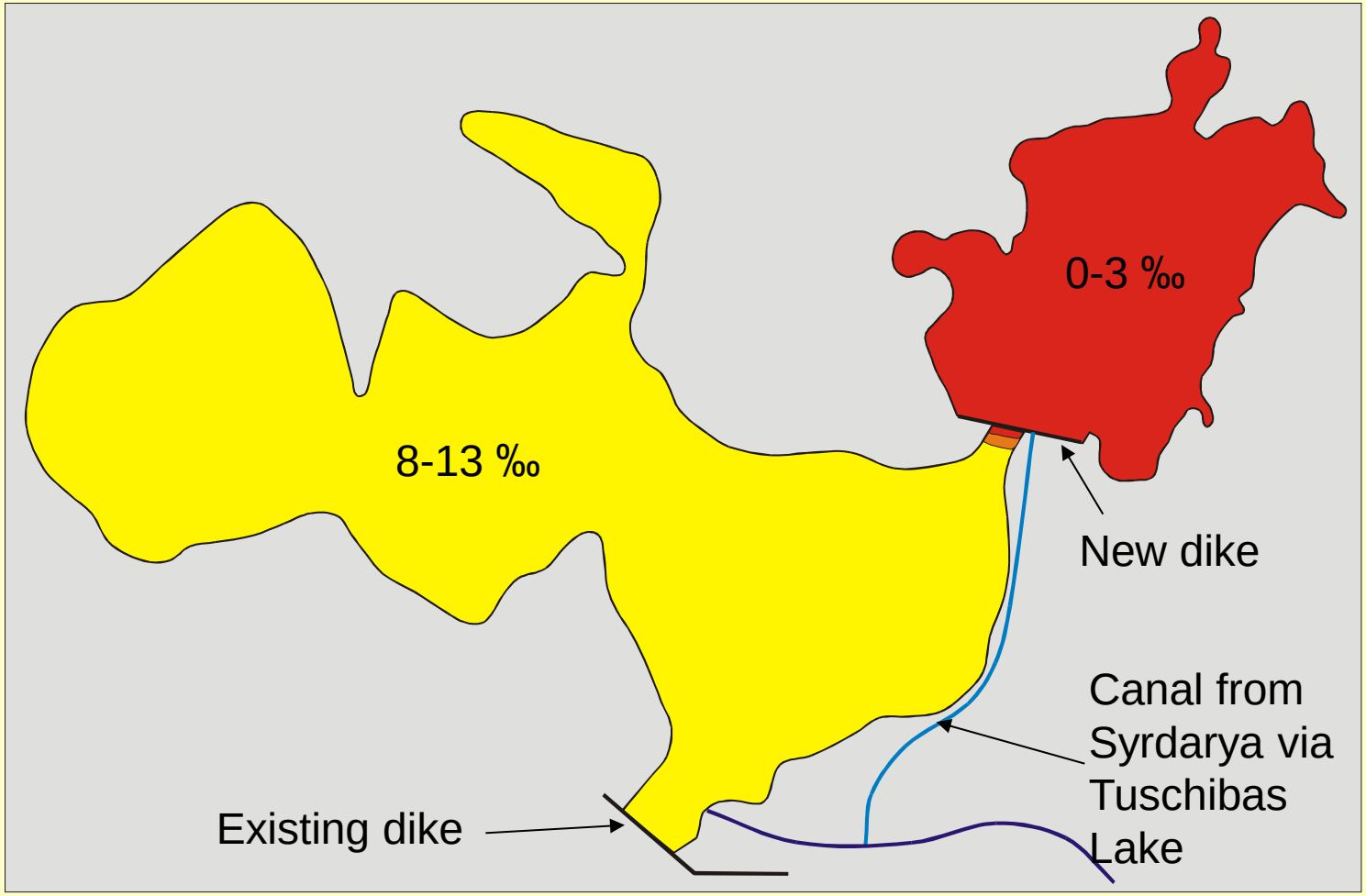
# When water gates are open in Kok-Aral dike all remnant water bodies of the Aral Sea are connected


# Dike in Berg's strait funded by GEF and Kazakhstan government allowed to improve brackish water environment of Small (Northern) Aral Sea

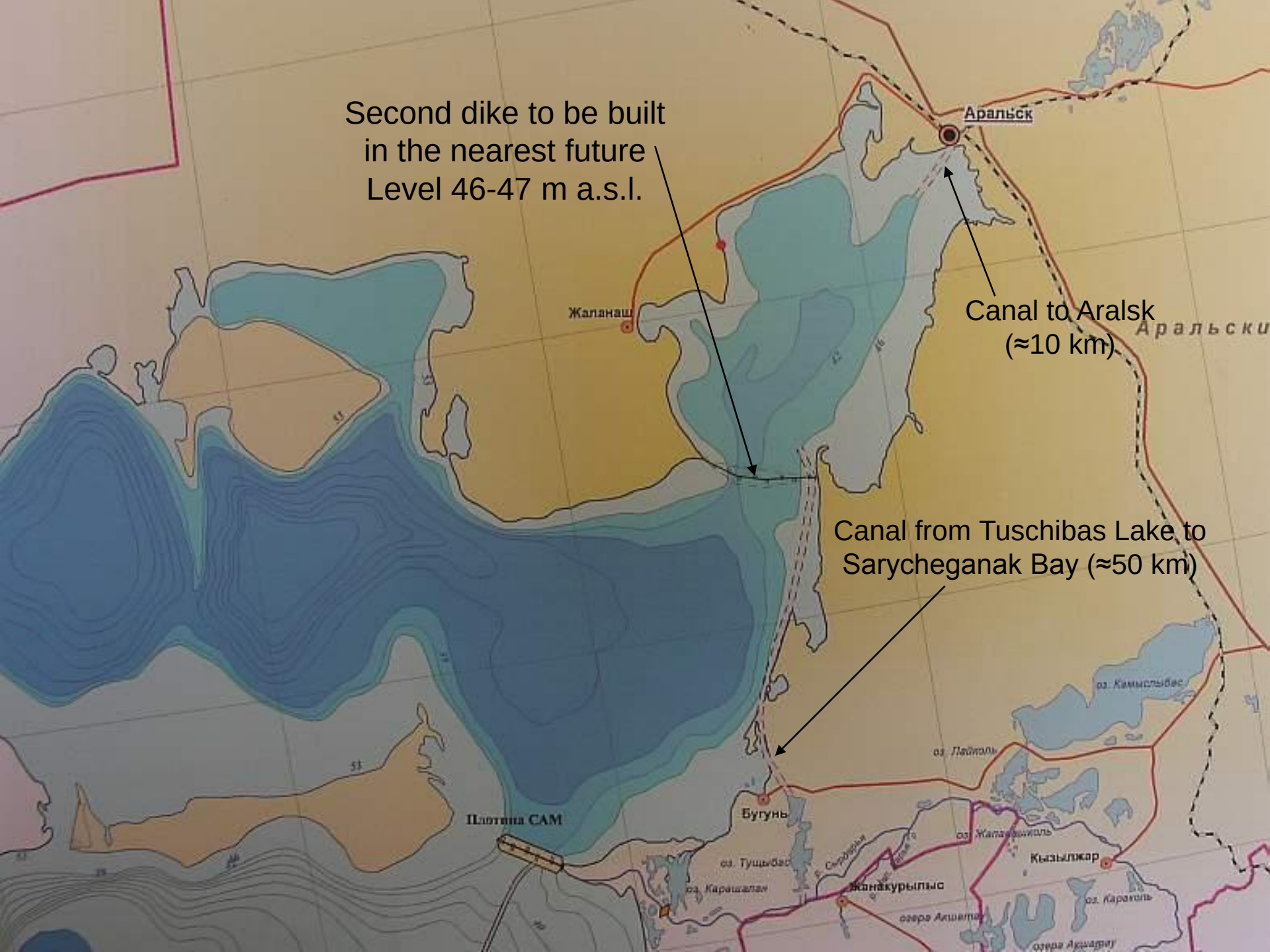



- **Dike in Berg's strait allowed increase of level in Small (Northern) Aral Sea to +42 m a.s.l. with "forcing" to 42.5 m.**
- **Present average salinity in Small (Northern) Aral Sea is about 16-17 g/l. In the nearest future it will reach 8-13 g/l.**
- **For further improvement of situation there are needed improvements in irrigation efficiency to raise inflow from Syr Dar'ya.**
- **It is possible to make the present dike a bit higher and raise the level to +45 m a.s.l. This will allow to enlarge the volume and area of Small (Northern) Aral Sea.**

# Alternative 2nd phase of the Small Aral rehabilitation project

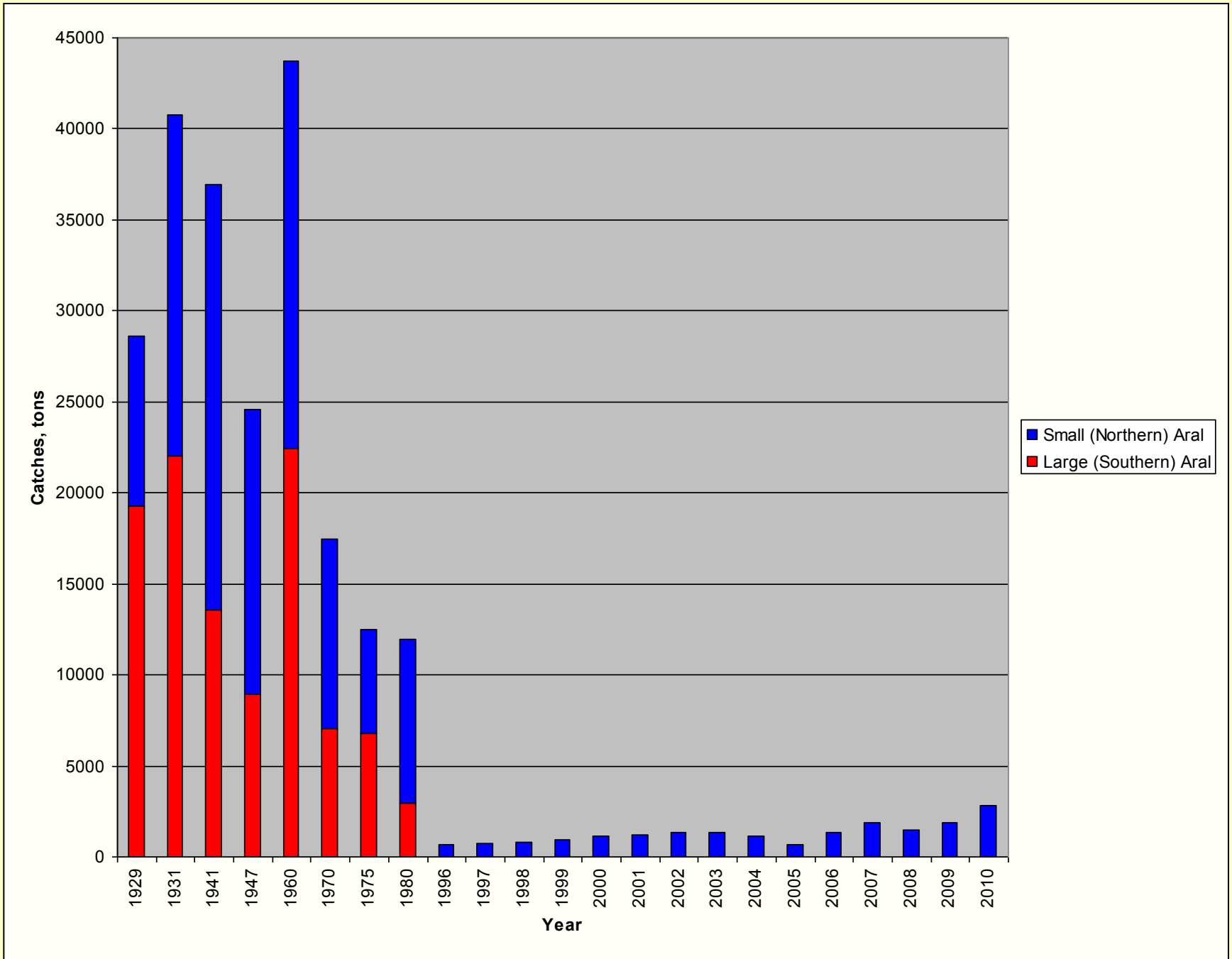



- **Alternative 2nd phase of the project would raise level only of Saryshaganak Gulf.**
- **Second phase would allow further improvement of the health of the local people, to decrease unemployment and increase living standards as well as income to the local families.**
- **The local economy also will be improved (fishery, shipping, etc.).**
- **Local microclimate around Small (Northern) Aral Sea will be much better than now.**


Second dike to be built
in the nearest future
Level 46-47 m a.s.l.
Аральск
Жаланаш
Canal to Aralsk
(≈10 km)
Аральски
Canal from Tuschibas Lake to
Sarycheganak Bay (≈50 km)
оз. Камыслыбас
оз. Лайсаль
Плотина САМ
Бугунь
оз. Тущыбас
оз. Карашалан
Кызылжар
оз. Жаланашколь
оз. Караколь
озера Акшатау

# View to Aklak dike

# Dynamics of fish catches in the North and South Aral Sea



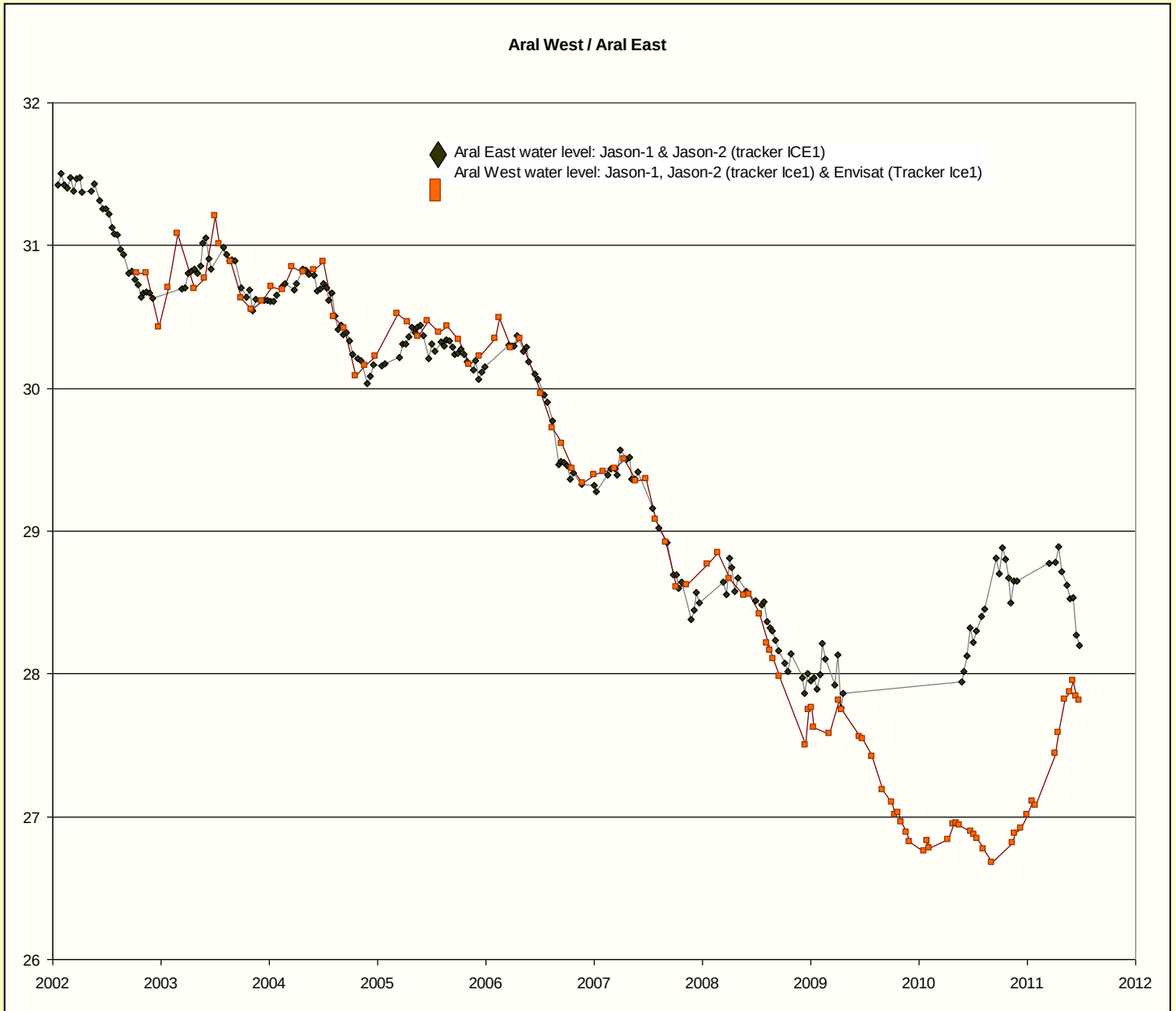
**When in 1992 a dike in Berg strait was built, fishing on the Small Aral was recommenced. According reports of fishermen in 2004 silver carp (*Ctenopharyngodon idella*) reappeared in Small Aral**

**Flounder (*Platichthys flesus*) totally disappeared from the Large Aral Sea because of rising salinity.**

# Way 2.
# Conservation and rehabilitation of Large Aral and its ecosystems

# Since Aral Sea divided into 2 lakes at the end of 1980s level of Large Aral Sea is declining

## (data from satellite altimetry, courtesy of Jean-Francois Cretaux)



# Since beginning of 2003, when the level in the Large Aral Sea dropped by 22 m and reached about +31 m, the Large Aral Sea is practically divided into the Eastern Large and Western Large Aral


**Sept. 6, 2009: Area 4922 km$^2$ (8% from 1960)**
**Volume 58 km$^3$ (6% from 1960)**
**Salinity: Western part and Tschebas Bay – >100 g/l, Eastern part – >200 g/l)**

**In 2010 Eastern part can be desiccated almost completely.**

**In both lakes salinity increased so high that all fishes gone and only few free-living invertebrates could survive.**

**Western part and Tschebas Bay of Large Aral:**
**Infusoria – 2; Rotatoria – 2; Copepoda – 1; Ostracoda – 2; Branchiopoda – 1; Gastropoda - >2.**
**TOTAL: >10?**

**Eastern part of Large Aral :**
**Branchiopoda – 1.**

**At the end of 20th century brine shrimp *Artemia parthenogenetica* appeared in the Large Aral Sea.**

**Nowadays industrial harvesting under aegis of international company INVE Aquaculture is being considered, but in 2005 the company postponed activities until salinity increase to levels more favorable for brine shrimp.**

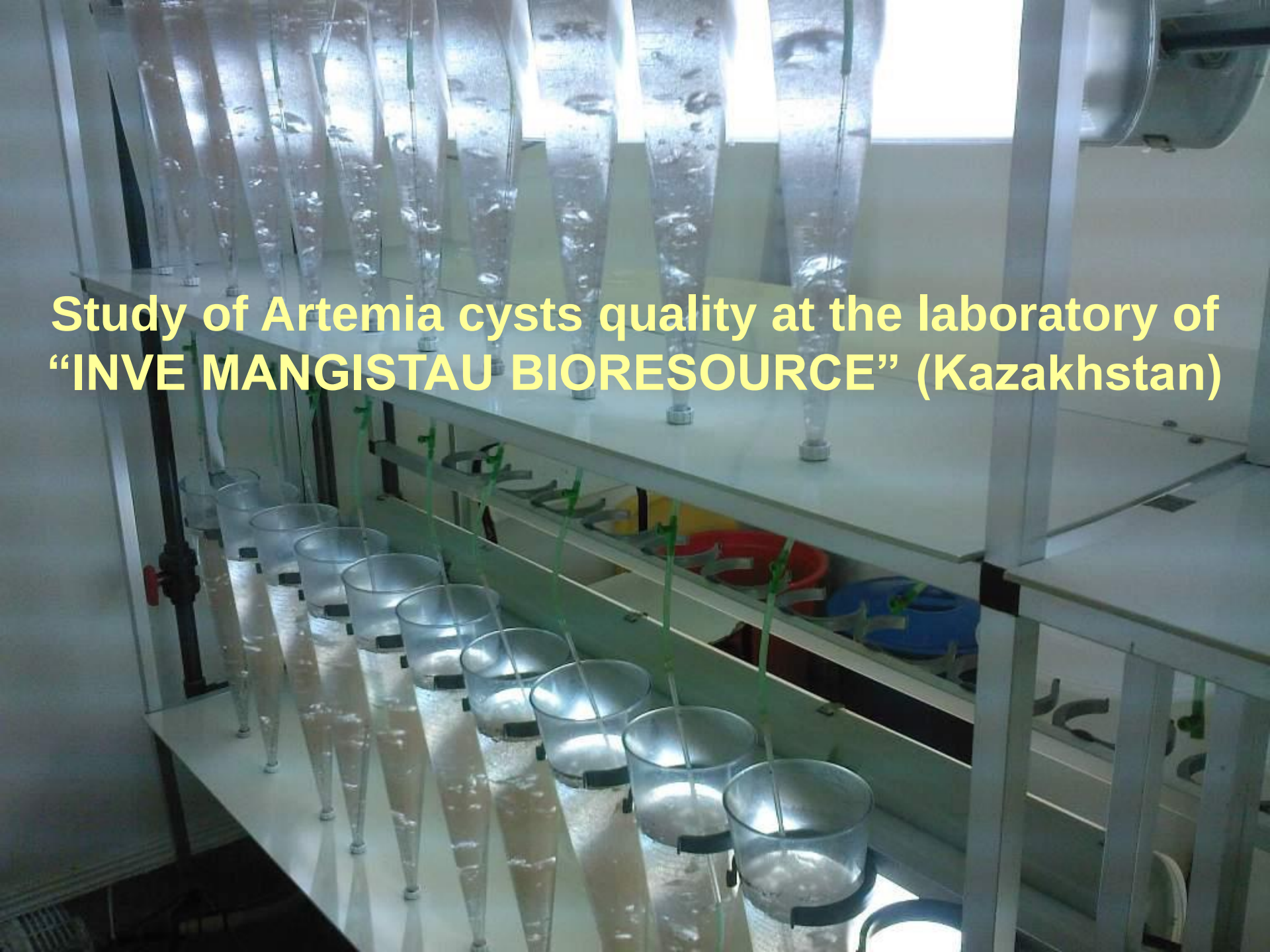

Floating cysts of *Artemia*


At the right:

Head of “INVE MANGISTAU BIORESOURCE” Mr. Aslan Hanukiev (Kazakhstan)

At the left:

Chief scientist from “Great Salt Lake Artemia” Dr. Brad Marden (USA)



# Study of Artemia cysts quality at the laboratory of “INVE MANGISTAU BIORESOURCE” (Kazakhstan)

**Former Aral Sea bottom without ground water supply is like this. Karakalpakistan, September 2004 (photo by P.Annin)**

**Former Aral Sea bottom with ground water supply is rich with reeds. Karakalpakistan, September 2004**
**(photo by P.Annin)**

**Special water way and water discharge gates under construction in September 2004 to supply Eastern depression of Large Aral from Mezhdurechensky reservoir via Akdarya river bed. (photo by P.Annin).**

**Unfortunately completed spillway and water gates failed soon after being put into operation in autumn 2005.**

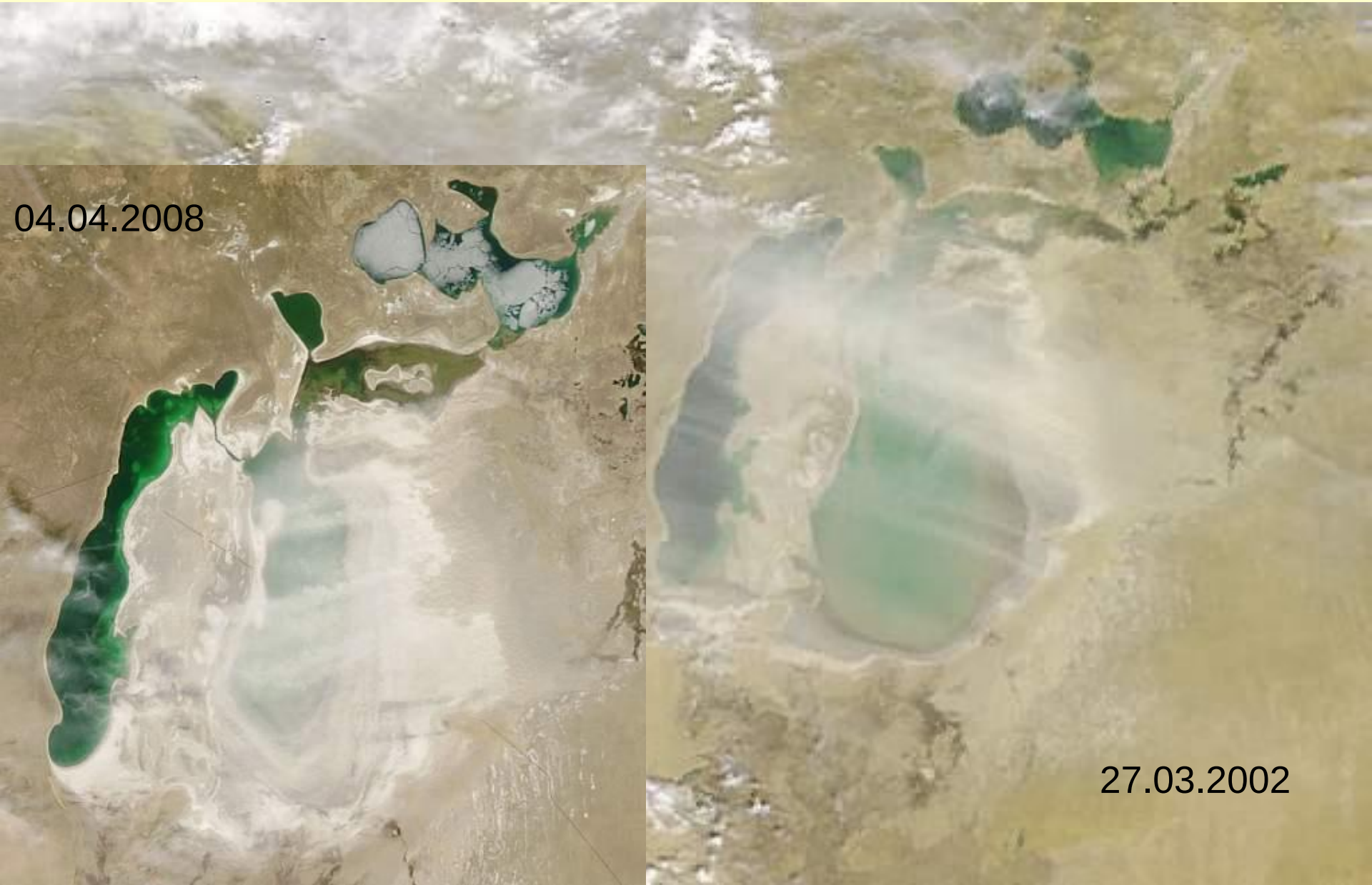
**Special water way and water discharge gates just after construction in September 2005. Photo by P. Micklin**

**It was built to supply Eastern depression of Large Aral from Mezhdurechensky reservoir via Akdarya river bed**

**Unfortunately completed spillway and water gates failed soon after being put into operation in October 2005. Photo by B. Mukhamadiev.**

# Health problems of the local people

# Salt & Dust blowing from dried bottom of Aral Sea

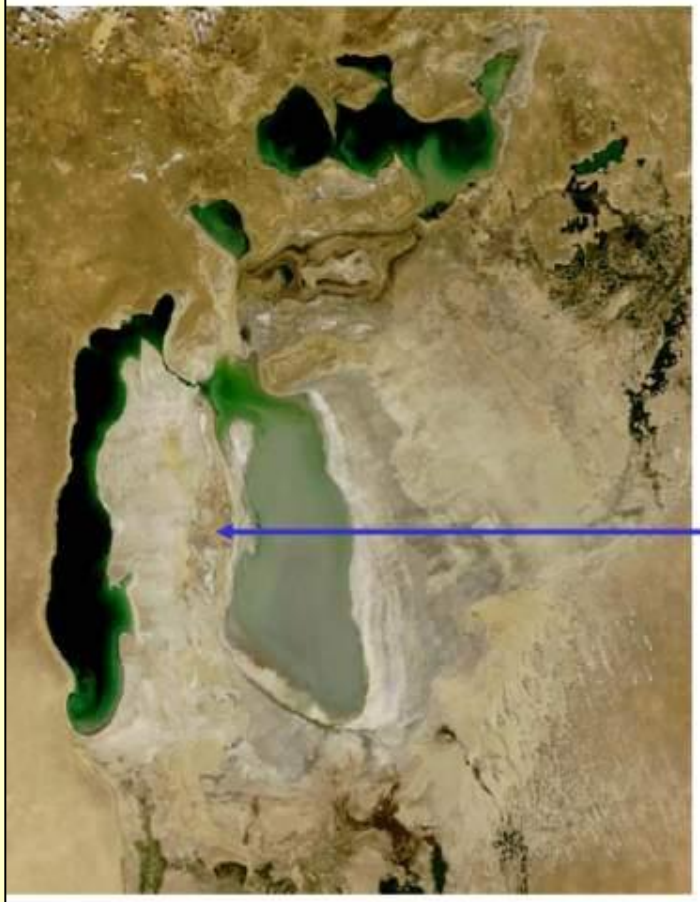


- Salt and sand are being blown away from dried Aral Sea bottom giving a lot of risk for local people health.
- Health experts say the local population suffers high levels of:
  1. respiratory illnesses,
  2. throat and esophageal cancer,
  3. digestive disorders,
  4. high blood pressure due to breathing and ingesting salt-laden air and water,
  5. liver and kidney ailments,
  6. eye problems.
- The loss of fish has also greatly reduced dietary variety, worsening malnutrition and anemia, particularly in pregnant women.


Terra/Modis image
October 21, 2002
250 meter resolution
original Vozrozhdeniye
Island bioweapons
test site

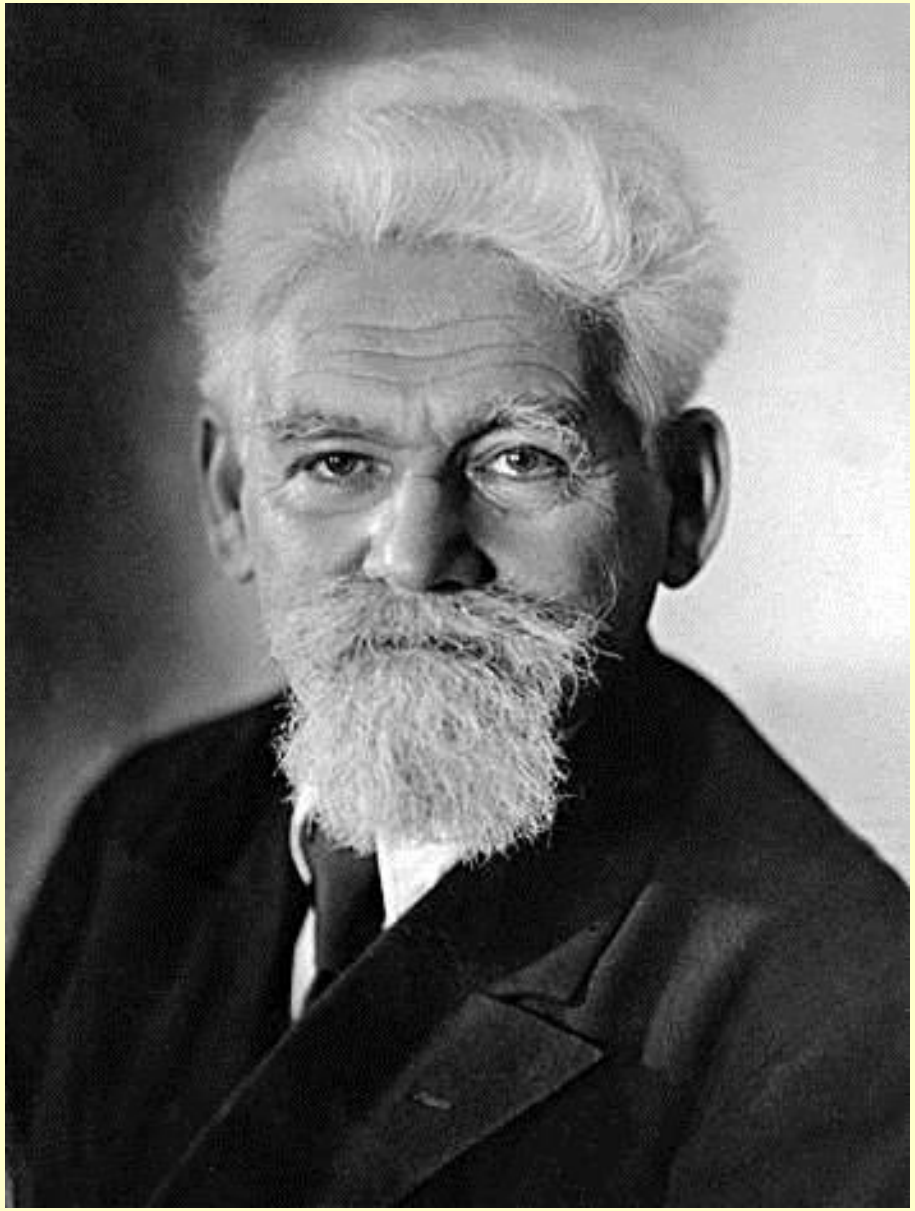
- Vozrozhdeniya (Resurrection) Island also poses a unique problem.
- This Island was once a small, remote outcrop in the middle of the Aral Sea. Beginning in 1952 the Soviet Union used the island as a testing ground for super-secret biological weapons. Genetically modified and weaponized pathogens were tested on horses, monkeys, sheep, donkeys and laboratory animals, including:
  anthrax,
  tularemia,
  brucellosis,
  plague,
  typhus,
  Q fever,
  smallpox,
  botulinum toxin,
  Venezuelan equine encephalitis.
- Fishermen and local residents worried about reports of mass deaths of animals and fish, as well as infectious diseases among people who worked on the island.

**Vozrozhdeniya Island bioweapons test site (1957 & late 1990s from Google Earth) right and MODIS (8-11-07) below**

- Upon the Soviet Union’s 1991 collapse, the military allegedly decontaminated the island. However, due to receding waters, by 2001 Vozrozhdeniya had united with the mainland to the south. Health experts feared that weaponized organisms such as anthrax survived and could escape to the mainland via fleas on infected rodents, which are numerous on the dried lands, or that terrorists might gain access to the organisms. In 2002 the U.S. sent $6 million and a team of experts to help Uzbekistan destroy any remaining pathogens.

# Evidences of medieval desiccation of the Aral Sea

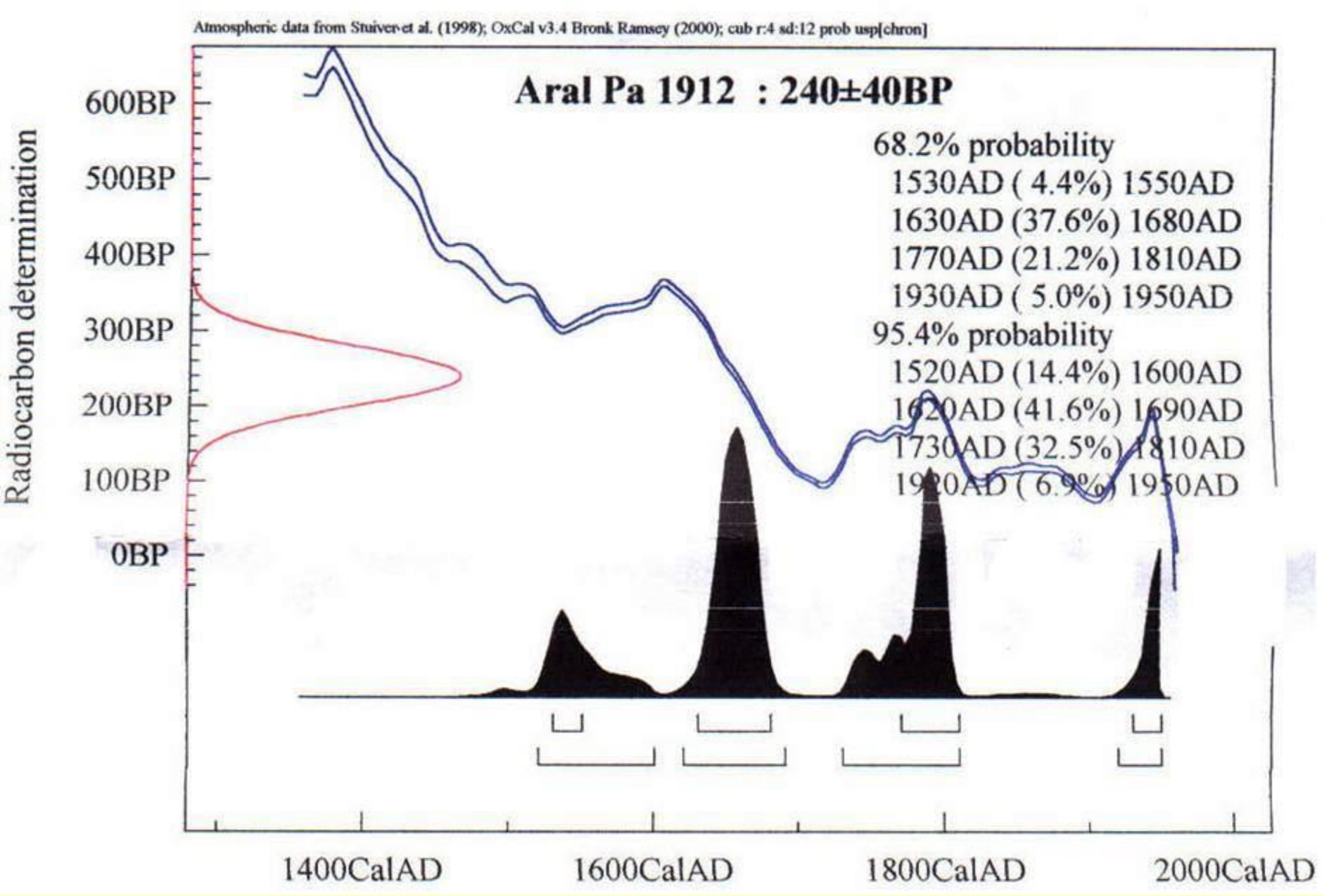


L.S. Berg

V.V. Bartold

**Remnants of medieval saxauls on the dried bottom**

**Remnants of medieval saxauls under water**



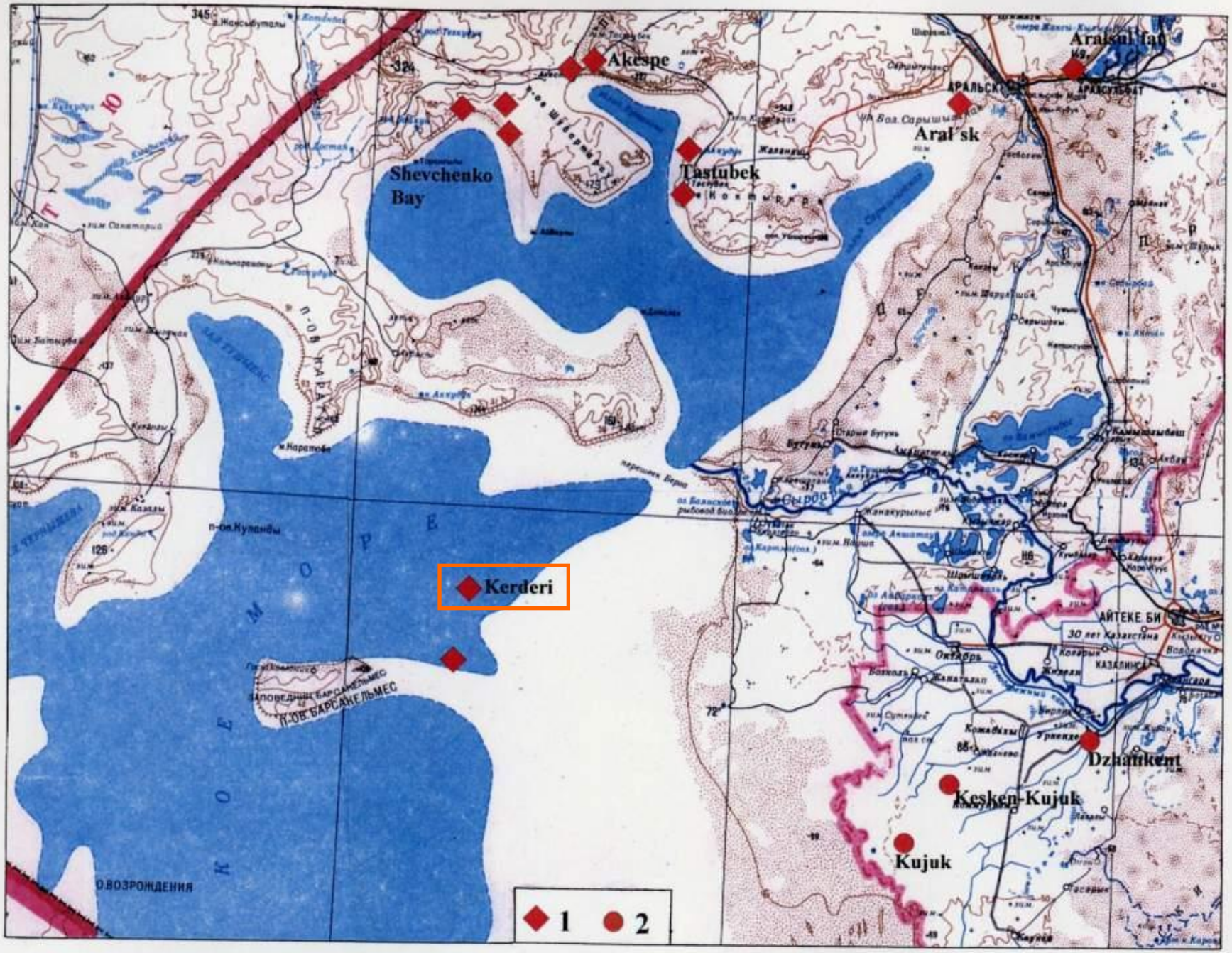

**Radiocarbon dating of saxaul stumps**

# Coring in the Aral Sea. August-September 2002.

**Cutting the core with metal plate and splitting into two halves**

Cut cores

# Location of Kerdery Mausoleum



**Ruins of medieval mausoleum (Kerdery) on dried bottom.
In 1960 it was about 20 m below lake level
(photo by N.Boroffka).**

**Decorative ceramics from the Mausoleum. (photo by E.Putnam).**

**Bones of *Homo sapiens* and domestics animals were found near mausoleum (photo by E.Putnam)**

Photo by D. Eliseev, member of National Geographic expedition, June 2005

Millstone found on the bottom of the Aral Sea not far from Kerdery mausoleum

Photo by D. Eliseev, member of National Geographic expedition, June 2005

**Elements of ceramics and scull of *Homo sapiens* found on the bottom of the Aral Sea not far from Kerdery mausoleum**

Photo by I.Plotnikov, member of National Geographic expedition, August 2005

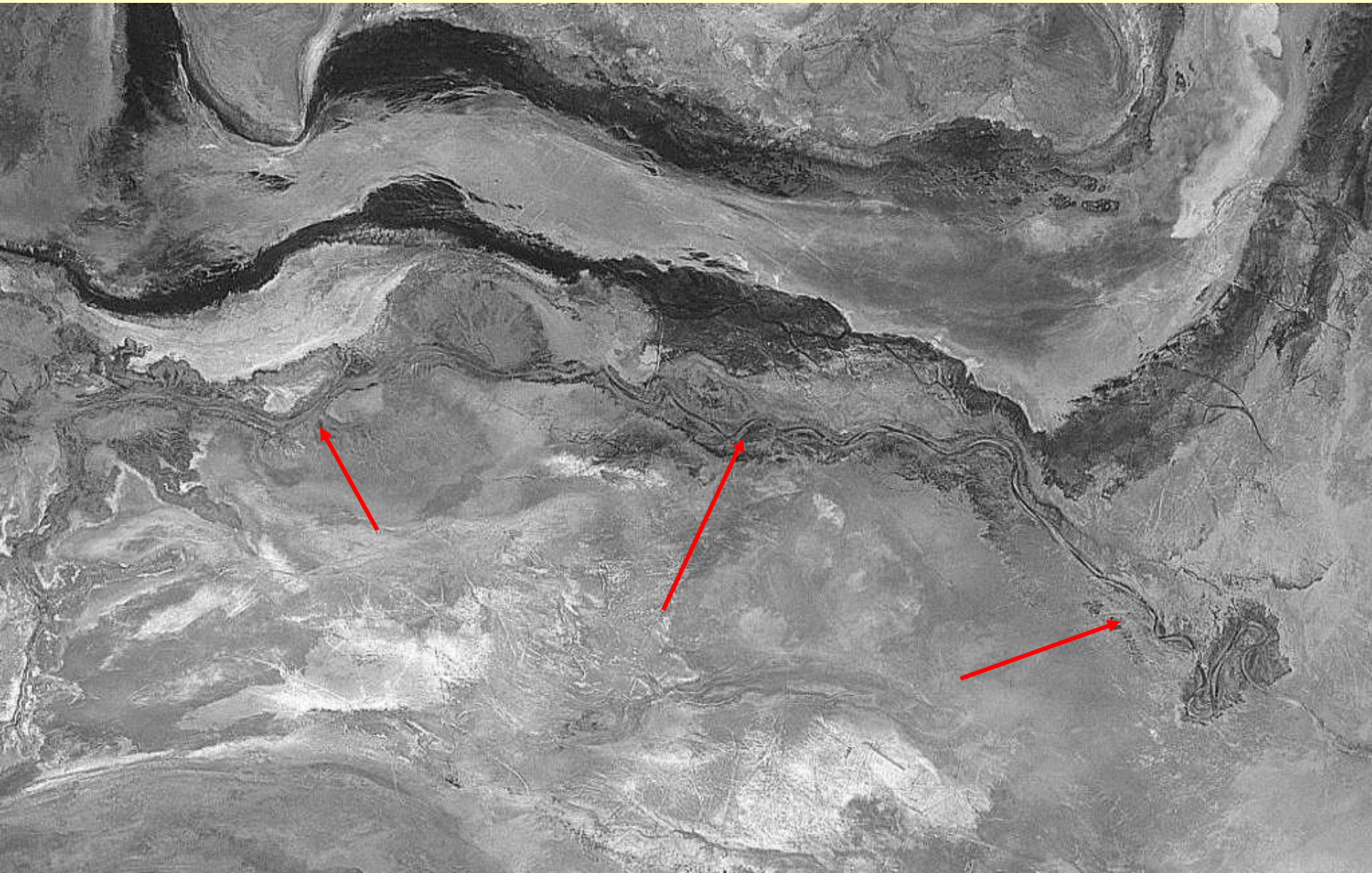
Broken jug found on the bottom of the Aral Sea not far from Kerdery mausoleum

Needle and arrow-head from Kerdery-2

**Remnants of Medieval river beds on the former Aral Sea bottom**

**ANCIENT RIVER BEDS IN THE NORTHEAST FROM BARSAKELNES ISLAND. LANDSAT 5, SEPT. 11, 2007, BAND 1 (BLUE-GREEN), 30 METERS, SHARPENED AND CONTRAST ENHANCED. IN MIDDLE, STRETCHING EAST TO WEST IS OLD RIVER BED (SEE RED ARROWS).**

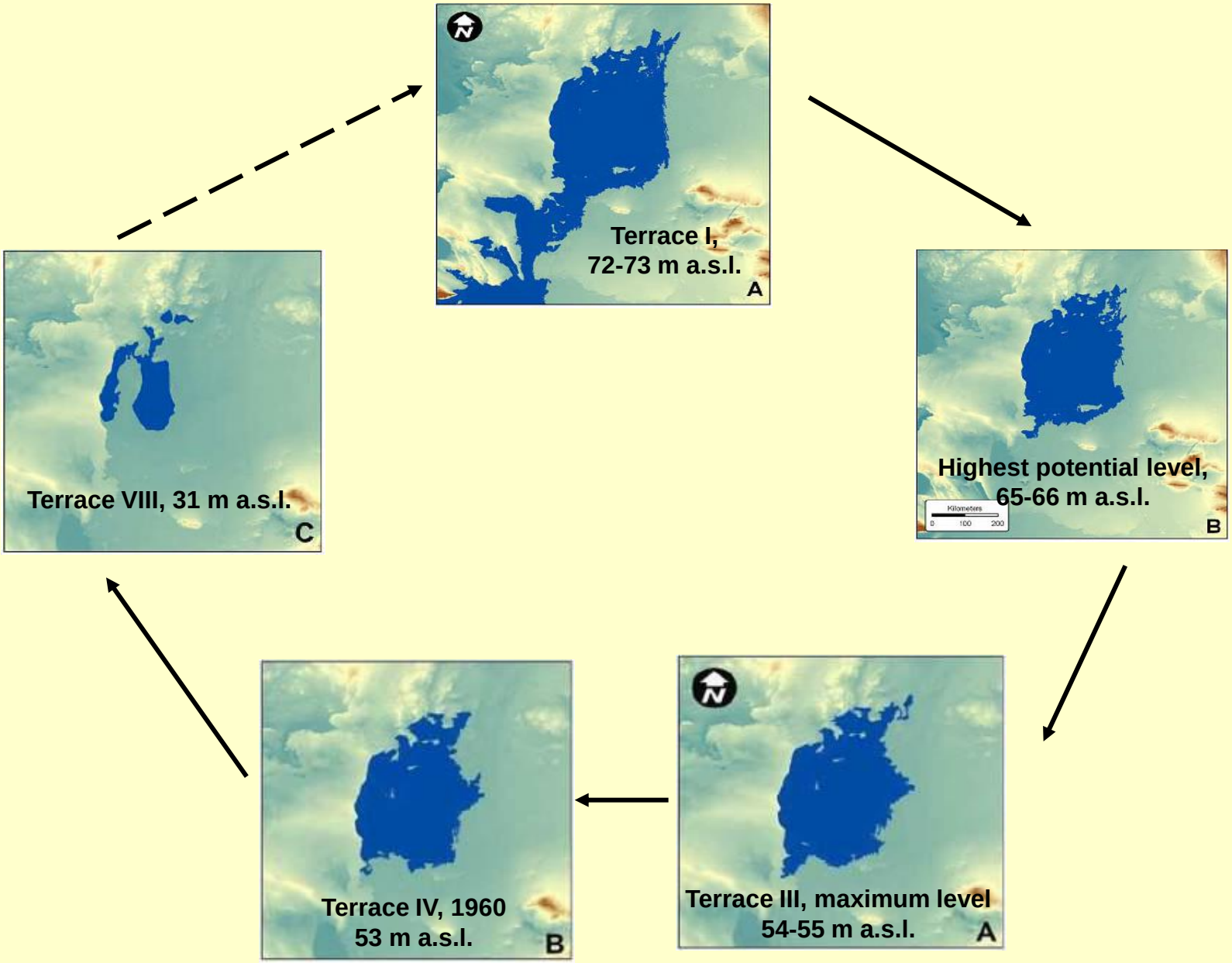
Courtesy by P.Micklin



Fossil (probably Medieval) canal between Western and Eastern Large Aral discovered by Prof. Dr. Rene Letolle and predicted by Dr. David Piriulin

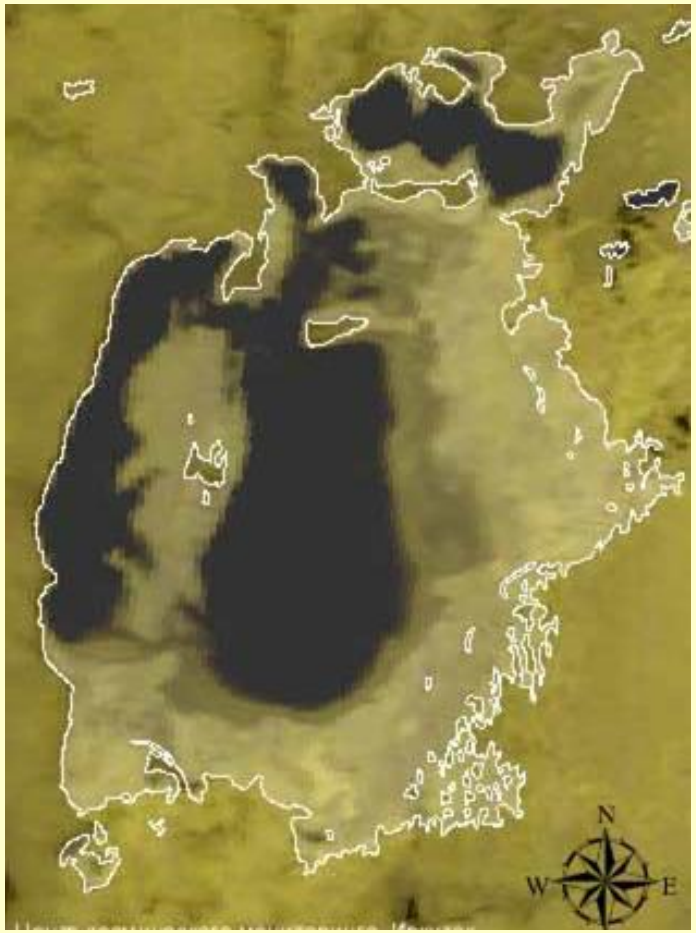
# Surface areas of the Aral Sea at different levels

By: Ch. Reinhardt, 2006, 2007



# Evolution of the Aral Sea

Middle Ages




Middle of the XIX century


Beginning of the XXI century

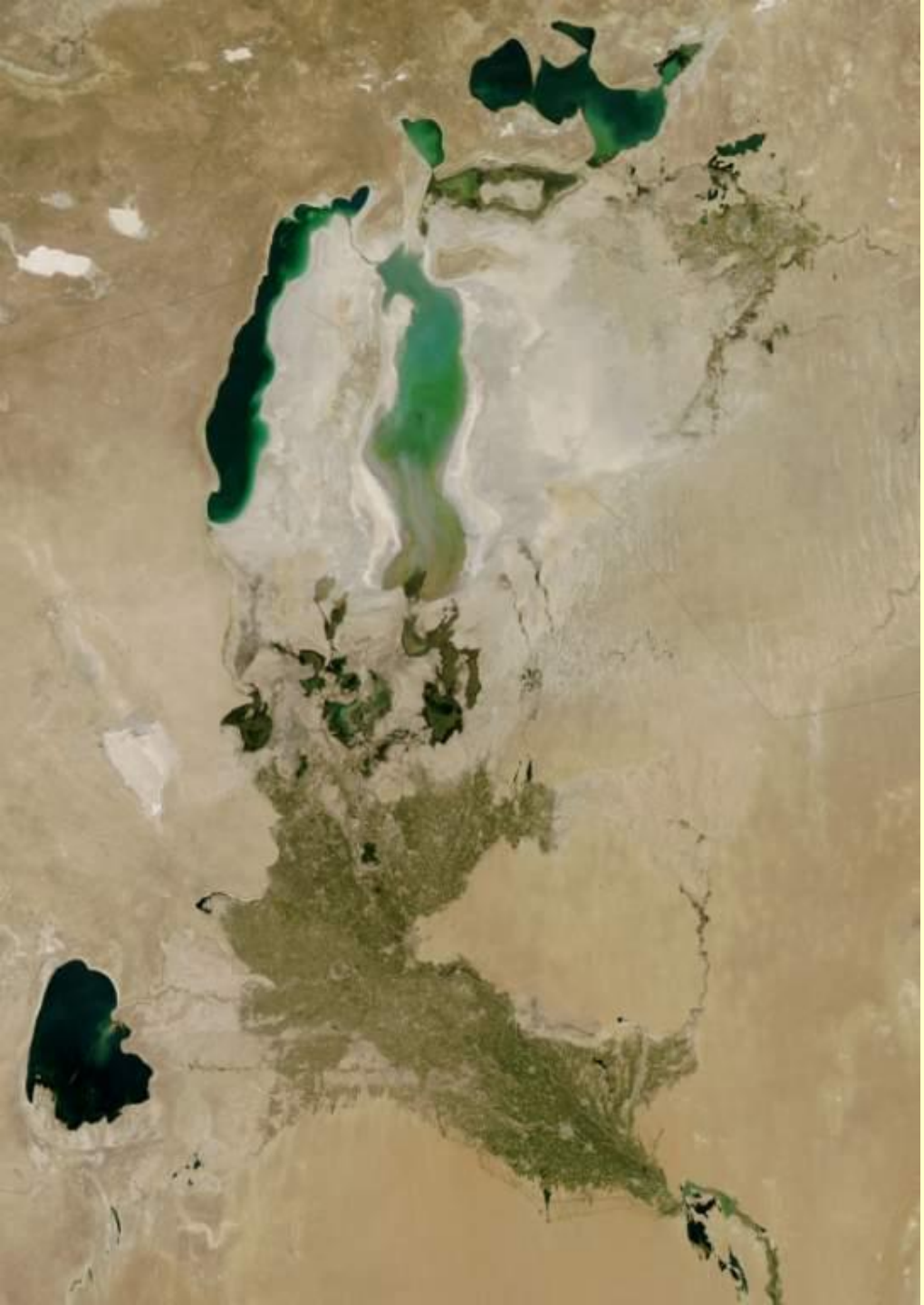
**Paleolimnological data allow us to hope that discussed ways of preservation and rehabilitation of the Aral Sea will approach its revival in XXII century.**


# MODIS image of the Aral Sea from September 30, 2009

1. Small (Northern) Aral Sea. Common name – “Kazaral Sea”. Correct scientific name – Northern Aral Sea derived brackish-water regulated reservoir.
2. Western Large (Southern) Aral Sea. Common name – “Western Uzaral”. Correct scientific name – Aral Sea derived Southwest hyperhaline non-regulated lake.
3. Eastern Large (Southern) Aral Sea. Common name – “Eastern Uzaral”. Correct scientific name – Aral Sea derived Southeast hyperhaline non-regulated lake.
4. Former Tschebas Bay. Common name – “Tschebas-Kul”. Correct scientific name – Aral Sea derived Tschebas hyperhaline non-regulated lake.
5. Strait between Eastern and Western Large Aral (common name – “Uzun-Aral”). Correct scientific name – natural Kulandy Channel.
6. Remnants of strait from Small Aral to Large Aral.

**MODIS image of the Aral Sea from June 14, 2010**

Luckily Eastern Large (Southern) Aral (“Eastern Uzaral”) could have some water back if Amu Darya river delta will release water to it. An evidence of this is clearly visible on this satellite image. Unfortunately newly born Eastern Large Aral is very shallow and it will dry up shortly after closing of Amu Darya river water discharge. It is a pity that this event is occasional and is not repeated annually.



**MODIS image of the Aral Sea from September 13, 2010**

Apparently on the satellite image from September 13, 2010 the good situation on the Large Aral was preserved till the autumn. Water has sufficed not only for irrigation, but also for discharge to the Eastern Large Aral.

# Future of the Aral Sea is connected with oil and gas excavations

# Oil and gas drill tower on the former Aral Sea bottom (photo by P.Annin)

**Gas condensate plant not far from Muynak.**
**(photo by P.Annin).**

# Conclusions

- Still prior to the beginning of anthropogenic regression and salinization of the Aral Sea its ecosystem has survived consequences of new species introductions that has begun in the end of the 1920s.
- The main and only cause of modern desiccation and salinization of the Aral Sea is withdrawal of Amu Darya and Syr Darya waters for irrigation.
- It is possible to distinguish 3 main stages of Aral Sea biodiversity decrease process in owing to its salinization:
- - in 1971-1976 when salinity has exceeded 12-14 g/l, brackish-water species of freshwater origin have disappeared;
- - in 1986-1989 when salinity has exceeded 23-25 g/l, brackish-water species of Caspian origin have disappeared;
- - in the end of 1990s and beginning of 2000s in the Large Aral Sea when its salinity has exceeded 80-100 g/l, species of marine origin have disappeared.
- In 1989 the Aral Sea because of desiccation has divided into 2 parts: Small Aral in the north and Large Aral in the south. On the place of one lake it was formed 2 water bodies.
- After division Aral Sea in 1989 Small Aral has positive water balance and its salinity began to decrease. After construction of a new dike in Berg's strait there is possible recovering of biodiversity and revival of fishery.
- Large Aral Sea having negative water balance continues to dry up and salinity is increasing; to the end of the 1990s it has turned into hyperhaline water body. Recovering of its biodiversity and fishery is not a real possibility. The only possibility of economic activities on Large Aral is harvesting of brine shrimp.
- By present time Large Aral has divided into 3 separate water bodies: the Western and Eastern basins connected by channel, and lake Tsche-Bas.
- The essential raise of irrigation efficiency in the basin of Aral Sea could save significant volume of water which could replenish the water balance. However it requires comprehensive and very expensive reconstruction of irrigating systems, and also essential changes in social and economic sphere that is improbable for the present.
- Volume of underground waters incoming the Aral Sea is essentially larger than it was assumed earlier.
- Vozrozhdeniya Island being during Soviet time proving ground for exploring and trial of biological weapons now is peninsula. It remains "delayed-action bomb" since preserved there active pathogens can get on the continent.
- Plans of oil and gas excavation on the dried up bottom of the Aral Sea can reduce interest of authorities to its saving.

# Flight over Aral Sea

September 5 and 9, 2010
during the big flood from
Amudarya River











The Aral Sea has future


Thank you for your attention