BIELEFELDER
ÖKOLOGISCHE
BEITRÄGE

BAND 15 1999

246

ECOLOGICAL PROBLEMS OF SUSTAINABLE LAND-USE IN DESERTS

Bonn / Königswinter, Germany
5th - 9th of May 1999

bmb+f
Federal Ministry for Education and Research

United Nations Educational, Scientific and Cultural Organization

United Nations Convention to Combat Desertification

University of Bielefeld
Department of Ecology

Herausgegeben von
Siegmar-W. Breckle, Anja Scheffer, Maik Veste & Walter Wucherer

Abteilung Ökologie der Universität Bielefeld

ISSN 0178-0697

bmb+f

Bundesministerium für Bildung und Forschung
Federal Ministry for Education and Research
D-53170 Bonn - Germany
Internet: www.bmbf.de

BEO
Projektträger Biologie, Energie, Umwelt des BMBF
Forschungszentrum Jülich GmbH

Project Management Biology, Energy and Ecology
for the Federal Ministry for Education and Research
National Research Center Jülich
D-52425 Jülich - Germany
Internet: www.kfa-juelich.de/beo/

United Nations Educational, Scientific and Cultural Organization.

United Nations Educational, Scientific
and Cultural Organizations (UNESCO)
Science Sector
1 Rue Miollis
F-75015 Paris – France
Internet: www.unesco.org

United Nations
Secretariat of the Convention to
Combat Desertification (UNCCD)
Haus Carstanjen
Martin-Luther-King-Strasse 8
D-53175 Bonn - Germany
Internet: www.unccd.de

[redacted]

University of Bielefeld
Department of Ecology
PO Box 100131
D-33501 Bielefeld – Germany

BIELEFELDER ÖKOLOGISCHE BEITRÄGE Band **15** 1999

Herausgegeben von der
Abteilung Ökologie
Fakultät für Biologie
Universität Bielefeld
Postfach 100131
D-33501 Bielefeld

ISSN 0178-0697

BIELEFELDER
ÖKOLOGISCHE
BEITRÄGE

BAND 15 1999

246

ECOLOGICAL PROBLEMS OF SUSTAINABLE LAND-USE IN DESERTS

Bonn / Königswinter, Germany

5th - 9th of May 1999

bmb+f
Federal Ministry for Education and Research

United Nations Educational, Scientific and Cultural Organization

United Nations Convention to Combat Desertification

University of Bielefeld
Department of Ecology

Herausgegeben von
Siegmar-W. Breckle, Anja Scheffer, Maik Veste & Walter Wucherer

Ecological Problems of Sustainable Landuse in Deserts

Content: Page

ECOLOGICAL PROBLEMS OF SUSTAINABLE LAND-USE IN DESERTS

Timetable

(as from 05/05/1999)

Wednesday, May, 5th 1999

INTRODUCTORY KEYNOTE LECTURE

17:00 – 18:00 S.-W. Breckle (Bielefeld, Germany)
The Deserts of the World

Thursday, May, 6th1999

OPENING

09:00 J. Kutscher, BMBF-Project Management BEO, National Research Center Jülich / German Research Activities in Arid Zones
09:15 V. Moustafaev (UNESCO, Paris)
UNESCO / BMBF Project on the Aral Sea
09:30 Representative of the UNCCD, Bonn

SESSION 1: DESERTIFICATION PROCESSES

09:40 Keyser, D., (Hamburg, Germany)
Irrigation, water division, salinization, desertification - an inevitable succession

10:20 W. Wucherer, S.-W. Breckle (Bielefeld, Germany)
Vegetation dynamics on the dry seafloor of the Aral sea

10:50 Coffee

11:10 R.M. Razakov (Taschkent, Uzbekistan)
Desertification in the Aral sea zone

11:40 Babaev (Aschchabad, Turkmenistan)
National program of Turkmenistan to combat desertification

12:10 Lunch

13:30 N. P. Ogar (Almaty, Kazakhstan)
Vegetation dynamics and modern land use at the Syrdarya delta

14:00 P. Felix-Henningsen, B. Rummel (Giessen, Germany)
Influence of shrub vegetation on the salt dynamics in dune soils of Nizzana (Negev, Israel)

14:30 I. Springuel (Aswan, Egypt)
Sustainable development on shores of Lake Nasser, Egypt

15:00 J. Hill (Trier, Germany)
Remote sensing - monitoring land degradation and desertification processes

15:30 A. Karnieli, L. Orlovsky, C. Glaesser, M. Dourikov (Sde Boqer, Israel; Halle, Germany; Aschchabad, Turkmenistan)
Space monitoring of soil and vegetation dynamics in the Negev and Central Asia Deserts

16:00 Coffee

16:20 C. Werner, W. Beyschlag, O. Correia (Bielefeld, Germany; Lisboa, Portugal)
Restoration of disturbed areas in the Mediterranean - a case study in a limestone quarry

16:50 K. Karibayeva (Almaty, Kazakhstan)
Environmental problems of the South Region of Kazakhstan

SESSION 2: RECLAMATION

17:20 A.Yair (Jerusalem, Israel)
Runoff water redistribution in arid and semi-arid areas

17:50 G.K. Hartmann (Katlenburg-Lindau, Germany)
Desert soil recultivation and monitoring of (phyto-) toxicity (DEREMOTOX): a pilot project in three phases lasting four years

18:30 Joint Formal Dinner

Friday, May 7th 1999

09:00 - 18:00: Excursion by bus: Open mining areas west of Cologne, recultivation (Rhein-Braun) (limited to 54 participants)

Saturday, May 8th 1999

09:00 G. Meirman (Kzylorda, Kazakhstan)
Phytoreclamation on the dry seafloor of the Aral Sea

09:30 L.A. Dimeyeva (Almaty, Kazakhstan)
The ways for conservation and restoration of vegetation cover in the Aral Sea coast

10:00 X. Zhang (Urumqi, China)
The control of drift sand on the southern fringe of the Taklamakan Desert

10:30 Coffee

10:50 A. Singer, A. Banin, L. Poberezsky (Sde Boqer, Israel; Taschkent, Uzbekistan)
Proposed pathway for the development of soils and crusts from the Aral Sea bottom following its exposure by desiccation

11:20 N.M. Novikova (Moskow, Russia)
Ecological basis for botanical diversity conservation within Amudarya and Syrdarya river deltas

11:50 S.Y. Treshkin (Nukus, Uzbekistan)
The floodplain vegetation of Central Asia: Modern State, Ecology and Biodiversity Conservation

12:20 Lunch

13:30 C. Toderich, R.L. Goldshtein, G.S. Rashidova, W.B. Aparin (Samarkand, Uzbekistan)
Environmental state and an analysing of phytogenetic resources of halophytic plants of Kyzylkum Deserts

SESSION 3: IMPACT OF GRAZING

14:00 N. Jürgens (Köln, Germany)
Impact of grazing on vegetation and biodiversity – a comparison between southern and northern Africa

14:40 A. Moustafa (Ismailia, Egypt)
Impact of grazing on Saint Catherine vegetation, South Sinai, Egypt - conservation and rehabilitation of endemics and rare species

15:10 Coffee

15:30 O. Sharkas (Palestinian Authority)
Vegetation degradation in northeastern Jordan

16:00 Pause

16:30 S. Milton (Matieland, South Africa)
How grazing turns rare seedling recruitment events to non-events in arid environments

17:00 F. Jeltsch, T. Stephan, G. Weber (Leipzig, Germany)
Spatially-explicit simulation models – a tool for arid and semiarid rangeland management

Sunday, May 9th, 1999

SESSION 4: WATER MANAGEMENT IN DESERTS

09:00 O. Agachanjanz (Minsk, Belarus)
The Sarez Lake, a hydrological part of the Aral Basin

09:30 Y. Waisel (Tel Aviv, Israel)
Salinity: the number 1 enemy of sustainable agriculture

10:00 S. Sokolov (Almaty, Kasakhstan)
Potable water: seasonable changes and conditions research

10:30 Coffee

11:00 N.S. Orlovsky, M. Glantz (Sde Boqer, Israel; Boulder, CO USA)
Ecological consequences of arid land irrigation in the Aral Sea Basin

SESSION 5: HISTORICAL, SOCIAL AND ECONOMICAL ASPECTS

11:30 B. Knerr (Kassel, Germany)
Economic-demographic strategies in reaction to increasing discrepancies between carrying capacity and population density in arid regions

12:10 Final Diskussion, Organisational, Closing and Farewell Remarks

Good bye Coffee

List of presented posters

D. Abiyeva (Almaty, Kazakhstan):
Relief, dynamics and development of sandy massives of Zaissans depression

N.V. Aladin (Sankt Petersburg, Russia):
Past, Present and Future of the Aral Sea Fauna

S.K. Arndt, M. Popp (Vienna, Austria):
Why is the Ziziphus tree drought resistent?

S.K. Arndt, S.C. Clifford, M. Popp (Vienna, Austria; Efford, UK):
Ziziphus - a multipurpose fruit tree for arid regions

S.K. Arndt, R. Albert, M. Popp (Vienna, Austria):
Osmotic adaptation of Chinese desert plants

S. Baoping, F. Tianzong (Beijing, China):
China s Desertification and Its Control

G.K. Bizhanova (Almaty, Kasakhstan):
Assessment of modern state of sand desert vegetation in Kazakhstan

N.I. Bobrovskaja (Sankt-Petersburg, Russia):
The productivity of utilization of water by dominant species of Centralasian steppe and desert communities (Mongolia)

S.-W. Breckle, W. Wucherer, A. Scheffer (Bielefeld, Germany):
Halophytes on the drying sea floor of the Aral Sea

A.A. Butnik, U.N. Japakova, G.F. Begbaeva (Tashkent, Uzbekistan):
Halophytes: structure and adaptation

L.Y. Dimeyeva, N.P. Ogar, T.I. Budnikova (Almaty, Kazakhstan):
Planning of phytoreclamation on the drying Aral sea bed

K. Fischer, R. Schiene, N. Zier, J. Katzur (Dresden & Finsterwalde, Germany)
Artificial humus prepared from lignin

G.V. Geldyeva (Almaty, Kazakhstan):
Landscape-ecological assessment of the Syrdarya delta for land use purposes

B.V. Geldyeva, N.P. Ogar (Almaty, Kazakhstan):
Assessment of desertification processes using remote sensing and GIS methods

E. Giese (Giessen, Germany):
title not yet fixed

M. Kappas (Mannheim, Germany):
Detection of potential sites for pearl millet growth in the Sahel of Burkina Faso with the help of remote sensing and soil condition data

L. Kapustina (Tashkent, Uzbekistan):
Degradation of the vegetation in the Kyzylkum Desert (Uzbekistan)

A. Karnieli, C. Glaesser, L. Orlovsky (Sde Boqer, Israel):
Spectral characteristics of cyanobacteria soil crust in the northern Negev desert

T.I. Kazantseva (St. Petersburg, Russia):
Pasture ecosystems of northern Gobi and their modern state (Mongolia)

G. Lyubatinskaya (Almaty, Kasakhstan):
Ecology of priaral aqueous medium

G. Manske (Bonn, Germany):
Root morphology of wheat genotypes grown in residual moisture

C. Muradov (Aschchabad, Turkmenistan):
Activity of the Consulting Center to combat desertification in Turkmenistan

L. Muszkat, L. Feigelson, L. Bir, K.A. Muszkat (Bet-Dagan, Rehovot, Israel):
Field studies in solar photocatalysis for the detoxification of organic chemicals in waters and effluents

K. Nadrowski, G. Jetschke (Jena, Germany):
Relating patchiness and productivity in desertified shrublands

V. N. Permitina (Almaty, Kasakhstan):
Transformation of soil cover in the north-east Caspian

E.I. Rachkovskaya (Almaty, Kazakhstan):
Anthropogenic transformation of desert ecosystems in Mongolia

E. I. Rachkovskaya, S.S. Temirbekov, R.E. Sadvokasov:
Application of remote sensing methods for assessment of the degree of anthropogenic transformation of rangelands

A. Rau (Almaty, Kasakhstan):
Rehabilitation of irrigated land given up in the case of secondary salinisation in the Aral Sea area

M. Runge (Göttingen, Germany):
Ecological basis for a sustainable management of the indigenous vegetation in a Central Asian Desert

L.L. Stogova, S. Robinson, S.A. Govorkhina (Almaty, Kasakhstan & Warwick, UK):
Peculiarities of vegetation dynamics at the Betpak-Dala desert against the background of weather and social-economic conditions

K.N. Toderich, A. Wojnicka-Poltorak, W. Prus-Glowacki, E. Chudzinska, E.V. Shuiskay (Samarkand, Uzbekistan; Poznan, Poland):
Cytoembryological and genetic variation of introduced and wildspread perennial populations of *Kochia prostrata* (L.) Schrad in desert conditions of Uzbekistan

M. Veste, S.-W. Breckle, T. Littmann, J. Kalek, A. Yair (Bielefeld, Halle, Germany; Jerusalem, Israel):
The ecology of biological soil crusts on desert sand dunes of the northern Negev (Israel)

D. Vetterlein, C. Bergmann (Halle, Cottbus, Germany):
Plant induced spatial variation of soil osmotic potential. Implications for water uptake and plant growth

W. Wucherer, A. Aleschkovskii, S.-W. Breckle (Bielefeld, Germany; Almaty, Kasakhstan):
Colonization by plants of the dry sea floor of the small Aral Sea

O. Agachanjanz, Minsk, Belarus

The Sarez Lake, a hydrological part of the Aral Basin

The Central Pamir in Tadshikistan is a remote and seismic very active area, with only few settlements. The magnitude of earth quakes in that region can reach 7.1 - 8.3 (GLASYRIN et al. 1986). In February 1911 a strong earth quake caused a huge landslide, which created a natural dam in the Murghab valley. This huge dam (relative height 567 m, length 5 km, width 3,2 km) was termed "Usoiskii" related to the village "Usoi", which was covered and totally destroyed by that landslide. One year later a large lake developed above the natural dam, the Sarez Lake, named after the settlement which was inundated by the lake. This lake is part of the Amudarya drainage system. The lake level of the Sarez Lake is 3263 m a.s.l., his length 56 km, maximal depth 500 m. In 1987 the surface area was about 79,6 km^2 and the lake water volume 16 - 17 km^3 (AGACHANJANZ 1987, 1989; GLASYRIN et al. 1986). The lake water level is rising by about 20 cm per year. A critical sea lake level thus would be reached only in the 22nd century. In the Pamirs there are some lakes and mountain collapses or landslides of this type. The biggest are the Yashilkul, the Zorkul, Turumtaikul, Shiva and some others. They exist for thousands of years. The Sarez Lake is 88 years old.

The Sarez Lake is an additional water storage of about 17 km^3 for the dry Aral basin, where a severe water shortage dominates. There are many interested groups who are regarding this sweet water lake as a perfect reserve for irrigation purposes. Already in the sixties there were catastrophic prophesies concerning the dynamics of the Lake (landslide of the Northern lakeshore, dramatic wave activities, danger of dam breakage etc.) and thus to argument for the use of this perfect water for irrigation. For the implementation of such projects money was lacking.

Today the Aral basin is dissected by new state borders. Tadshikistan itself is not suffering water shortage. But just Tadshikistan had asked for means for preventing a catastrophic situation (REUTERS 1998), as stated of endangering the life of 3000 - 5000 people and causing big damages to the whole valley. The panic character of such informations is due to the irresponsibility of some journalists.

Our studies and calculations have shown, that there is no need of actions on the system of the Sarez Lake and his dam because of the following reasons:

- The shape and the size of the Usoiskii-dam prevents a breakage of lake-water
- The unrealistic landslide of the Northern Lakeshore and a huge wave would not destroy the dam, thus the lower settlements in the Bartang-valley are also under no danger
- The rise of the lakewater level until the 22nd century and the creation of a new overflow or water corridor will not cause flooding of settlements
- The maximal capacity of water flow in the Bartang Valley is about 4 km^3 per year. This limits the use of water for operational purposes. The lowering of the sea level by about 10 m would need 6 years
- The investigation of the Sarez Lake, which at the moment stands still, should be continued. Without any technical means the Sarez Lake will stay a clean water reservoir with great importance not only for the Amudarya basin but for whole Central Asia. The Sarez Lake needs protection of highest priority

Possible Lecture:

N.V. Aladin, Sankt Petersburg, Russia

Palaeolimnology of the Aral Sea

Palaeolimnological changes to the Aral Sea during the last 10 000 years are considered. In Holocene several periods of transgessions and regressions in Aral are known. At prehistoric time the changes of level and salinity happened because of natural climate transformation. During wet climate phase Syrdarya and Amudarya were full of water and level of the lake was high and salinity was low.
In opposite to this during dry climate phase both rivers were poor with water and level of the Aral Sea was low and salinity was high (Shnitnikov, 1969).
At historic time after appearance of Horesm Kingdom the changes of level and salinity start to be mainly controled by human irrigation activity. During successful phase of local countries development the irrigation fields usually were numerous and large and so, a lot of water was taken from both rivers. As a result of this the level of Aral was low and salinity was high. During unsuccessful phase of local countries development (wars, salinization of land, etc.) .the irrigation fields usually were collapsed and rivers were again full of water and so, the level of the lake was high and salinity was low (Kvasov, 1976). This very complicated unstable hydrological regime of the Aral Sea finally resulted in a very low biodiversity. Only because of this fauna and flora of the Aral Sea are very poor and lack of endemics (Aladin et al.,1992).
It is very important to underline that these unfavourable conditions finally created a very special ecosystem that could transform in accordance with environment. When the Aral Sea is full of water and salinity is low the fresh water fauna and flora are dominating in it. Simultaneously marine and hyperhaline fauna and flora are surviving in shallow and more saline bays. But when Aral is shallow and salty the hyperhaline and marine fauna and flora are dominating in it. During this time representatives of fresh and brackish water fauna and flora survive in the deltas of rivers and are waiting for better times.

A.G. Babaev, Aschchabad, Turkmenistan

National Program of Turkmenistan to Combat Desertification

Desertification is one of the most serious ecological and social economical problems arisen before the mankind on the threshold of XXIst century. Desertification is a result of interconditional action of natural and anthropogenic processes resulted in the loss of the Earth's biological potential. Basically, it is characteristic of arid areas and present itself like degradation of land, water, vegetation and other resources in the conditions of demographic burst and ecological stress.

The UN Convention to combat desertification envisages the development of regional and national action programs. It urges institutional structures and separate persons to see, in them, leading and national principles of long-term struggle policy for environment's safety and increasing its resource potential as a basis for sustainable social and economical development.

Turkmenistan is a new independent neutral state on the world political map. In the beginning of 1995 Turkmenistan joined the UN Convention to combat desertification, and Medjlis (Parliament) ratified it on 18th of June 1996, thereby, took upon itself responsibility for the implementation of basis provisions of the document.

Turkmenistan's area makes up 491.2 thousand km^2, the population is 4483.3 thousand. Turkmenistan's territory is wholly located in the zone of Central Asian deserts, and is characterised by extraordinary extreme national climatic conditions. At the same time Turkmenistan has enormous land and vegetation resources, gas and oil, raw materials for the development of chemical, food, high and construction industries etc.

At the end of 1995 in Turkmenistan there was established Government commission on the preparation of National Action Program to combat desertification. In the beginning of 1996 with the financial support of UNEP and ESCAP such manyplanned Program was developed and given to the Government for realisation.

The basic goal of it is the estimate of the present state of natural economic potential of Turkmenistan in extreme arid conditions, the reveal of indicators and criteria of desertification, the development of science contain but economical technologies on restoration of violated landscapes and rational use of country's natural resources, based on ecological principles. On developing the program there deeply studied and at most taken into account century-old traditions and methods of local population in the development and use of arid lands.

246 B

S.-W. Breckle, Bielefeld, Germany

The Deserts of the World

From the distance all deserts look alike. Plants are sparsely scattered or almost absent, vegetation cover is very low. The substrate gives the dominant impression. However, the differences between the various deserts on the globe are very conspicuous. Every desert has its special features. Typically for all deserts is the negative hydrological balance. The input of water by rain, snow, fog is much lower than the potential evaporation. It varies greatly from year to year. There are deserts with summer-rains, with only winter-rains, with only episodic rains, those with a high number of days with fog (fog deserts). There are deserts which have a very continental climate, with frosts in winter and very hot summers (cold and temperate deserts), those with a very hot climate (hot deserts, subtropical deserts) and others with a tropical diurnal climate regime (tropical deserts). The arctic and antarctic cold deserts will not be dealt with here. There are big regional differences in the distribution of the various zonobiomes on the continents and especially also the deserts which arise from the distribution of land and sea and of high mountain ranges. The position of the subtropical desert belt of the Zonobiom III is determined primarily by global circulation in the earth's atmosphere, just between the tropical Hadley circulation and the extra-tropical Ferrel circulation. In the first, the trade winds on each side of the equator, between 0° and 30° latitude, carry moist air towards the Innertropical Convergence Zone, causing zenith rains and then, as dry antitrade winds flowing towards the poles, resulting in permanent high pressure centers in the subtropics with descending air currents and adiabatic warming. The result is clear sky and high radiation: a subtropical desert.

The producers and most of the consumers are different in the different deserts, thus the ecosystem structure differs from desert to desert. The same is due to the anthropogenic influence, which according to the totally different history of mankind in the various continents, can already last for many thousand years or might be only recently.

Some examples of deserts will be discussed (Sahara: S-Egypt, S-Tunisia; Negev: Nizzana; Namib, Kalahari and Sceleton Coast; Australia; Mohave desert; Atacama; Central Asia: Iranian deserts, S-Afghanistan, Kyzylkum, Aralkum) and illustrated with typical slides. The characteristic features of deserts, the desert types according to particle size of substrate (hamada, serir, reg, erg, takyr, sebkha, oasis) or the adaptation of organisms to drought (soil crust, life forms) and some of the special examples of sand movement effects and loessic deposits, the accumulation of salts in endorrheic basins, will be shown. The water factor plays the major role in desert ecosystems, its traces are most prominent in geomorphology of deserts.

A sustainable use of deserts is only possible by adapting methods and obeying the ecological rules of deserts. The most sensitive areas are the borders of deserts where by inappropriate means desertification is caused, thus man-made deserts are enhanced.

L.A. Dimeyeva, Almaty, Kasakhstan

The ways for conservation and restoration of vegetation cover in the Aral Sea coast

Formation of desert landscapes, ecosystems close to modern ones of the Aral sea region should be assigned to Miozene period (Fedorovich, 1946). Development of dersert plant associations with *Haloxylon*, *Tamarix*, *Nitraria* in the region started in Eocene period (Zaklinkaya, 1954). By the time of origination of the Aral Sea in the late glacial age, sand and saline landscapes, clay deserts with various plant communities had formed on the Turan lowland. Its develpoment took millions of years, the distinction can be in a few years.

Modern vegetation of the Aral Sea coast comprised by three types: psammophytic, halophytic and meadow-tugaic. Sand desert vegetation is represented by communities and seral plant aggregations of various stages of sand overgrowth (*Artemisia terrae-albae*, *A. arenaria*, *Haloxylon persicum*, *H. aphyllum*, *Calligonum* spp., *Ammodendron bifolium*, *Stipagrostis pennata* etc.). Halophytic ecosystems are distributed along shores of salt lakes, in depressions, on the dried sea bed. They are formed by perennial and annual saltworts (*Halocnemum strobilaceum*, *Halostachys belangeriana*, *Salicornia europaea*, *Climacoptera aralensis*). Woody, shrub tugai and grass-forb meadow vegetation grows in the Syrdarya river delta and as fragments in the desiccated seabed. It is represented by communities of *Phragmites australis*, *Elaeagnus oxycarpa*, *Tamarix* spp.

Main threat to biodiversity in the region is processes of desertification caused by human activity. These are mainly overgrazing, clearing trees and bushes, technogenic factors on the background of Aral crisis. Anthropogenic habitats differ in terms of structure and composition from natural biotopes.

Palpable loss of biodiversity in the Aral Sea region began in the 19th century. Saxaul woodlands (*Haloxylon*) were cut to provide Aral steamship flotilla by firewood. Clearing of saxaul became heavier after construction of railway at the beginning of the 20th century and as a result saxaul woodlands had been almost totally cleared on islands and the coast of Aral Sea. Boundary of saxaul shrublands distribution shifted to the south. Nowadays all this repeated with another species – *Tamarix*.

Two ways are suggested for biodiversity conservation: 1) restoration of lost ecosystems, 2) establishment of a network of regional protected areas. Phytoamelioration and afforestation were carried out episodically in the Aral Sea coast. Plantations of the Kazak Institute of Agroforestry in the dried seabed has successfully demonstrated a better way of increasing vegetation coverage. Restoration of natural ecosystems could be fulfilled by artificial phytocenoses. Natural vegetation remained on the sea coast can serve as model for creation of man-made ecosystems as well as source of seeds. Re-introduction of disappeared wild vegetation in suitable habitats will provide formation of seed banks and natural dissemination of vegetation. Thanks to grant GEF/SGP a test area of 4ha and several plots of 100 sqm. Have established at the south-west edge of Aralsk town in 1998 for reviving of saxaul and tamarisk communities.

A network system of prtected areas is not developed in the region. There is an island – State reserve Barsaelmes. The island has been combined with the eastern original coast after decreasing of the Aral Sea level by 18m. Exposed seabeds with former islands Kaskakulan, Uzynkair, Akbasty are unique examples of primary successions and formation of rear ecosystems of *Haloxylon aphyllum*, *Nitraria schoberi*, endemic species – *Astragalus brachypus*. It is very important to expand the protected area and include the territory of the exposed seabed. Urgent measures can protect woodlands of saxaul from clearing. In the most accessible places saxaul has been cut down. Setting up a network of regional areas at the local authority level will conserve biological diversity in its natural surrounding as natural monuments.

P. Felix-Henningsen, B. Rummel, Gießen, Germany

Influence of shrub vegetation on the salt dynamics in dune soils of Nizzana (Negev, Israel)

The sand dune field near Nizzana is affected by atmosperic deposition of salts. The salt distribution and salt dynamic in soils of different ecosystem units was investigated in order to characterize the element fluxes in the dune system.

At the mobile dune ridge salinization is very low. The composition of the salts shows hardly any variation with depth. Low soluble salts of the bicarbonates dominate, thus, the salt dynamic is directed downwards, where the salts are differentiated according to their solubility.

At the north facing and south facing dune slope, the biogenic crust strongly influences the salt dynamic. Refering to depth the salt distribution has a salt maximum at the biogenic crust of the Calcaric Arenosols and therefore the biogenic crust indicates a function of salt accumulation. The concentration of low soluble salts increases with depth indicating a downward salt movement.

At the old dune ridge the Calcaric Arenosol is characterized by higher salt contents and a higher content of fines than at the dune ridge and dune slopes. In the saline playa and interdune the influence of the soil fraction is evident. Salt content increases with depth and reaches its highest value in the horizon with highest clay content. The influence of the halophylic Chenopodiaceae *Anabasis articulata* on the salt distribution in soils is shown by higher concentrations, particularly those of K^+ and NO_3^-, at the soil surface under the shrubs which are probably related to an active uptake of elements by its roots and return to the soil by litter. Compared to *Anabasis articulata* the influence of other shrub species on the salt concentration is distinctively smaller. In the more humid northern dune area, located about 20 km north of Nizzana, initial investigations of Arenosols with a biogenic crust show similar salt distributions to the ones in the crusted Arenosols in Nizzana. The salt accumulation under *Anabasis articulata* in the northern area is relatively greater than in Nizzana which is probably caused by the capacity to accumulate more salts according to the higher precipitation.

G.K. Hartmann, Katlenburg-Lindau, Germany

Desert Soil Recultivation and Monitoring of (phyto-) Toxicity (DEREMOTOX): A pilot project in three phases lasting four years

G.K. Hartmann, Katlenburg-Lindau, Germany
J. U. Kügler, eng. bureau Kügler; Essen; Germany
L. Weissflog, UFZ, Leipzig, Germany
G. S. Golitsyn, I. Granberg, N. P. Elansky; IAP, Moscow; E.B. Gabunshina, Kalmykian Arid Center, Elista; V.Alexeev, MSU, Moscow, Russia
E. Putz, G. Pfister, A. Steiner, IMG/UoG, Graz, Austria
K.H. Weiler, Fho-Emden

It is proposed to combine/apply at least the following methods in the selected area for recultivation, the Kalmykian steppe:

1. The (new), successfully tested „Soil Conditioning Process" proposed in 1994 by J. Kügler et al. under the acronym **SOREC** (Soil sealing and Recultivation), combined with so called brush walls or so called "Benjes Hedges" (**BENHEDGE**), and complemented with: Solar cooking and solar water sterilization at the recultivation location and with the extraction of fresh water from atmospheric water vapour in arid regions.
2. Modified and complemented **Phyto-Toxicological Investigations** (**PTI**) as done in context with the EU research project ECCA (L. Weissflog 1998).The PTI part is subdivided into three parts: a) Analysis of local pollution pattern and its effects, b) Investigation of pollution transport and deposition mechanisms, c) Concepts for a future pollution control and protection of the agricultural areas, e.g. through a greenhouse. This will be simultaneously tested.

Suggested project phases:

Phase A (*first 12 months*): Determination of boundary conditions in a location to be selected in the Kalmykian steppe with respect to: a) political, legal, and infrastructure aspects, b) geographic and climatic aspects, c) available resources and local soil conditions, d) status of (phyto-) toxicity. (Rough cost estimates and start of fundraising)
Phase B (*the following six months*): Detailed end to end planning using amongst others the so called **MIPS** concept. Assembling of the DEREMOTOX team. Refined cost compilation for phase C and final fundraising for it.
Phase C: (*last 30 months*) construction and evaluation phase

Remarks:

- *The three methods are also required when we deal with preservation of still possible agricultural land use but which is endangered by erosion and pollution processes.*
- *Costs for phase A: t.b.d*
- *MIPS: **M**aterial **I**nput **P**er **S**ervice Unit (F. Schmidt-Bleek, Wuppertal, 1998)*
- *DEREMOTOX is a subproject of the already discussed pilotproject „**Eco-Village System Development**", which is also part 1 of the proposed pilotproject **LEDGEM** (Local eco-village system development and global environmental monitoring)*

O. Hererra[1] & E.R. Porto[2,]
[1] Recife, Brasil, [2] Petrolina, Brasil

Use of Obtained Saline Residuals of an Extractor of Salt in Halophyte Crops

In Brazil, where 12% of all fresh water of the planet are encountered, the water resources stored in the different reservoirs, natural or built by the man, are theorically more than enough to assist the global demand of multiple uses.
However, in the semi-arid area (Northeast) the problem of the non attendance of the demand is linked with the nunsufficiant quantity/quality of the water resources.
In the Northeast, during summertime, underground water is generally the only available one. About 70.000 wells drilled in crystalline rocks exploit fissure aquifers. They have a low or medium efficiency, about 2.000 l/hour, but high salinity, with an average of 3.000 ppm NaCl. This salinity is mainly related to climatic and pedologic conditions, factors that contribute in the last few years increasingly, so that some 30% of this wells are abandoned. In the "Polygon of Drought" about 80% of the waters from drilled wells, the present salt content is above the acceptable concentration for human consumption, which in agreement with WHO (World Organization of Health) is 200 mg/l. Most of the times, its inadequate quality is also a factor impeding cultivation of crops and water consumption of animals.
Due to the shortage of water of good quality, the need of the use of other underground waters in the semi-arid Brazilian is evident. Desalinization techniques appear as an innovative alternative and effective corroborate of conversion of brackish water to drinking water.
In that sense, those desalinization processes that use conventional energy, with its different techniques and methods, the Inverse Osmosis is outstanding. It possesses proven efficiency concerning the costs of water desalinization. Very auspiciously the quality of the water obtained after the process is good, but the largest problem of the desalinization program of water in the Northeast area of Brazil is, that the saline soils with high texts of salts themselves, that are being exposed to open sky, contribute to the increase of disturbed areas. The options of disposition of the saline residues are several, among which can be mentioned: discharge in superficial waters, injection in deep wells and percolation ponds, among others. Considering the characteristics of the environment of the semi-arid area, other options are being tested. One is the use of the residues as liquid medium in the breeding of fish (tilápias), crystallization of the salts, and the halophyte crops forage.
In order to check the usefulness of waters from brackish underground waters, two tubular wells were drilled in the municipal district of Petrolina (worth of San Francisco), in Pernambuco. The water was desalinized by Inverse Osmosis and the saline residue were used to irrigate plants of ***Atriplex nummularia*** under field conditions, in an area previously walled and insolated. The forage production was checked. The plants were irrigated with water containing saline residues in 4 concentration levels: 25%, 50%, 75% and 100% respectively. There were made several counts of the aerial parts of the plants to verify growth and produced biomass. The amount and extent how the plants extract the salts contained in the residue were also checked by successive periodic tests. Finally the palatability by sheep of the hayed material was studied.
The first results showed that whole the plants survived all 4 levels of tested salts, observing the largest growth and biomass accumulation with 50% of concentration.
The use of the saline residues in halophyte crops and forage is a useful alternative. This is shown in the desalinization program and in handling of the salts in the semi-arid Brazilian area of northeastern Brazil.

J. Hill, Trier, Germany

Remote Sensing - Monitoring Land Degradation and Desertification Processes

Dryland lands cover approximately one third of the continental surface of the earth. In particular the semi-arid ecosystems provide important land resources for adapted agricultural production and grazing systems. While often considered areas at risk in the context of global climatic change and world-wide desertification dynamics the importance of thoroughly monitoring the state of the environment in these areas has long been recognised. However, with regard to the spatial extension but, at the same time, limited accessibility of dryland systems it becomes obvious that terrestrial observation alone is hardly able to cope with this task. Remote sensing with air- or spaceborne sensor systems provides a comprehensive spatial coverage, is intrinsically synoptic, and collects objective, repetitive data and is thus ideally suited for monitoring environmentally sensitive areas. The major problem associated with its use is to quantitatively interpret a measured signal that has interacted with remote objects in terms of the properties of these objects.

Since most of semi-arid lands are characterised by frequently cloud-free atmospheres it is quite obvious that remote sensing systems operating in the optical range of the wavelength spectrum are and have been used predominantly. Besides airborne systems for individual surveys on local to regional scale, several geostationary and polar-orbiting satellites (e.g., METEOSAT/GOES, NOAA-AVHRR, Landsat, SPOT) are available which operate in the reflective and emissive domain and can be used for regional to global assessments. As continuity for most operational remote sensing systems (which are already operating for 10-20 years) seems guaranteed they can be used for continuous environmental monitoring but also for retrospective studies on environmental change that has occurred in the past. For the future, one can expect that remote sensing systems with increased spectral resolution (imaging spectrometers) as well as microwave sensors may further increase application perspectives.

M.S. Ishankulov, Kokshetau, Kasakhstan

Soil chemical contamination of irrigation massives in the basin of Syrdaria river

Soil pollution of Aral-adjacent area is varied in forms: salt, pesticides, nitrates and nitrites, petroleum products, chemical elements.

In connection with phase shift of metamorphisation of surface water salt composition in Aral-adjacent area, the problem of change of the macrocomponental soil composition sprang up. In the last ten years the rise of chlorides in toxic quantity for soil is noted and the danger of magnesium soil salinization increases and consequently the accumulation of surplus magnesium in food-staffs, grown on such soils. This problem needs for scientific investigation.

The soil pollution with pesticides does not cease. Though, the volumes of their brining in soil reduce, but they are still sufficiently high: 129 *tons* 1990, 93 *tons* in 1993.

Hard domestic wastes are the menace for soils. At present, there are more than 500 thousand m^3 of hard domestic wastes in Kzyl-Orda and district centers. The main part of them is removing and storing on dumps without separation into components, it lead to the soil pollution.

It is accepted to think that soils of the delta's plains of Kzyl-Orda oblast are polluted sufficiently vastly. But the long-term researches of the technogenic soil pollution laboratory of the Institute of Soil Science of the National Academy of Sciences of RK under the leadership of M. Sh. Ishankulov, carried out on irrigation tracts, are the first steps in that direction do not confirm these notions. It was established that the soils of all irrigation tracts of Aral-adjacent area (Kzylkum, Shardara, Arys-Turkestan, Shiily-Janakorgan, Togusken, Kzyl-Orda, Kazalinsk areas) are polluted with one or another chemical elements and characterized by traits have not been noted earlier in other regions of RK and it is in prospect to account for them. The analysis of more than 2500 soil samples and up to 10000 elements, including the determination of gross content of chemical elements as well as their mobile forms, were assumed as a basis of such conclusion.

According to data of the semi-quantitative spectral analysis, which allows to determinate the gross content of chemical elements and there are no any pollutants in the overwhelming part of soil. The only total soil pollutant of the region is lead. But the level of lead pollutant of soil, as a rule, is not high – within 1,5 – 2,0 maximum permissible concentration. There is high possibility of interpretation of this phenomenon, from one side it is explained by its high rock content; at the other hand – by technical pollution from Shymkent lead plant.

The wide spectrum of pollutants is revealed by mobile (active, available plants) forms of chemical elements. On the irrigation tracts it contains lead, cadmium, cobalt, copper, fluorine, boron.

There is a distinctive tendency of content increase and gradual satiation of the soil profile by mobile forms of lead, copper and cadmium (the latter one is represented in the anomalous quantity) in the direction of final flows of the Syrdaria delta and in the boundaries of each separate delta.

Such halogens as fluorine and boron appear in amounts higher than maximum permitted concentrations in the deltas that are situated at the middle and final flows (Kzyl-Orda and Kazalinsk irrigation massives).

Concentrations of cobalt and zinc closely depend on the locations of development and enrichment of polymetallic deposits at the Karatau ridge.

At the estimation of soils pollution as a factor of health in the conditions of strained soil-geochemical anomalies, the question is about the remote consequences of ingress of harmful substances into human organism through food-staffs, and it can be raise.

F. Jeltsch, T. Stephan, G.E. Weber, Leipzig, Germany

Spatially-explicit simulation models – a tool for arid and semiarid rangeland management

In arid and semiarid regions, the effects of grazing management on natural communities of long-lived plants generally take years or even decades to become evident. Event-driven dynamic behaviour, disturbances, unpredictable and low rainfall and complex interactions between species make it difficult to gather sufficient understanding of vegetation dynamics for developing guidelines for sustainable management of arid and semiarid rangelands. This is even complicated by the importance of spatial scales and patterns, e.g. patchiness of rainfall, heterogeneous grazing behaviour of domestic livestock or distances between artificial watering points.

Simulation models that consider the essential processes determining vegetation dynamics offer scope for quantitatively exploring long-term vegetation dynamics of arid and semiarid rangelands. If these models are spatially-explicit they additionally allow for the investigation of spatial processes, such as competition or dispersal, and patterns, such as landscape features or structures imposed by management (boreholes, paddocks etc.).

In this paper, we discuss the promises and limitations of spatially-explicit simulation models as (often neglected) tools for rangeland management. We focus on model examples from rangelands in southern Africa, namely a set of models simulating cattle grazing in the southern Kalahari and a model simulating a Karakhul sheep farm at the border of the Namib desert (Namibia).

Results of the Kalahari models show the existence of a grazing threshold that determines the long-term sustainability of livestock grazing. This threshold depends on rainfall, grazing intensity and grazing heterogeneity. Its effect is illustrated with the spatial vegetation dynamics around artificial watering points. The model of the Karakhul sheep farm is used to investigate a successful example of sustainable rangeland management under harsh conditions.

N. Jürgens, Cologne, Germany

Impact of grazing on vegetation and biodiversity – a comparison between southern and northern Africa

Following archaeological records (Wendorf & Schild 1984) stock industry with cattle first developed in Africa some 8.000 to 10.000 y BP in the region which today is situated close to the border between Egypt and Sudan. Subsequent processes resulted in slow expansion of the new technology towards other parts of Africa and its arrival in Southern Africa much later, e.g. in Namibia and parts of RSA ca. 2000 BP.

Details of archaeological studies support the hypothesis that until very recently grazing pressure by stock was very low over vast areas of Southern Africa. For example, archaeological excavation of settlement sites in Kaokoveld, Northern Namibia, which had been inhabited since 3000 BP, did not show important changes in woody vegetation in spite of the invasion of the cattle keeping OvaHimba, some few hundred years ago. Similar observations from other regions support the hypothesis that until onset of european colonial farming grazing pressure by stock was low in large parts of Southern Africa.

In contrast, in large parts of Northern Africa grazing pressure by stock was of considerable magnitude since the times of the Koran and even the Bible. Large scale devastation by military movements and sieges has been reported in several historical documents in detail; deforestation and other desertification processes are also well known from many parts of the Mediterranean since early Greek and Roman times.

Obviously, the much older history of rangeland use by stock in Northern Africa resulted in much stronger changes in species composition and structure of vegetation if compared to Southern Africa. However, these important differences and their impact on a correct and objective evaluation of the potentials and risks of land use have never been systematically analyzed. On the other hand, the large difference in history of land use by stock might have important implications: Vegetation in North and South which seems to be very similar by structure and biomass, might possess a very different potential for land use as well as a different resilience against degradation processes. If history of intensive land use is so much younger in Southern Africa, we should expect that in spite of seemingly well-planned sustainable use of rangeland slow processes could result in slow degradation of Southern African pastures.

Several aspects of this question are discussed and resulting research needs derived. The most important consequence should be the coordination of a number of standardized long term monitoring sites of biodiversity and vegetation structure in both African hemispheres, allowing comparison and analysis of slow and long-term changes. These monitoring sites should be closely linked to development projects.

Wendorf F & Schild R (1984) The Emergence of Food Production in the Egyptian Sahara. In: Clark JD & Brandt SA (eds.): From Hunters to Farmers. Berkley 1984: 93–101.

K. Karibayeva, Almaty, Kasakhstan

Environmental problems of the South Region of Kazakstan

The southern agricultural region comprises four districts: Almaty, South-Kazakstan, Kyzyl Orda and Zhambyl; total area is 711.6 ths. sq. km (26.6% of the total area of the Republic of Kazakstan). Population number as of early 1998 is 5 mln. 307 ths. people which makes up 33.8% of the total population of Kazakstan.

The most of the population lives in oblast centers of the region. The highest urbanization degree is in Almaty oblast, the lowest – in Kyzyl Orda oblast. Generally, the vast areas of southern Kazakstan are thinly populated (population density is 9.2 pers/sq. km).

By environmental features, the most of the region pertains to desertic zone. Scarce rains and high summer temperature, severe winter frosts, frequent winds causing sand storms, extremely dry air, temperature fluctuations are typical.

In the south and south-east of the region sands spread near the Tien-Shian mountainous system Glaciers and show crests give spring to many rivers, which gave the name to the region "Zhetisu" – Semirechie ("Seven rivers"). The largest lakes of Kazakstan: Balkhash and Alakol and the continental Aral Sea are located in the region. In Zhambyl oblast Talas and Shu rivers flow. In South-Kazakstan and Kyzyl Orda oblast Syr Darya river flows and falls into the Aral Sea.

The environment of desertic, mountainous and foot-hill zones of the region is diverse; rare and endemic species of plants and animals are abundant.

Agricultural production and primary agrarian products processing are developed in the region. Industrial and financial capacity of the region is limited and requires permanent subsidies.

The extreme environmental conditions, ecological calamity, zones hamper the region's development. The Internal Gross Output (IGO) makes up in the region's oblasts per person: Almaty – 1425, Kyzyl Orda – 1208, Zhambyl – 816, South-Kazakstan – 814 US Doll. The index of human potential makes up: 0.61; 0.59; 0,58; 0.57, accordingly. The southern region's share from the All-Republic's surplus value is 22%.

The main economic sector is agricultural production. Cattle breeding has traditionally been of great importance in the structure of agricultural gross production in the southern region of Kazakstan. Thus, in 1990 animal production made up 61% of the gross agricultural production, plant-growing – 39%. As of January 1 1997 these indices up 38% and 62%, accordingly.

Action implementation is aimed at conservation of vital activity conditions and improvement of sanitary situation for more than 5 mln. people; conservation water supply sources for farms; extension of forest and agricultural areas and raising their productivity; raising yielding capacity of low productive pastures and irrigated lands; generation of cheap, environmentally friendly energy; performance of obligations on international conventions.

Necessary legislative basis is created for the realization of these measures as well as for economic reforms connected with the land to realize a novel stage of the land reform.

First, the transition from state-owned assets to private took place. All the kolkhozs and sovkhozs were reorganized and on their basis new enterprises were set up: producers' farms. Currently, there are 78 state-owned farms and 14,260 peasants' farms in the region.

Second, radical changes took place in land relations, land market is being developed.

Third, management structure has been improved, market structure is being formed, oblast agroindustrial exchanges exist.

Fourth, market changes improved price, credit and tax policy, the system of products sale.

State purchase prices were replaced by contractual ones. The process of attracting foreign and home investments into agriculture has started. The above changes lay the basis for the development of agroindustrial complex of the region.

Environmental projects for solving the problems in Region C were presented to and approved by the akimats of Almaty, South-Kazakstan, Kyzyl Orda and Zhambyl oblasts. NEAP/SD projects were recomended and included by Agency for Strategic Planning into the plan of foreign assistance and the program of governmental investments till 2000.

A. Karnieli*, L. Orlovsky*, C. Glaesser, M. Dourikov*****
*** Sede Boker, Israel, ** Halle, Germany, *** Ashkhabad, Turkmenistan**

Space Monitoring of Soil and Vegetation Dynamics in the Negev and Central Asia Deserts

Several difficulties can be encountered in detecting and monitoring spatial and temporal changes in vegetation using multispectral imagery from airborne or spaceborne sensors. These difficulties are due to (1) temporal change in the vegetation state; (2) temporal change in the soil/rock signature; and (3) difficulty in discriminating vegetation from soil or rock background.

The seasonal dynamics of soil and vegetation was investigated over two years on different terrains in the semi-arid region (100-200 mm annual average rainfall) of the Northern Negev, Israel. Results show that temporal analysis of natural vegetation in semi-arid regions should take into account three ground features - perennials, annuals and biogenic crusts; all having phenological cycles with the same basic elements - oscillation from null (or low) to full photosynthetic status. However, these cycles occur in successive periods throughout the year. NOAA/AVHRR and Landsat-TM images were processed for calculating the spatial and temporal dynamics of the terrain in terms of vegetation indices. Ground truth measurements were conducted for validation and verification.

In the Karakum desert of Turkmenistan, vegetation dynamics signals at the satellite sensor level as observed by NOAA/AVHRR were analyzed for a 13-year time period. Three vegetation indices were calculated: the Normalized Difference Vegetation Index (NDVI), the Soil Adjusted Vegetation Index (SAVI), and the Global Environment Monitoring Index (GEMI). In most of the investigated years, local maxima (second mode) in the NDVI annual curve were observed in the beginning of the rainy season, after a relatively small amount of rain, followed each year by the yearly maxima (first mode). The major maxima are due to the development of greenness of the annuals and perennials whereas the second mode maxima are interpreted as due to the photosynthetic activity of the biogenic crusts. The SAVI peaks at the same time as the NDVI confirming that the NDVI signal is the result of photosynthetic activity rather than darkening of the soil background due to the rainwater. Coincidental peaks in the atmospherically resistant GEMI indicate that the NDVI signal is attributed to the surface signal and not a mere effect of the atmospheric water vapor and/or aerosol.

It is concluded that in arid environment, where the higher plants are sparse, the biogenic crusts signal is detectable in satellite imagery and has considerable contribution to the overall signal. It is further concluded that changes in the microphytes spectral reflectances may lead to misinterpretation of vegetation dynamics and overestimation of the ecosystem productivity.

D. Keyser, Hamburg, Germany

Irrigation, water division, salinisation, desertification - an inevitable succession?

Land-use in arid regions of the world has many aspects. Up to now the land is mainly used for agriculture, recreational exploitation is not very often found and technical usage of these regions, i.e. solar radiation power constructions or wind energy fields has not started yet, except some rocket launch or nuclear power test sites.
Agriculture can utilize these soils in three different ways, like
1. Animal husbandry mainly used in a nomadic way of living.
2. Purely precipitation fed agriculture depending on the amount of precipitation and the installed technical components.
3. Irrigation agriculture depending on suitable water resources.

In this paper a short overview of the course of development of irrigation is given. Irrigation systems are some of the most comprehensive undertakings of mankind, they do not only involve technical and scientific measures, but they also are inflicting social and cultural changes. Economic alterations for the population and the whole society are likely. Management questions are one of the essential points of success or disaster. A historical look on some examples of irrigation cultures gives an idea of imposed difficulties and hazards irrigation societies have to cope with.
Differences of recently installed systems and their performance are evaluated and judged against their proposed aims. Shortcomings are identified in several fields: i.e. in technical approach, in planned economic possibilities, in social changes and influences on cultural questions, in water management tasks or in their recognition of environmental hazards.
A key problem is building big industrial agricultural complexes without proper acceptance by the local population; alteration of lifestyle and inability to accept local knowledge and distinctive environmental features, by overriding it by pure technical installations.
Having identified some of the important problems recommendations are offered to moderate the negative effects. Financing of the irrigation operating system must be guaranteed. Labourer and management must be well trained and motivated. Rotation patterns of crops must be strictly enforced. Decisions which plants has to be grown at what magnitude by considering the economical and ecological impact is one of the most important tasks. The market for the produced goods must repay the input. New technologies have to be evaluated and installed. In case of financial problems reduction of areas of cultivation as well as of animals relying on the fodder are essential. Ingenious ideas of new products i.e. making use of local weeds or agricultural use of saline lakes must not be refused but strongly supported. A larger diversity of crops will help to reduce fertilizer and pesticide impact as well as the dependence on a certain market.
Finally the political difficulties in accepting and applying these recommendations are addressed.

B. Knerr, Kassel, Germany

Economic-demographic strategies in reaction to increasing discrepancies between carrying capacity and population density in arid regions

This contribution deals with the question, if it is to be expected that economic-demographic changes taking place in reaction to increasing discrepancies between carrying capacity and population density in arid regions tend to support the way to an equilibrium between both forces, or rather contribute to a permanently unstable situation, implying a threat to the natural environment and to the people living in it.
To collect, compare and draw conclusions from experiences made in this area is of vital and increasing importance as declining availability of water is, in many regions all over the world, both a result of and a threat to human activities. It is developing into a central issue of the future of mankind, implying questions of food security, of social peace, and of international conflicts.
The analysis starts from hypotheses deduced from theoretical considerations based on the standard neo-classical economic theory which concentrates on forces and conditions that lead to an equilibrium after some disturbance has taken place. It implies certain behavioural assumptions which appear rational. The following empirical analysis will first and briefly consider comprehensive investigations about people's reactions to a deteriorating relationship between carrying capacity and population density, the most popular among them being those of Malthus and Boserup. Built on that, the analysis will test if the rules deduced from theories and general empirics are valid in arid rural regions. By doing this it will draw on experiences made in different arid regions of countries with low per-capita income, relying largely on case studies from Asia, Africa and Latin America made carried out by the author as well as by other researchers. The results demonstrate that for economically rational reasons demographic strategies may be chosen which lead to further deteriorating conditions and to cumulating downward processes.
The investigation includes five levels of activities, where potentials and restrictions to adapt to a changed environment may coincide in a way which contributes to turn the situation from bad to worse: the family, the household-farm unit, the region, the national, and the international level. By identifying such conditions, and reflecting on possibilities to modify them, the author intends to join in the effort to bring ecological and demographic development in arid regions on a way towards a socially accepted equilibrium.

G. Meirman, Kyzylorda, Kazakstan

Phytoreclamation on the Dry Floor of the Aral Sea

At present, the Aral Sea area is considered a region in crisis. As a consequence of the sea level´s decreasing from 1960 until 1995, 18.400 km² of the sea area in Kazakhstan dried out. 60 % of the newly created landscape are solonchak, where the soil is easily blown away. The dry seafloor is seen as the climax of the natural and anthropogenic developments in the region. The primary source of salt dust loss is the dried-out sea floor. Climatic conditions have an effect on soil development. After investigations of the dry seafloor, the decision to carry out phyto-melioration where the soils started to desalinize, was made. Furthermore, the climatic conditions have to be taken into account. It has to be stressed that melioration of dried-out salt soils (1990) of the Aral Sea is extremely difficult. Soil development of the seafloor is in process but an equilibrium of the ecosystem of the dried-out Aral Sea has not been achieved yet.
The aim of these experiments is to promote natural vegetation dynamics and to find methods to re-establish the seedbank in the dried-out sea floor.
The recultivation should not only support the vegetation cover but although the land use of the new land surface.
In cooperation with the Institute of Botany (Almaty), two plots of different soil types of the Kaskakulan transect on the east coast of the Aral Sea which dried out in the seventies, were established in November 1997. Indigenous halophytes were chosen as plant material. In the first experiment 17 species were sown on clayish solonchak. Due to the high soil salinity only three annual species survived: *Micropeplis arachnoidea*, *Suaeda acuminata* and *Climacoptera aralensis*.
The soil of the second experiment was sandy. 6 out of 9 species sown established themselves. *Haloxylon aphyllum*, *Salsola nitraria* and *Climacoptera aralensis* showed good vitality.
As a joint project with Bielefeld University the transect "Bajan" was investigated in June and August 1998. An interesting feature of this transect is its location, because it reaches into the Aral Sea area which dried out in 1990. Some of these areas are covered with therophytes, but perennial vegetation is still absent. For an experiment one to two year-old-plants of *Tamarix laxa*, *Halostachys caspica*, *Halocnemum strobilaceum* and *Haloxylon aphyllum* were planted in autumn 1998.

The cooperation of researchers of the Institute for Agro-Ecology and Agriculture (Kazakhstan) and Bielefeld University has started successfully. This joint project is concerned with the development of the technology of cultivation of perennial halophytes on the dry Aral seafloor and is supported by the BMBF.

S.J. Milton, Matieland, South Africa

How grazing turns rare seedling recruitment events to non-events in arid environments

Keywords: florivory, Karoo, recruitment event, seed production, vegetation composition

When livestock numbers are high in relation to the percentage of the vegetation comprising preferred forage plant species, and where no provision is made for occasional livestock withdrawal during periods of flowering and seed set, grazing will deterministically lead to the near eradication of certain forage plant guilds from rangelands. Recruitment events for long-lived plant species, and even for ephemeral plants, are uncommon in arid (<200 mm/year) environments and are closely tied to weather sequences that favour the particular plant species by promoting first seed-set and then germination and seedling survival. Preferred forage plant species, whether ephemeral or perennial, with or without soil-stored seed banks, decrease or disappear from areas where the grazing regime, by preventing seed-set, turns potential recruitment events to non-events. This paper provides evidence for the rarity of recruitment events in an important forage plant (*Osteospermum sinuatum*) in South African Karoo shrubland and analyses population structure and seedling densities in protected (9.4 SD 7.7 seedlings m^{-2}) and grazed areas (0.02 SD 0.3 seedlings m^{-2}) two years after a sequence of years that favoured seedling recruitment. Seedling to adult ratios were 5:1 in protected areas and 0.7:1 in grazed areas. Although refuges have potential to increase seed availability in heavily-grazed rangelands, seed input to sink populations will be constrained by the dispersal mechanism. Seeds of *O. sinuatum* are tumbled over the ground by wind, and an exponential decrease in seedling density with distance from the seed source ($n = 25$, $r = -0.699$, $p < 0.001$), indicated that most seeds are dispersed no more than 10 m from the source. When grazing control by fencing is not economically feasible, many small refuges (such as provided by spinescent and toxic plants) may be more effective than seed plantations in maintaining key forage species in rangelands.

A.-R.A. Moustafa, Ismailia, Egypt

Impact of Grazing on Saint Catherine Vegetation, south Sinai, Egypt Conservation and Rehabilitation of Endemics and rare species

The vegetation of Saint Catherine protectorate (southern part of Sinai) is subjected to a great disturbance through the unmanaged human activities, including overgrazing, overcutting, uprooting, tourism and quarrying. Many plant species are threatened due to these severe impact of human activities. Our plan of work was designed to survey the vegetation of protectorate and adjacent wadis (overview and identification) preliminary determination of the conservation status of vegetation cover, as well as management regulations. 18 main localities within and adjacent to the St. Catherine protectorate were studied through choosing of 231 sites. The vegetation survey included estimation of grazing intensity, updating of vegetation status (plant communities), vegetation cover percentage, threats and human activities.

316 plant species were recorded in this study including 19 endemic species, 10 extremely endagered, 53 endagered and 37 vulnerable species. One of the most important results in this study is 18 new recorded species, 5 of them are new recorded species to Sinai, and the others are to certain specific areas in the protectorate. More than 200 plant communities and associations were recorded in the studied locations. The most dominant plants of these communities are: *Artemisia herba-alba*, *Artemisia judaica*, *Zilla spinosa*, *Fagonia mollis*, *Anabasis articulata*, *Acacia tortilis* subsp. *raddiana*, *Haloxylon salicornicum*, *Zygophyllum coccineum*, *Retama raetam* and *Iphiona scabra* in low elevated wadis and plains. *Artemisia herba-alba*, *Tanacetum santolinoides*, *Agathophora alopecuroides*, *Phlomis aurea*, *Menthe longifolia*, *Stachys aegyptiaca*, *Teucrium polium* and *Achillea fragrantissima* in high elevated mountainous areas. The total plant cover and species richness in mountainous areas are higher than in that of low elevated wadis. The gorge habitats showed the maximum vegetation cover percent 30-40% (e.g. Shaqq Sha'arany) followed by slope habitats which support 10-15% plant cover. The minimum percent of plant cover was recorded in wadis and terrace habitats 5-10% or less. Low wadis and plains support a sparse vegetation with a plant cover percent 1-5%. In many localities in low wadis such as W. Mandar, Ladid area and Nabq area, the vegetation cover was less than 1% due to high grazing intensity. Mt. Catherine supports the highest value of species richness, 144 plant species, followed by Mt. Serbal and Mt. Musa which support 141 and 114 plant species respectively. These three mountains are the main harbor of the endemic species in addition to the threaten species.

Grazing intensity as well as unmanaged human activities represent a great disturbance for natural vegetation and threatening some endemic and rare species of extinction, disappearance of pastoral plant communities, paucity of trees, dominating most of the wadis with unpalatable plant species such as *Artemisia judaica*, *Anabasis articulata*, *Haloxylon salicornicum* and *Fagonia mollis*, and causing environmental degradation which include soil erosion. Palatable species (e.g. *Pennisetum*, *Panicum*, *Crotalaria*, *Acacia* and *Zilla*) and moderate palatable species (e.g. *Achillea fragrantissima*, *Retama raetam* and *Lycium shawii*) suffer from the high pressure of grazing and cutting. In addition, some unpalatable species (*Fagonia mollis*, *Fagonia arabica*, *Artemisia judaica* and *Artemisia herba-alba*) suffer also from grazing. In some wadis (W. Kld, W. Lithi, W. Mandar, W. Kheriza), overgrazing and other disturbances cause a lot of changes in soil surface and moisture loss, and reduce the total plant cover even for unpalatable species such as *Fagonia mollis* and *Haloxylon salicornicum*.

213 species were previously recorded in the protectorate boundary, but none of them were either collected or recorded by the team work of the last few years. 46% (96 from 213) of them are annual species, 17% are shrubs and 3% endemic species (*Centaureum malzacianum*, *Juncus bufonius* and *Astragalus fresenii*). Compositae (34 species), Leguminosae (19 species), Crucifarae (18 species), Chenopodiaceae (15 species) and Caryophyllaceae (13 species) are the families that are most represented in this study.

N.M. Novikova, Moscow, Russia

Ecological basis for botanical diversity conservation within Amudarya and Syrdarya river deltas

Botanical diversity (BTD) is an important part of a biodiversity and object for a real actions for it's conservation. BTD includes, according to our understanding, plant species, plant communities and its spatial combinations (symphytotaxones). We differ the potential, the registered, the actual BTD. Potential species richness (local flora) of the Amudarya and Syrdarya river deltas includes 727 species. 273 species are presented in bought deltas, 301 species are only in Amudarya and 153 species are only in Syrdarya delta. There are 574 species compose floristical richness of the deltaic landscape of Amudarya and 426 species of Syradarya. Registered species richness in Amudarya includes 230 species and actual is only 192. Potential and registered plant communities richness includes 56 associations and 21 formations: 15 communities are in Amudarya and 14 are in Syrdarya. Actual community's richness is less on 3 formations: *Populeta pruinosae*, *P. arianae*, *Saliceta songoricae*. There are 9 potential symphytoassociations, but nowadays the actual are only 3. The ecological positions in the scales of ground water table and soluble salts in soils were studied for every plant community. The ranges of plant communities in time (main types of successions in directions of desiccation, halophytization and psammophytization) and in space as an spatial ranges within landscapes of levees and interflow depressions were composed. Analysis of the map of the landscapes ecology (scale 1:500 000, 1988, Authors A. Vostokova, A. Bachiev, T. Kozlova, N. Novikova etc.) showed the possible regions for water management for supporting existed tugai communities and for renovation wetland conditions.

N.P. Ogar, Almaty, Kazakhstan

Vegetation Dynamics and Modern Land Use at the Syrdariya Delta

Vegetation of modern Syrdariya delta is characterized by complicated spatial structure and fast pace of dynamics. The reason has to do with physical-geographic peculiarities of the region, consequences of centuries-old economic use and active impact of modern anthropogenic and anthropogenically stimulated processes.

Powerful factors of modern vegetation dynamics in modern conditions are the shrinkage of Aral sea, decline and contamination of the Syrdariya river's runoff and presence of irrigated agriculture.

Character, pace and direction of vegetation successions in modern conditions are determined by hydrodymanic and halogeochemical processes against the background of arid climate.

Change in character of vegetation successions at semihydromorphic and automorphic habitats is influenced by the increasing aridisation of climate, first of all by the increase of temperature (by 0.5-0.7^{0}C) and decrease of humidity (by10-20%) at ground surface level as well as by decay of breeze from the sea. This is evident from the loss of biodiversity by plant communities, simplification of their structure, loss of certain plant species and synusia, re-distribution of the composition of ecobiomorphes.

Vegetation dynamics at the hydromorphic habitats is of chaotic character because of the influence of irrigation and depends on ameliorative state of the land in a concrete year. However general tendency of increasing halophytization is observed at these habitats. This results in reduction of meadow areas, their replacement by halophytic shrubs and consequently loss of hayfields.

Syrdariya delta is characterized by unstable land use in conditions of Aral sea shrinkage. Area of irrigated lands and hayfields has been continuously reduced since the beginning of 1980-ties and gradually transformed into pastures. Grazing pressure on hydromorphic ecosystems sharply increased as a result of severe degradation of pastures of adjacent deserts, eolian and deluvial-proluvial delta plains. Vegetation of hydromorphic habitats degrades very rapidly in conditions of water deficiency aggravated by uncontrolled grazing. Successions are of catastrophic irreversible character and accompanied by convergence of plant communities and loss of their resource potential.

Total cumulative effect of the natural-anthropogenic vegetation dynamics is the growing desertification of Syrdariya delta.

N. Orlovsky* and M. Glantz**
*** Sede Boker, Israel, ** Boulder, CO USA**

Ecological consequences of arid land irrigation in the Aral Sea basin

In recent years, the development of arid lands has been taking place at an increasing rate all over the world and irrigation has become the most important factor for the improvement of productivity in these potentially arable by arid areas. However, such anthropogenic (human) activities as irrigation, water drainage, regulation of the surface runoff, modification of hydrographic networks, and the creation of new water reservoirs and collectors of return flow, affect the stability and rhythm of natural processes. They cause significant changes in the ecological situation at the scale of entire regions. Thus, they often bring about negative consequences not envisaged by planning, construction, and land development authorities. Such consequences include, for instance, secondary salinization, waterlogging, and increases in the mineralization of the return flow and changes in the groundwater level. These processes are characteristics of all areas subjected to intensive development of irrigation especially those located in arid zones. An extreme example of this process of adverse change is one of the largest inland drainage basins - that of the Aral Sea.

Since the end of World War II, the Aral Sea basin has experienced major development of agricultural irrigation because of population growth, increasingly sophisticated technology, use of chemicals in agriculture, and an intense focus on monoculture, e.g., cotton cultivation, leading to the development of large expanses of salinized lands and other lands unfit for cultivation under conditions of a limited supply of irrigating water. All these factors have seriously deteriorated the natural environment, including a decrease in the Aral Sea level and the living conditions of the local population, and caused numerous negative consequences, often referred to collectively as the "Aral crisis." For a long time the population in the area and large segments of the scientific community were misinformed about or unaware of the real ecological state of the region. This, coupled with the Soviet Command and Control system of government, made it difficult if not impossible to take the necessary actions toward environmental remediation.

Our purpose is to show the wide scale character of anthropogenic effects (impacts) on the natural conditions of the region, to consider the consequences of such anthropogenic interference, and to identify lessons for future reference from the incorrect and unreasonable agricultural and water use policies in the region.

Andreas Pölking[1], Martina Sass[2]
[1] agroplan - Büro für Umwelt- und Agrarplanung, Vechelde, Germany
[2] Planungsgruppe Ökologie & Umwelt, Hannover, Germany

Land-Use and Desertification in the Issyk-Kul Region in Kyrghyzstan

The mountainous semi arid region around the Lake Issyk-Kul is heavily endangered by a desertification-process due to agricultural land-use. Erosion is caused by rain and the yearly occuring snow melt in higher areas. But the cause and effect chain "livestock over-use and desertification" explains the natural-science point but does not help very much in the task to find solutions for the problem behind. Answers to the question, what kind of land-use and which intensity of agriculture will be sustainable for the future could be found only together with the local people concerned. But awareness among local people for these environmental problem is of cause low facing the economical and social problems of the farmers and shareholders since the russian interest and influence tends towards zero in this country.

The German Agency for Technical Cooperation (GTZ) supported Kyrghyzstan for a period of four years in the process to install a biosphere territory in the Oblast Issyk-Kul. With the concept of the UNESCO biosphere-territorys the country tries to protect the nature from an increasing over-use and dersertification. The authors accompanied the efforts with consutancy missions. Because of the enlargement of the region - it covers an area of 43 000 sq.km - three representative model regions were defined. In each model region a typical village or small town is located. Secondly the people in the regions were asked to analyse their situation regarding their "strengths", "weaknesses", "opportunities" and "threats" (SWOT). This analysis used parts of the PRA methodology, i.e. transect walks, personal interviews, village meetings and mapping. The lack of inputs like irrigation water, good seed, fertilizer, pesticide and mashines were stated as the cause for the problem, that yields decrease from year to year. This leads to shortages in the supply of winter fodder for the animals. The farmers reduced the livestocks and/or expanded the period and areas of grazing.

The limited crop rotation and the trend to grow only wheat as the most important marketable and self consumed crop was found to be one important reason for the decreased yields. Not agri-chemicals (nitrogene and pesticides) were needed but a wider crop rotation with clover and other legumes for an environmental sound fertilizing.

R.M. Razakov, Tashkent, Uzbekistan

Desertification in the Aral Sea zone

Shrinking of inner lakes in the result of growing national economy and population is a natural processes for arid zones of the world. Hovewer, desertification in the Aral Sea zone, connected with dramatic uncontrolled droping of the Aral Sea level (till 18 m), have not analogy on the scale and intensity in the world experience, which directs to unsustainable development of agriculture in the Central Asia. This process of desertification are aggrevating by increasing antropogenic human impact in Kizilkum and Karakum deserts, also by waterlogging and salinization of irrigated lands becouse of poor technical level and exploitation of irrigation and drainage systems. It was fulfilled integrated ten years field investigation on the Aral Sea problem, which includes:

1. dynamics and tendency of transformation natural resources, geochemics of landscapes using remote sensing information;
2. quantitative and qualitative assessment of eolean transfer of dust and salt aerosols from solonchaks of South Aral Sea zone, their deposit and impact to cultural and natural plants;
3. dynamics of antropogenic pollutions of hydroecosystems, eutrophication shallow lakes and water bodies, their assimilation behaviour, migration and destruction in elements of agrobiocenosis;
4. climatic changing in the Aral Sea zone, including dust-blow phenomena on 200 meteorological stations;
5. amelioration state of irrigated area, their salinization;
6. assessment of quality of main drinking water sources in lower streach of Amudarya river.

On the base of experimental study on pilot stations and field research it was worked out integrated nature protection measures: to combat desertification by designing cultural landscapes, conservation biodiversity, protection of Wildlife, improving social-economical state of population, stabilization of ecological situation on the Aral Sea Zone taking into account long term perspectives.

O. Sharkas, Birzeit, West Bank

Vegetation Degradation in Northeastern Jordan

This paper provides examples of the extent to which Jordanian farmers (Fellaheen) and Bedouin contribute to vegetation degradation in northeastern Jordan. Irrigated cultivation of marginal lands, deep ploughing of the fragile rangeland, overgrazing, cutting and uprooting the perennial xerophyte species for fire, and even deliberate burning, has in some areas led to a process of desertification.

It is known that the rangeland in northeastern Jordan used to support large numbers of highly palatable species for grazing such as *Artemisia sieberi* (Syn.: *A. herba-alba*), *Salsola damascena* (Syn.: *S. vermiculata*), *Atriplex halimus*, *Achillea fragrantissima*, *Hamada eigii* and *Noaea mucronata* ...etc. They were quite dominant, provided a high degree of surface cover and were widely distributed.

At present these palatable species are no longer found in northeastern Jordan, except in the Surra, Khanasri and Shaumari reserves. The palatable species, however have been replaced by invader, segetal and thorny plants, such as *Peganum harmala*, *Anabasis syriaca*, *Salsola jordanicola*, *Halthamnus hierochunticus*, *Xanthium spinosum*, *Onopordum macrocephalum*, *Chenopodium album* and *Chenopodium murale* and others.

This phenomenon can be considered and used as an indicator of vegetation degradation in northeastern Jordan.

A. Singer[1], A. Banin[1], L. Poberezsky[2]
[1]Rehovot, Israel, [2]Tashkent, Uzbekistan

Proposed pathways for the development of soils and crusts from the Aral Sea bottom following its exposure by desiccation

The development of the bottom material upon desiccation is determined to a large degree by its particle-size distribution:

On bottom material that is fine-sandy to sandy:

Bottom material that is fine-sandy to sandy in texture desiccates to form sand dunes. There will therefore be only limited capillary rise of groundwater and accumulation of salts on the surface. Crust formation will be minimal. The land surface will remian bare, and serve as a source area for short-range aeolian transport of coarse-grained particles. The shifting dunes will be mostly unconnected with groundwater but fed by the, albeit limited, local rainfall. In due time, vegetation can establish itself on these dunes.

On bottom material that is silty to fine-sandy in texture:

If groundwater is close to the surface, with time, active capillary rise and evaporative processes will lead to salt accumulation and crust formation. The time required for the salt crusts to develop is estimated to be approximately 5-10 years. In the presence of the salt crusts, the surface will remain bare (no vegetation) because of the high salinity. This is the common pathway for solonchak soil formation.

Well-developed and cemented crusts, even if totally composed of salts, can be expected to protect the surface from wind erosion. Dust generation will be reduced, because dust entrainment from crusts will be reduced. While it can be expected that salt crusts will be more resistant towards deflation, electron microscopy has shown that the salt crust is frequently overlain by second generation powdery and fine-grained salt crystallites – not yet very consolidated – and consequently salt from this layer could be entrained by wind.

Salt crusts will develop not only in the presence of groundwater close to the surface, but also when periodic flooding takes place. Salt crusts and salt pans develop upon evaporation from various small water-bodies in the Amu Darai River Delta. The source of these water bodies is not clear. They possibly represent (a) entrapped sea water (b) surface run-off of rainwater that had collected in depressions. Most likely are (c) artesian seepages of shallow groundwater fed by drainage water from the irrigated areas of the delta layer to the south.

In the absence of groundwater (or surface water) close to the surface, salt crusts will not form, or will form only to a very minor degree. Clay crusting will take place and ultimately Takyr soils will form. The rate of formation of these crusts is much slower than the salt crusts. Dust entrainment from these surfaces will be much more pronounced. After some time, vegetation of shrub-like Xerophyts and Halophyts (such as Tamarisks) will take root in this areas. As vegetation covers the surface, deflation will decrease. Vegetation recovery apparently can take place relatively rapidly, within 15-20 years of the exposure of the sea bottom. The local rainfall (annual average 100 mm) appears to be sufficient to support this vegetation in non-cultivated areas, stabilizing their surface against further wind erosion. An example of this pathway are the extensive, shrub-covered areas east and southeast of Muynak.

A salt crust was observed to consist of one layer, in which salt crystallites were arranged in one dense, interlocking matrix. Chemical scan showed the crystallites to be composed of sodium and magnesium sulfates and chlorides. Less frequently, gypsum crystallites were identified, usually as a secondary growth on top of these dense matrix. Spot analysis of individual crystallites suggested that the crystallites were either sulfates or chlorides, but not mixed salts. By their cubic habit, halite crystallites were easily recognizable. The chemical composition of these crystallites (by spot analysis) indicates only Na and Cl, with some small, additional amounts of Mg. Some of the crystallites were pitted by secondary solution channels.

This research was supported under Grant No. CA16-013 U.S.-Israel Cooperative Development Research Program, Economic Growth, U.S. Agency for International Development.

S. Sokolov, Almaty, Kazakhstan

Potable Water: Seasonable Changes & Conditions Research

One of the key issues and problems of the local people living standard in the Aral Sea region is the problem of safe drinking water supply systems. Especially this problem is actual for the population of the remoted villages. As people living in these villages have to use water for drinking purposes from shallow wells and boreholes. As the physical conditions of the ground water are characterized by high salinity the problem of safe water supply became very important.

In accordance with the data from Giller Institute, which estimated the social problems of Kazakhstan Prearal, water supplying is a factor which actually decreases quality of populations life and economical development. Cost of water is enormously high and people are forced to use water from Syrdarya river, irrigating channels and preparing ice in winter time. In many villages at Soviet time (1963-1965) were built wells with pump sets for using underground water. However preliminary investigation results show that this water, with high level of mineralization is very harmful to health.

In this project it is planned to spend observation on conditions of drinking water sources in all inhabitant places in Kazalinsk and Aralsk regions agreed these problems with local authority. To suggest practical decisions on the drinking water supplying system problems for each village.
To organize interviewing of local people, to attract regional sanitarian epidemological stations and health department.
In accordance with the plan worked out in former Soviet Union in relation of developing agriculture water supplying systems in Kyzylorda oblast, the need for drinking water in inhabited places was planing to provide a way of building mainly water pump systems. But the realization of accepted water supplying systems is still unsatisfied. Establishing the sustainable system of quality drinking water supplying system of Prearal people from Aral-Sorbulak underground water during 10 years remain the key unsolved problem of social rehabilitation of region.

I. Springuel, Aswan, Egypt

Sustainable development of the area around Lake Nasser, Egypt

Lake Nasser was created as a result of the construction of the Aswan High Dam, which was completed in 1969. The water of the Lake has covered the whole Nubian Nile Valley and deeply penetrated into the desert through tributary wadis. This lake is about 500 km long, of which 291.8 km lies in Egypt. Since its formation, the quantity of water in the lake has varied dramatically, determining the dynamics of the lake and its ecotone zone and hence the developing programmes of the area and their rationale. The position of the lake, bounded by Arabian rocky desert on the east side and Libyan sandy desert on the west, creates a large habitat diversity that provides an opportunity for integrated development of the area around lake.

The downstream part of Wadi Allaqi, which is the largest of the wadis in the southern part of the Eastern Desert of Egypt and drains to the Lake was selected as the area for *in situ* research. In our research we have tested the possibilities for sustainable development of the area by enriching the diversity and productivity of the natural vegetation in ecotonal zone. The concept of agroforestry could be applied to this type of land management. Economically important indigenous desert plants were selected for cultivation in ecologically favourable habitats. These are medicinal plants and plants with multi-uses. Preference was given to trees (*Balanites aegyptiaca* and *Acacia* spp) which are drought resistant and at the same time could endure water excess.

An experimental farm with 800 trees of *Balanites aegyptiaca* and 200 trees of *Acacia albida (Faidherbia albida)* was set up in the main channel of Wadi Allaqi. The rate of the trees growth and other plant parameters were regularly measured. The obtained results show that with sufficient water supply the desert plants grow fast and some individuals of *Balanites* reached a height above 2 m in less than two years. Surface and subsurface irrigation schemes were used. The homogenous growth of trees was observed at subsurface irrigation, at surface irrigation the height of the plants varied greatly and soil salinity increased. This is a long-term experiment which s still in progress. It could be considered complete when plants will be self sustain and survive without irrigation and protection from grazing.

C.N. Toderich, R.L. Goldshtein, G.S. Rashidova, W.B. Aparin
Samarkand, Uzbekistan

Environmental state and an analysing of phytogenetic resources of halophytic plants of Kyzylkum Deserts

The present paper focus on the contemporary environmental state and analysing of phytogenetic resources of halophytic plants of Southern regions of Kyzylkum desert that have been working during many Complex International expeditions (1996-1998) in Uzbekistan.

The appearance of large irrigation drainage lakes in the Kyzylkum desert, especially in the Buchara oasis changes fundamentally the water salt-balance of environment of adjoins territories. Buchara oasis situated in the lower part of Zerafshan river valley was chosen as the object for biomonitoring and as a model site for afforestation and establishment of halophytic pastures for undertaking cattle/goat/sheep farming in arid and sandy Kyzylkum desert. A map of extent of salinity and pollution of soils in Southern areas of Kyzylkum is shown. Soils are characterised by low productivity almost high salinity (1,2-2,0% with a predominance of carbonates and sulfate-chloride type of salinization), heterogeneous particle–size composition, unfavourable water, physical and physicomechanical properties and a high degree of compaction. The humus content ranges from 0,5 in sandy desert and grey-brown sites to 0,7-1,2 % in the virgin and newly irrigated takyrs. The mineralization of superficial waters vary widely: 0,7-4,6 g/l; subsoil water changes from 1,5-5g/l, while the mineralization and hardness of subsoil water in the Kashkadarya river valley are highest (1,5-2 times). High human activities in the Kyzylkum lead to pollution of irrigated lands with pesticides, nitrates and various contents of heavy metals. The botanical diversity of these territories is poorest and is mainly presented by plant communities varying from xerohalomorphic to halomorphic species. A computer database of more than 120 native wide ranging polymorphs annual and perennial species as well as narrowly distributed taxa belonging to 80 genera and 25 families indexed alphabetically is proposed. Representatives of Chenopodiaceae have a major place on the composition vegetation cover of salted desert sites. Detailed information's of life form, its botanical, cytoembryological characteristics, pastoral and nutritional values, economic interest, distribution and maximum reported salinity tolerances as well as bibliographic references are analysed for each species. A great attention is given also on the fruit morphology (SEM analysis), ecology of seed germination and creation of seed banks. The plant reproduction specificity and anatomical bases of C_3/C_4 type of Kyzylkum vegetation in relation with salinity of soils are undertaken too. Four big groups of halophyte plants using both for rehabilitation and livestock feeding in arid and sandy areas of Uzbekistan are described. Hyperhalophyte consists of 4,3 % (31 species) and could be growing on all salt marshes and wet salted habitat with superficial (0,5-1,5 m in depth) and high mineralised underground water. Most typical is: *Salicornia europea, Halostahys caspica, Halochnemum strobilaceum*, and some species of *Suaeda, Aeluropus, Climacoptera*. Halogemimezophyte representing by some graminous and annual *Salsola*s, as well as *Basia, Halogeton, Haloharis, Atriplex* species could use mineralised underground water of various contents of salts settling down 1,5-2,5 m in depth. Halomezoxerophyte characterised by *Tamarix, Halolachne songarica, Seidlitzia rozmarinus, Nanophyton erinaceum. Limonium gmelini, Kalidium caspica, Nitraria shoberi*, as well as many species of genera *Salsola, Phragmites* and *Artemisia* possess a wide range of salt tolerant properties to salinity with a level of underground water with 1,5-4,0 m in depth. A most frequently distributed in the sandy desert of Uzbekistan is considering haloxeropyte group, which is able to grow on salt-affected soils with deepest distribution of underground water. *Anabasis salsa, A. aphylla, Ephedra strobilaceae*, many *Salsola* shrubs and semishrubs, *Halothamnus subaphylla, Haloxylon aphylla* and other tree like arid species are belong to this group. Thus, our results should enable more rigorous selection of halophytic plants for intensive field evaluation as sources as fuelwood. timber, oil, commercial products, forage, medicine and rehabilitation of saline/sodic sites of Kyzylkum deserts.

S.Y. Treshkin, Nukus, Uzbekistan

The floodplain vegetation of Central Asia: modern state, ecology and biodiversity conservation

Terrestrial ecosystems are extremely vulnerable in arid regions. They respond even to insignificant changes of the environment, which may result in irreversible modifications of ecosystems and often in the complete loss of their scientific, social, and economical value. Intrazonal hydromorphic landscapes undergo the greatest transformation, the main component of which is flood-plain vegetation.

Flood-plain vegetation is the most valuable kind of biological resources of Central Asia and is characterized by high biodiversity (more than 1000 species) and comparatively high productivity (190 t/ha). The process of intensive usage and agricultural development of the flood-plain-tugai's ecosystems as well as increasing anthropogenic impact lead to catastrophic reduction of the large tracts of tugai's forest. Flood-plain-tugai's ecosystems that have been widely spread in previous times in Central Asia are preserved now only as fragments (basin of the river Atrec, deltas of the rivers Syrdarya, Murgab and Tedgen, Tarim, Chu, Ili and Zeravshan).

The most large flood-plain-tugaiôs ecosystems can be met in the middle and lower flow of the Amudarya (60 thousands of hectares) and in reserve õTigrovay Balkaæ on the Vahsh located in Tadjikistan (35 thousands of hectares, 1993 year, but the military actions in this republic led to the complete loss of this unique reservation area) that is 10% of the territory they occupied at the beginning of 30-irs.

Nowadays the modern processes of formation and development of flood-plain-tugaiôs ecosystems are taking place on the base of altered and very unstable hydrological regime rivers of Central Asia which leads to the succession row of desertification, which stages we determined for all described associations. The main edificators in flood-plain vegetation are xeromesophillous mesothermic trees: *Populus ariana*, *P. diversifolia*, *P. pruinosa*, *Elaeagnus turcomanica*, *Salix songarica*, often entwined by lianas (*Cynanchum sibiricum*, *Clematis orientalis*), as well as bushes and tall grasses: *Tamarix ramosissima*, *T. meyeri*, *T. florida*, *T. laxa*, *Halimodendron halodendron*, *Phragmites australis*, *Calamogrostis dubia*, *Trachomitum scabrum*.

The main factors that cause the anthropogenic dynamics of flood-plain-tugaiôs ecosystems are: uncontrolled cuttings, fires, pasturing, ploughing up and technogenic load. Depending upon the character and strength of anthropogenic impact, gradual, sometimes very fast changes in the composition and structure of communities, partial or often complete replacement of communities take place. Thus development of the processes of anthropogenic desertification in Central Asia leads to the radical change of species composition of flood-plain-tugaiôs ecosystems and disturbance of ecological stability of communities.
The problem of preserving of tugai forests at present time can be solved only by the government or intergovernmental organizations, because it is connected with the redistribution of water resources, being the ecological only it turned into the ecological-political and social-economical problem.

Y. Waisel, Tel Aviv, Israel

Salinity: The Number 1 Enemy of Sustainable Agriculture

The food supply of the world is on the verge of insufficiency. In part this is because of the shortage in availability of high quality irrigation water. Therefore, the only sources of water that are left for productive agriculture in arid regions are saline water.
Except for rare and limited sites in humid regions salinity there does not constitute a serious problem. The use of saline irrigation water is a unique but doubtful privilege that was solely granted to the people of the arid and regions.
With the growing population of the world and the increased pressure on resources for food production, the proper use of marginal water for sustaining agriculture, would become in the near future a critical matter.

Salinity has two main sources: rainwater and irrigation water:

Rainwater: Depending on the distance from the sea and on the regional topographic contour, salt concentration of the rainwater in the Middle East varies between 10 and 50 mg/l, with an average of some 30 mg NaCl/l. This means that even for dry farming i.e., in areas with up to 300 mm mean annual rainfall, salt is added to the fields at an annual rate of 10g/l per $1m^2$. Scaling those figures to agricultural dimensions this means an annual addition of 100 kg of NaCl per hectare. In runoff basins of highly arid areas, such additions of salts are even higher.

Irrigation water: All irrigation waters contain salts, with some sources containing more and some less. The average salt concentration of irrigation water in Israel is approximately 500 mg NaCl / l. If we assume an annual use of such irrigation water, at a rate of 1 m^3 of water/$1m^2$ of land, the balance would show an annual input of at least 500 g NaCl to each $1m^2$ of arable land. On a field scale this means the annual addition of 5 tons of NaCl per hectare.

As most crop plants accumulate in their shoots only small quantities of NaCl, the balance between salt input and salt output by crop harvesting is annually added to the soil. Thus, irrigation with saline water means a massive accumulation of NaCl in the upper layers of the soil of irrigated fields and makes it a crucial problem for the arid regions of the world.

The take home message is that, with the present agricultural practices, the use of saline water for sustaining reasonable agricultural production is doomed to fail.

C. Werner[1], C. Maguas[2], W. Beyschlag[1] and O. Correia[2]
[1] Bielefeld, Germany, [2] Lisboa, Portugal

Restoration of disturbed areas in the Mediterranean, a case study in a limestone quarry

Desertification and soil degradation is a phenomena of increasing importance in the Mediterranean region, where the pronounced seasonality of the climate, with hot and dry summers provides an additional problem for reclamation processes. In particular, soil degradation as a result from quarrying activities has extremely strong environmental impact, since it implies the clearance of the vegetation and loss of soil. The exploitation in platforms increases the drainage and, therefore, the physical and chemical erosion of the substrate, delaying the natural germination and recolonization of natural species. Water and nutrient stresses, characteristic of the Mediterranean ecosystems, are additional problems for pioneer plants under such conditions. Artificial revegetation of natural woody species can accelerate the process of soil formation, buffer the impact of erosion agents such as rain and runoff and reduce the impact on the landscape.

A reclamation project was conducted in a limestone quarry of the Serra da Arrábida (South-west Portugal), a natural park with a dense evergreen sclerophyllous shrub community. The successive revegetation of each platforms (in 3 years intervals) result in distinct plant communities of different age and cover, which allow the evaluation of establishment and growth of introduced species as well as the succession of spontaneous germination and stabilization of natural vegetation. Plant cover, vigor, composition and diversity was studied in vegetation plots of five different stages (3-15 years).

Furthermore, a new revegetation project was conducted using three native species from the area (*Olea europaea* var. *silvestris, Pistacia lentiscus* and *Ceratonia siliqua).* Different treatments were applied to evaluate the capability of lowering environmental stresses and thereby improving the stabilisation of new plant communities and accelerating the revegetation process. These treatments comprised i) fertilization, to overcome growth limitation due to nutrient deficiencies; ii) mycorrhization, to improve nutrient uptake by plants, as well as their competitive capacity for other resources; iii) addition of a long-term water-holding polymer to the soil to reduce water stress. A combination of different treatments for each plant species was tested in a randomized plot design. Two year old nursery plants were planted in March 1998 and species establishment and survival was studied a few weeks after planting and will be recorded during the next years. Growth and vigor of the plants was monitored, and various ecophysiological studies were conducted, comprising water relations and fluorescence measurements to evaluate the physiological status of the plants.

The results of the first year revealed species specific differences during the adaptation processes, with *Olea europaea* being the most robust species. *Ceratonia siliqua* was the most sensitive species to the transplantation stress, but after the initial adaptation highest growth rates were found in this species. Furthermore, fertilization significantly increased growth rate. Survival rate was very high in all species, and more pronouced effects of the treatmets are expected during the second year.

In a future project these studies will be extended in quarries and degradated areas of several Mediterranean countries, where the ecological aspects of plant establishment, competition for resources, soil processes and other factors will be addressed which will strongly determine recolonization and plant establishment in degradated areas.

W. Wucherer, S.-W. Breckle, Bielefeld, Germany

Vegetation dynamics on the dry seafloor of the Aral Sea

The Aral Sea, in 1960 the 4th largest sea on the globe, is critically drying out. The sea level has dropped by about 18 m, at the flat east coast horizontally almost 100 km. A new dry surface area of about 40.000 km^2 is exposed. The development of seperate smaller independant water bodies is reality. The terms „Great Aral Sea", „Small Aral Sea", as well as „Aral Sea Syndrom" for an ecological crisis, and „Aralkum Desert" for a new desert area are used now.
The dynamics on the drying sea floor is unique. Unconsciously human mankind has created a huge experiment, an experimental set, a laboratory of nature with thousand of local events. The drying seafloor is a new surface, which is invaded actively by organisms. The dry seafloor is the biggest area worldwide where a primary succession takes place. With an extraordinary multiplicity it exhibits the appearing and disappearing of vegetation units:

- There have evolved unique plant communities and ecosystems
- 245 angiosperm species have enlarged their distributional area
- The high diversity of local stands is favouring microevolutionary processes
- The drying seafloor and the coastline of the Aral Sea is one of the diversity centers for Chenopodiaceae and Polygonaceae (Calligonaceae) in Central Asia

The new knowledge on vegetation dynamics in the Aralkum Desert, which is a mosaic of sand- and salt desert ecosystems, is very important for the understanding of the ecosystem dynamics in the whole central Asian area.
Since about 1990 the hydrological dynamics of the northern and southern part is different. The water level of the Small Aral Sea became more or less stabilized. The vegetation dynamics around the Small Aral Sea is now governed mainly by biotic factors. The retreat of the water level of the Great Aral Lake, however, still continues. The salt concentration of the water has increased now to about the level of ocean water. In consequence here exogenic and abiotic factors are dominating the ecosystems dynamic, especially the first few years after drying. Since about 1985 vast dried areas have developed to open salt deserts, hence the colonization with perennials is hinderned increasingly. This causes the absolute dominance of various halophytes as pioneer species and the lack of almost all other life forms at the present colonization of the dry seafloor.
The study of the mechanisms of the ecosystems dynamics and the ecological attributes of the dominant species is of great importance for clarifying the following open questions:

- Will there be an ecological limitation of colonization by plants and where it will be?
- Which mechanisms are governing the development of salt desert and of sand desert (barchanes)?
- By which means the natural colonization by plants can be accelerated?
- Which geological, geomorphological and edaphical processes are affecting the present ecosystems development?

The dry seafloor of the Aral Sea at present is a huge open salt flat. According to several estimations it is the source of many million tons of salt and dust blown out by wind and transported to even distant neighbourhood areas, with irrigation areas and settlements. The present and future development of the drying sea is characterized by the creation of salt desert flats. The continuation of the drying process at the Great Aral Sea will increase the problem of salt dust storms tremendously. In this case the agricultural used areas east and south of the Aral Basin will be hit even more. It is high time for strict measures to decrease the salt dust output.
Preliminary results from the started BMBF-research project have already shown, that any plant cover on the dry seafloor is from eminent importance for stabilization of the soil surface.

A. Yair, Jerusalem, Israel

Runoff Water Redistribution in Arid and Semi-Arid Areas

The scarcity of rainfall in arid and semi-arid areas, coupled with the high evaporation rates, prevent deep water infiltration and result in a bad water regime and saline soils. Despite the said above, Mediterranean plant species are found at specific sites in desert areas. The presence of such species is explained by the positive effect of water concentration due to runoff. Areas with limited infiltration respond quickly to rainfall and generate high runoff rates. Due to the short duration of most rainshowers, runoff generated at latter area is absorbed by riparian areas with high infiltration rates where infiltration at a depth beyond that allowed by the direct rainfall occurs. Runoff generating areas are represented in these environments by rocky outcrops or biological crusts, while absorbing areas are represented by highly porous soil covered areas. The paper will present the monitoring of rainfall-runoff relationships at three different environments in the Negev desert. The first study site is located north of the Beersheva Basin, in the Lehavim area. Average annual rainfall is 280 mm. Hillslopes are steep, gravelly and well vegetated. The second site, Sede Boqer, is located in the Negev Highlands. Hillslopes are rocky, with a limited soil cover. Average annual rainfall is 90 mm. The third site, Nizzana, represents a sandy area, partly covered with a biological crust. Data obtained clearly indicate that the most efficient process of water concentration occurs at the Sede Boqer site, where the ratio of rocky to soil covered areas is high. The process of water concentration is less efficient at Lehavim where this ratio is low. The lowest water concentration occurs in the sandy areas, where despite the sealing effect of the biological crust the frequency and magnitude of runoff generation is low.

X. Zhang, X. Li, H. Zhang, Urumqi, China

The Control of Drift Sand on the Southern Fringe of Taklamagan Desert an Example from CELE-COUNTRY

Based on textural research, Cele County Town during the historical period (including the township under Yutian county befor ostablishing county) was compelled to move three times because of shifting sand encroachment. In the 50's to the beginning of the 80', the desert in the northwest part of the countytown moved and expanded 80-100m every year, the desert of Cele village moved 5Km from 1957 to 1980, mobile sand dunes ware only at a 1.5Km distance from countytown. The cause was meinly 2666.6 ha *Populus euphratica* forests and many *Tamarix* spp. were destroyed by blind reclaimating and excessive cutting from the ending of 50's to the beginning of the 60's. The increasing desertification made the fragile ecological environment further deteriororte. Befor the project starting, the area of farmland desertification occupied 25% of total cultivated area of this village, 60 households were compelled to move to other places because of sand-burial.

Situated on the southern fringe of the Taklamagan Desert, Cele county belongs to the extra-arid desert zone. Being very poor in water resources for planting trees and grass in spring and auturmn, the coverage of vegetation in this region is only 0.24%. With fine particles of sand matrial, rich sand sources and frequent winds and sand activities, the unreasonable human activities accelerate the process of desertification. According to the natural condition of local area, starting with restoring natural vegetation and developing artificial vegetation through making full use of rich floodwater resources, this project solved the difficult problem of forestation in summer, set up a comprehensive protective system possessing original characteristics. It not only probed the ways for extending coverage of vegetation and controlling the expansion of drift sand, relieved the threat of the city being under sand siege, but also protected and extended oasis. It should be mentioned that both the sand-control system prossessing original characteristice in the studies on the protective system for the control of blown sand disasters and the artificial direct seeding over large areas using summer floodwater in the forestry are creative works, which reflect research level and the latest achievements of our country then in studies on the protective system and the method of forestation.

The Points of methodes and measures are as follows:

1. Design and foundation of the comprehensive sand-control system.
2. Forestation with summer floodwater.
3. Artificially promoting the restoration of natural vegetation.
4. Improvement of the sandy land.
5. Plantation technology and rational utilization of the wind-breaking and sand-fixing fuel forest.

Key words: Control of Drift Sand, Fringe of Taklamagan Desert, CELE

Posters

D. Abiyeva, Almaty, Kazakhstan

Relief, dynamics and development of sandy massifs of Zaissans depression

The sandy massifs of Zaissans depression concerning the most northern deserts of Kazakhstan are located on the left side of the river Black Irtish (Black Irtishs massif) and the left side of the river Irtish, at its output from lake Zaissan (Bukons massif). They are generated in result overwork of lacustrine- alluvial deposits of quarternary age.

The relief of sand is various. Northern, more levelled part Black Irtishs massif, has hillock, hillock-ridges, hillock-honeycomb relief with separate altitude till 10-20 m. For raised sites is characteristic hillock-barchan relief. Relative height separate barchans reaches 60-80 m. Dune valleys are engaged with solonchaks of hollows. Bukons sand are submitted barchan and hillock-ridges relief.

For study of dynamics of a relief of sandy massifs were analysed dates on force and mode of winds on all Zaissans depression, the basic directions of winds and their connection with orientation eolian forms of a relief are determined. Most dynamical are the not fixed sands, which create a number of problems for economic objects, is especial in western part of a depression.

The sandy massifs of Zaissans depression for a long time were intensively used as autumn-spring pastures, and some fixed sites - for selective haymaking. On space photographs of the beginning of the eightieths are well interpreted not only natural mobile sand but also grounds, violated as a result of economic development. Sands, which were not used in facilities (frontier strip), on space photographs are precisely allocated with more dark homogeneous tone, that is characteristic for fixed stable sands.

Now in connection with reduction of total number of live-stock, reduction of technical opportunities of an agriculture, these massifs send from sphere of economic development. The natural restoration of the broken grounds is characteristic for a modern condition of territory. Thus, usual climatic conditions, mobile background, differentiate relief broken modern transport network and the undeveloped social infrastructure complicate the development of these extensive sites. But this territory with unique kept is deserted - steppe fauna and flora represents a monument of a nature and can be announced by a zone of natural park.

N.V. Aladin, Sankt Petersburg, Russia

Past, Present and Future of the Aral Sea Fauna

Biodiversity changes in the Aral Sea, a large saline lake in central Asia, are considered. This lake was characterized by low species diversity of its inhabitans: 20 species of fishes, 195 species of freeliving invertebrates, 12 species of higher plants and 82 species of lower plants (Khusainova, 1958) were noted. The presented information about species diversity of the Aral hydrobionts cannot be thought as exact. Obviously for many groups the species composition was not determined completely. The species members are changing as well as progress in research in taxonomy sphere. By calculation of Yablonskaya (1974) the Caspian species made 17%, fresh and brackish water species from continental waters made 78% and Mediterranean-Atlantic species made 5% of the free-living Aral invertebrates. By Nikol'skiy (1940) the Aral fauna consisted of 3 genetic complexes. Firstly, remains of the Tertiary fauna, secondly representatives of the Aral-Caspian fauna, and thirdly,those of the North Siberian fauna. Thus, one of the significant Aral ecosystem trits was the strong prevalence of fresh and brackish water originspecies. The first considerable changes of biodiversity in the Aral ecosystem were connected with the acclimatization activities.

The second considerable changes of biodiversity of the Aral ecosystem are connected with the desiccation. Fish have virtually disappeared from the lake and diversity of associated bird and wildlife communities has decreased. The major cause of the biodiversity changes is the diversion of water, mainly for agricultural purposes, from inflowing rivers. Biodiversity changes have been accompanied by changes to regional rivers and terrestrial environments, groundwaters, climate, and to agricultural productivity. It is concluded that major values of the lake have been seriously diminished by recent changes to it. Since 1989 the fall in level has divided the lake into two parts, a northern Small Aral Sea and a southern Large Sea. The desirability of a scientific and engineering programme to rehabilitate the northern sea is discussed.

S.K. Arndt, M. Popp, Vienna, Austria

Why is the Ziziphus tree drought resistent?

Trees and shrubs of the genus *Ziziphus* are known to grow in arid and semi-arid habitats in several regions of the world. However, only very little is known about the drought tolerance mechanisms that enables *Ziziphus* to grow in arid environments.
The physiological investigations of *Ziziphus* in pot experiments and in the field clearly demonstrated that this species does not have a simple monocausal reaction system to drought stress, it posesses a variety of reaction opportunities.
The drought tolerance mechanism of *Ziziphus* species is a result of both desiccation avoidance and tolerance adaptations. The primary adaptation is drought avoidance through a deep and extensively developed root system that enables water uptake from moist soil horizones. When water becomes a limiting factor *Ziziphus* responds with versatile drought tolerance mechanisms.
As a first reaction increased sensitivity of stomata to soil drying delays dehydration and increases water use efficiency. Then osmotic adjustment aids to maintain turgor under low tissue water potentials, thus enhances the capacity for gas exchange, enzyme activity and water uptake, and thereby improves the competitive fitness of *Ziziphus* in the water limited environment. E.g. enzymes, like nitrate reductase, are able to display high activities under water limited conditions and therefore maintain metabolism under drought stress.
When water deficit further increases desiccation is avoided by sheding of leaves. *Ziziphus* can survive long periods of drought without any leaves due to high carbohydrate reserves in the root and probably water binding mucilage in the stem. When water is available again, remobilisation of stored carbohydrates leads to a vigorous and quick resprouting of new leaves and shoots.
This flexible combination of mechanisms of drought avoidance and drought tolerance initiates the successful and competitive inhabitance of *Ziziphus* in arid environments.

S.K. Arndt[1], S.C. Clifford[2], M. Popp[1]
[1] Vienna, Austria, [2] Efford, UK

Ziziphus - a multipurpose fruit tree for arid regions

The progressive desertification in many arid regions of the world causes the urgent need for plants that can cope with the arid environment and fulfil the peoples needs for food, fodder and fuel. Fruit trees from the genus *Ziziphus* represent an example for such a multipurpose plant. *Ziziphus* trees and shrubs inhabit arid enivironments on every continent due to a very flexible adaptation mechanism in response to drought stress. They play an important part in the conservation of soil because of their number and their powerful roots and wind shielding properties. Their leaves provide fodder for livestock, the wood is dense, hard, compact and tough, it is used for turnery and agricultural implements and it makes an excellent fuel and good charcoal. In many regions *Ziziphus* is grown as a hedge for fencing and its edible fruits improve peoples nutrition and provide a possible cash income when sold on local markets. Moreover, fruits, seeds, leaves, roots and bark of *Ziziphus* trees are used in many traditional medicines as a remedy against insomnia, some skin diseases, inflammatory conditions and fever. Therefore *Ziziphus* trees have a definite place in the integrated economy of the arid lands.

S.K. Arndt, R. Albert, M. Popp, Vienna, Austria

Osmotic adaptation of Chinese desert plants

The overexploitation of the sand-fixing vegetation belt on dunes causes desertification in the perimeters of the Central Asian Taklamakan desert. Replanting bare areas with well adapted indigenous plants should bring further desertification to an hold. Several species naturally occurring in the dune areas will be tested for their suitability to reinforce dune areas in the EU project "Ecological Basis for a Sustainable anagement of the Indigenous Vegetation in a Central Asian Desert". Accumulation of osmolytes in order to cope with the low water potentials of the soil is one important factor in plant adaptation to drought stress. The plant species investigated so far showed different strategies to cope with the conditions of the same field site. Further investigation of water relations, relative growth rate and vegetation ecology in response to drought stress of the different species will complete the picture of mechanisms of drought adaptation and resistance.

S. Baoping, F. Tianzong, Beijing, China

China s Desertification and Its Control

China's desertification situation is described in this paper. China is one of the seriously affected developing countries with vast desertification areas, in which have a very large population and frequent disasters, and with limited arable lands. The desertification affected lands are mainly distributed at a range of longitude of 74~119'E. and latitude of 19~49'N.. The total area of the arid, semi-arid and dry sub-humid areas is about 3.32 million km^2, of which 2.62 million km^2, covering 79.0% of total above mentioned zones, and occupying 27.3% of total land territory of China, has been desertified , at present, is still developing at an annual rate of 2,460 km^2. Authors introduce the general background on China's desertification, such as current situation, distribution, types, and causes of desertification, also including its damages. Major measures to combat desertification, including ecological protective project systems and special control measures(especially in sandy desertification region) are given in this paper. In addition, a practical study case (in Daxing County, Beijing), is introduced. The development trend of desertification combating in China is also stated in this paper.

G.K. Bizhanova, Almaty, Kazakstan

Assessment of Modern State of Sand Desert Vegetation in Kazakstan

Diversity of anthropogenic factors (agricultural and industrial) cause different extent of vegetation transformation. Series of maps has been made to study modern state and extent of anthropogenic transformation of the psammophytic vegetation. Map of modern vegetation is the base inventory map reflecting ecological situation of the mapping area, first of all distribution pattern of vegetation caused by relief and edaphic conditions. Series of plant communities, aggregates and combinations of series were used as mapping units. Map of potential vegetation was made on the basis of literature and cartographic sources as well as on materials of study of progressive vegetation successions. Map shows conventionally climax vegetation and its changes up to present time. Map of anthropogenic transformation of vegetation reflects the presence of active ruderal species, indicators of pasture digression. Succession series and types of weed infestation are presented for each conventionally climax vegetation type. Map of pastures shows distribution of pasture types and includes data on their vegetation, habitats, season of grazing, mean productivity and determined modifications (according to indicator weed species). Map of intensity of pasture use reflects extent (intensive, moderate, slight) and character of their use (grazing, hay making, cutting woody vegetation for fuel). Map of desertification shows extent of desertification (very strong, strong, moderate, slight). Map of anthropogenic dynamics of vegetation shows time and spatial successions in the past, present and future. Map has three dimensional representation showing succession and improvement factors, and character of their influence.

These cartographic material is useful for analysis and prompt assessment of the ecological potential and biological resources of the area.

N.I. Bobrovskaja, Sankt-Petersburg, Russia

The productivity of utilization of water by dominants species of Central Asian steppe and desert communities (Mongolia)

The investigation of water relations of plants has been conducted on great ecological profile from dry steppes through desert steppes to steppe deserts, true deserts and extreme arid deserts. Specific features of water relations of dominants of the most typical communities were determined to every subzones. The transpiration was calculated using our data on intensity of transpiration, water content and plant productivity. This coefficient shows the amount of water needed to build 1 g of dry matter. It appears that steppe and desert plants spend very much water to from aboveground phytomass. The transpiration coefficient of desert plants lies within the range from 1251 to 3406, of steppe plants – from 1404 to 4940 g water/ g dry mass. Such species of dry steppe as *Artemisia frigida* and *Caragana microphylla* and such species of desert steppe as *Allium mongolicum* utilize water the last efficient. Species of genus *Stipa* are characterized by maximum effectiveness in water utilization. Among desert plants *Sympegma regelii*, *Nitraria sphaerocarpa* and *Zygophyllum xanthoxylon* spend water more unproductive. On the contrary *Haloxylon ammodendron* and *Iljinua regelii* spend water the most effective. Steppe plants utilize on average 2640 and desert plants – 2220 g of water to build 1g of dry matter. The dominants of desert communities (steppe desert, true desert and arid extreme desert) form aboveground phytomass 6 times less than steppe dominants (dry steppe and desert steppe), in spite of that they spend in average just the same quantity of water to build 1 g dry mass. Annual fluctuations of transpiration coefficient in steppes are larger than this in deserts. This confirms the ability of steppe plants to react quickly to fluctuations of moisture. That has led to the situation that steppe type of vegetation has been widely distributed within the Eurasian mainland.

S.-W. Breckle, W. Wucherer, A. Scheffer, Bielefeld, Germany

246D

Halophytes on the dry seafloor of the Aral Sea

In Central Asia within a short time the development of a new and huge salt desert has taken place and still takes place caused by the drying of the Aral Sea. This process is by size comparable with the Great Iranian Salt desert or the Great Salt Lake in Utah. The total area of solonchak in Kazakhstan then will be comprised by 30% of this Aral Sea area. The dry seafloor is a mixture of clay, loam, sand and salt. The older sandy soils are almost free of salt. The new alluvial deposits of the retreating Aral Sea are covering by 1 - 6m the older layers. The salinization of the substrate varies to a great extent, causing a wide variety of saline soil types, various solonchaks: marshy solonchaks, crusty and puffy solonchaks, solonchaks slightly covered by sand, degraded coastal solonchaks, takyr solonchaks etc. (NEKRASOVA 1979, KIEVSKAYA 1979). This multiplicity of salinization processes are the main reason for a very diverse halophytic flora on the dry seafloor. From the 245 species, hitherto known, about 160 species are occurring on solonchaks or other saline soil types of the dry seafloor. The remaining 80 species may be influenced episodic or periodic by salt after germination or during other life phases. This results in a rich halophytic flora of the dry seafloor which on the one side is affected by salinity to various degrees and on the other side has to evolve adaptations for survival on those saline stands.

The group of "stem-succulent euhalophytes" with *Salicornia europaea* (s.l.), *Halocnemum strobilaceum, Halostachys belangeriana, Ofaiston monandrum* exhibits annuals and perennials as well as the group of "leaf-succulent euhalophytes" with several *Suaeda*-species (*S. crassifolia, S. acuminata, S. microphylla* and *S. physophora*), *Climacoptera aralensis, C. ferganica, C. lanata, Petrosimonia triandra, P. squarrosa, P. brachiata*, as typical examples. The recretohalophytes are represented by several *Tamarix*-species, but also by *Frankenia hirsuta, Limonium gmelinii* and *Aeluropus littoralis*. The Pseudohalophytes are the biggest group: examples are *Bassia hirsuta, Atriplex fominii, Kochia iranica* etc. The *Atriplex* species also can be grouped to the recretehalophytes. The investigation of the adaptive mechanisms of the various halophytes types is essential for a good assortment for phytomelioration of those saline soils. The phytomelioration by artificial plantings on the dry seafloor for acceleration of a closed vegetation cover is a big need to minimize the widespread negative effects of salt desertification in the whole area.

B 08 15

A.A. Butnik, U.N. Japakova, G.F. Begbaeva, Tashkent, Uzbekistan

Halophytes: structure and adaptation

Halophytes are the ancient ecological type the origin of which is connected with zone littoralis. Saline environments of their habitat have positive effect on them, as it reduces competition, prevents from diseases and vermins and creates humidity at the expense of accumulation of moisture by salt. The negative qualities of this habitat are the high osmotic pressure of soil solution and toxic effect of salt. The morphogenesis and structure of vegetative and generative organs of hyperhalophytes (*Halocnemum strobilaceum*, *Salicornia europaea*) and euhalophytes from *Suaeda* (*S. arcuata*, *S. acuminata*, *S. microsperma*, *S. prostrata*) and from ephemers (*Hymenolobus procumbens*, *Spergularia microspermoides*) were studied in Kyzylkum desert with chloride-sulphate salting of soil. The following peculiarities of plant's development, caused by specific habitat are revealed. The fruits of halophytes are not sclerified. The pericarp is parenchymatous. The testa have 2 layers of cells. Their adaptations to extreme desert conditions including salination are implemented at the expense of submerged position of fruits in fleshy cortex, the presence of tannins and melanins in testa, fat in embryos which makes it difficult for salt to penetrate. The assimilating organs of hyperhalophytes are the shoots with reduced leaves and chlorenchymatic non-kranz cortex of stems. Euhalophytes have small cylindrical leaves with kranz (*Suaeda arcuata*, *S. acuminata*) and non-kranz structure (*S. prostrata*, *S. microsperma*, *H. procumbens*, *Spergularia microspermoides*). However the main line of adaptation of halophytes in both groups is the succulent strategy when moisture is preserved at the expence of abundant water-bearing cells with thin walls. The structure of stems and roots of the studied species is anomalous, polycambialous, sclerenchymatous which guarantees well protection of lateral meristems and their substitution when they are damaged.

L.A. Dimeyeva, N.P. Ogar, T.I. Budnikova, Almaty, Kazakstan

Planning of phytoreclamation on the drying Aral sea bed

Phytoreclamation of the desiccated sea bed is necessary and advisable measure. The main purpose of it is to help the processes of natural overgrowing, to create seed banks for natural dissemination of vegetation that fixes the ground and prevents salt and dust transfer.

Natural overgrowing of primary marine surfaces, trend of succession processes depend on environmental and biotic factors such as: lithology, salinity, moisture of primary marine soils; level and mineralization of underground water; exogenous processes and deflation; climatic conditions; presence of seed banks, their remoteness and possibility of migration.

Study of successions and mechanisms of primary vegetation formation allowed to create series of geobotanical maps in different scales. The schematic map of botanical-geographic zoning was created on a basis of floristic investigation of the Aral sea coast. Above mentioned maps became a basis for compilation of the scheme of phytomelioration subdivision. There are 13 phytomelioration districts and 2 subdistricts. For each region there are typical floristic compositions and ecological characteristics. Symbols in the scheme show the phytomelioration groups consisted of ecologically and phytocenotically compatible plant species.

For selection concrete sites for phytoreclamation all possible factors should be taken into account. We used other basic maps for this purpose. The map of ecosystems of the modern Syr-Darya delta is related to the inventory maps. It represents spatial structure and diversity of ecosystems. Mapped units are elementary ecosystems. They are joined into types and classes of ecosystems according to meso-relief, moisture, salinity and mechanical composition of soils. Each unit characterizes correlation between main components of ecosystems: meso- and micro-relief, soils and vegetation.

The map of modern exogenous processes of the Aral sea exposed bed was worked out on a basis of field research with utilization of satellite images. The map reflects character, degree and trend of geodynamic processes as well as natural dynamics of environmental conditions according to the temporal and spatial aspect. The landscape map characterizes a spatial differentiation of natural complexes and dynamic trend.

The implementation of the experiment on two sites in phytomelioration district Kaskakulan has proved as correct the comprehensive approach on planning reclamative measures. The preliminary evaluation of ecological conditions was conducted on the basis of available maps and the list of perspective species for phytomelioration was composed. Field research determined that a process of natural overgrowing goes faster in the desiccated sea bottom of the 1970s. The complex assessment has shown that planting in the area of moving sands is ineffective. Plots with blown sand cover are not needed in additional plantings. But solonchaks could be ameliorated by sowing salt resistant species. 17 species of halophytes and hemihalophytes were sown on the test areas. Conditions of crust solonchak were harder for phytoreclamation (17 species were sown, 10 – germinated in the spring, 3 - have survived: *Climacoptera aralensis, Micropeplis arachnoidea, Atriplex fominii*). Crust-fluffy solonchak with thin blown sand cover was more favorable for germination and development through vegetative stage (9 species were sown, 7 - germinated in the spring, 6 - have survived: *Haloxylon aphyllum, Salsola nitraria, S.australis, Petrosimonia brachiata, Climacoptera aralensis, C. lanata*). Thus, experiment has shown that phytoreclamation of saline soils is possible by limited number of species. The list of "successful" species - phytomeliorants coincides with floristic composition of closest plant associations.

K. Fischer*, R. Schiene*, N. Zier*, J. Katzur **
***Tharandt, Germany, ****Finsterwalde, Germany**

Artificial Humus prepared from Lignin

The humus content decisively determines the functions and productivity of soils. Deficiency of natural humic substances has to be compensated by application of organic matter. The objective of our research work consisted in developing an artificial humus that is characterised by stable properties which in particular meet ecological requirements.

Our investigations resulted in the production of a novel artificial humus by oxidative ammonolysis of technical lignins originating from pulping processes. The results of artificial humification resemble those of natural humification.

So, processes such as demethoxylation/demethylation, the formation of o-quinones, oxidation of aliphatic side chains, the formation of new C-C-bonds, aromatic ring cleavage as well as reaction and condensation with nitrogen also take place during artificial humification.

Both artificial and natural humus can be described as a high-molecular organic matter of a complex structure. They are similar as to their element contents, N-content in different chemical forms of bonds, types of functional groups, and molecular weight.

Laboratory tests, pot trials and lysimeter experiments have been carried out to investigate the effects of applying artificial humus. The results show the outstanding properties of this material such as a long-term effect in supplying nutrients required for plant growth. So the artificial humus slowly releases nitrogen in arid soils for a period of at least three years.

In addition, the application of artificial humus leads to an essential decrease of N leaching and also to an immobilisation of toxic heavy metals. The pollution of seepage water is drastically reduced.

Therefore, considerable ecological advantages are attained by the overall effect of the artificial humus. In this way, the waste product lignin can be successfully recycled in the circle of nature.

B.V. Geldyeva, N.P. Ogar, Almaty, Kazakhstan

Assessment of desertification processes using remote sensing and GIS methods

Aral sea region is the arena of development of global scale desertification processes. In spite of various current research it is difficult to assess the scale and trends of development of these processes.

For this purpose it is appropriate to use modern technologies of Remote sensing and GIS. They allow not only to establish the reasons, pace and direction of desertification process, but also to get quantitative indicators.

Integration of different thematic and assessment cartographic layers in GIS allows to simulate different "scenarios" of land use and stimulated by them processes of degradation of different ecosystem components.

Syrdariya delta is characterized by complicated spatial structure of ecosystems and fast pace of natural and anthropogenic dynamics. Therefore to create GIS and maintain it in actual state different Remote sensing methods should be employed. Such methods as cluster analysis to perform different types of classifications, creation of cartographic models on the basis of images obtained in different years and others. Combination of field monitoring and Remote sensing methods will allow to make prompt assessment and extrapolation of obtained data to large areas.

We used digital data obtained from satellite NOAA (1 km resolution) and Resurs MSU-SK (160 m resolution). NOAA data cover the entire region of the Aral sea including neighboring countries. Data of satellite "Resurs" cover eastern part of Kazakstan's Priaraliye.

Processing of digital satellite data has been performed in computer program ERDAS Imagine 8.3.1. The NOAA AVHRR monthly data for the period April-November were used for determination of NDVI values and comparative analysis of differences between isolated ecosystem classes. Detailed land cover classification considering interrelationships of the main natural components (relief, soils, vegetation) and dynamic processes occurring in them has been developed for certain ecosystems on the basis of field studies. Coordinates of each class has been accurately measured by Magellan 3000 GPS. Classes on the images were determined by supervised classification, minimum distance method.

Multispectral image of MSU-SK obtained August 10, 1998 was used for mid-scale mapping with interpretation in the field. Classification of spectral signatures were made by supervised classification, minimum distance method.

Obtained masks of landscapes and ecosystems were converted from *img format (ERDAS) to GRID format of ArcView GIS 3.0 and added into GIS with further filling out attributive data base for each landscape type. Data base fields include information on genesis of deposits, relief, soil-vegetation cover.

This approach allows to assess desertification processes at different levels from regional to local. Work has been conducted under projetcs: "Geographical Information System for Research and Management of Natural Resources in the Delta of the Syr Daria (INTAS-KZ 95-0030), Project UNESCO/BMFT - 509/RAS 41 of the Ministry of Science and New Technologies, Germany, "Monitoring and simulation of desertification processes in river deltas of Syr-dar'ya and Amu-dar'ya for GIS, subproject K-5 and project "Monitoring of dust-salt storms in Aral region", 1998-1999, with financial support of International Fund for Aral Rehabilitation.

G.V. Geldyeva, Almaty, Kazakhstan

Landscape-ecological assessment of the Syrdariya delta for land use purposes

Irrigated lands were incorporated into the structure of modern natural complexes of the Aral sea basin as a new element and caused directed change of region's ecological state. Actually the new landscape-ecological environment with physics-chemical processes differing from former ones has been created. Since irrigated agriculture occurs with substantial change in superficial and groundwater moistening regimes it resulted in changing of natural soil formation regimes: water, heat, salt, biological and other regimes.

At the modern stage being under conditions of continuous decline of Aral sea level and desertification processes, Syrdariya delta has been exposed to most significant changes. Agricultural development of the delta dramatically changed natural landscapes and disturbed ecological equilibrium which in turn had negative effect on the entire land use system by broad development of secondary salinization, degradation of landscapes, reduction in yield and quality of agricultural products. This ecological situation in Syrdariya delta brought forth the critical task to find optimum variants of land use system that will allow to restore and preserve resource potential of the land.

Main peculiarity of the agricultural lands in Syrdariay delta is their location on deposition-alluvial and eolian plains. Natural complexes of deposition-alluvial plains dominate and occupy 70% of the delta. Analysis of the change in structure of agricultural lands in delta from 1960 to 1998 has revealed instability of land use system. General reduction of agricultural area and simultaneous conversion of ploughed fields and hayfields into pastures are noted since 1986. This tendency is explained by the growth of salinized and deflation-hazardous lands. Analysis showed that their growth is noted in Syrdariya delta system on deposition-alluvial, eolian, denudation-structural, deposition-coastal plains among which deposition-alluvial ones dominate and occupy an area of 1,465,100 hectares. In recent years productivity of pastures in Syrdariya delta decreased 1.5 times and ranges from 1.5 to 2.0 center per hectare.

Analysis of the landscape organization, extent and type of agricultural development, current desertification processes permitted to make landscape-ecological assessment of Syrdariya delta system and to reveal three levels of disturbance, namely, critical, intense and satisfactory.

As an illustration in the report it is supposed to use maps of agricultural development of delta landscapes for different periods, maps of landscape-ecological division of Syrdariya delta system performed as informational cartographic module reflecting significant regional factors for functioning of the complex natural-economic system.

M. Kappas, Mannheim, Germany

Detection of potential sites for Pearl Millet growth in the Sahel of Burkina Faso with the help of remote sensing and soil condition data

Water stress is one of the major millet growth limiting factors in the Sudano-Sahelian Zone of West Africa. Due to the complex interactions of multiple growth restricting factors, a scientific quantification of water deficits on plant growth is complicated. Deterministic plant growth models (e.g. SWASUC model, CERES-Millet model) are able to describe the interactions between growth determining factors and the environment. The development of simulation models would therefore be helpful in the classification of potential production zones of Pearl millet for the northern part of Burkina Faso. Before plant growth models can be build and applied, local measurements, calibration and verification are required. Many simulation results from models (see Fechter, 1993) indicated that growth restriction factors others than water influence on millet yield formation. The exploration of soil properties is of fundamental importance in the African Sahel to detect possible agriculture sites. By the combination of relief, soil types and soil water content sites for potential Pearl millet growth are derived. The derived field data have to be transfered to patterns in aerial photos and spectral signatures of satellite images (mainly Landsat TM and Spot XS) in order to link the field data to Remote Sensing informations. For integrating field data to Remote Sensing data robust parameters have to be found and advanced R.S.-technics like RGB to USGS Munsell Color transformation or the calculation of specific indices (i.e. Redness-Index or Brightness-Index) have to be used.

L. Kapustina, Tashkent, Uzbekistan

Degradation of the Vegetation in the Kyzylkum Desert (Uzbekistan)

The degradation of the desert vegetation and erosion processes of the soils was estimated in the Central Part of the Kyzylkum. Mapping was used to study the relationship among ecological conditions, land use and degree of the man-made changes natural pastures. Vegetation map was developed by GIS in Ecology Center, Inc. Distribution climaxes associations and their antropogenic modification are shown in this map. 73 maping units (associations, mosaic and series associations) were determined for vegetation map. Average dry mass of the plants and average protein content in dry mass of the plants were fixed for different pasture types.

A. Karnieli*, C. Glaesser, L. Orlovsky***
*** Sede Boker, Israel, ** Halle, Germany**

Spectral Characteristics of Cyanobactreria Soil Crust in the Northern Negev Desert

Large areas of sand fields in arid and semiarid regions are covered by cyanobacteria soil crusts. The objective of this research is to analyze (systematically throughout the VIS, NIR, and the SWIR regions of the spectrum) the unique spectral features of cyanobacteria crust relative to bare sands and under different moisture conditions. It was found that: (1) When biogenic soil crusts are wet, their NDVI value can reach 0.30 units due to their photosynthetic activity; (2) The closer the red edge inflection point is to the longer wavelengths, the higher the relative abundance and distribution of the microphytic community; (3) The phycobilin pigments, which are unique to cyanobactria, contribute to higher reflectance in the blue region relative to the sand substrate. A crust index based on this uncommon spectral feature can be useful for detecting and mapping, from remote sensing imagery, different lithologic /morphologic units; (4) Although most dune sand areas are generally made of quartz, other notable features appear on their spectra. In the study area, there are absorption features representing minerals (iron oxides at 860 nm, and clay minerals at 2200 nm) and biogenic crusts (chlorophyll at 670 nm and organic matter at 1720, 2180 and 2309 nm).

T.I. Kazantseva, Sankt-Petersburg, Russia

Pasture ecosystems of Northern Gobi and their modern state (Mongolia)

The researches (a part of joint Russian – Mongolian complex biological expedition) were carried out in the territory of Somon Bulgan. It is small, but typical part of Northern Gobi, which corresponds to a zone of deserted steppes (Junatov, 1974). Territory is characterized by sharp continental climate. The annual amount of precipitation is 107 mm; more than 60% of them drops out in summer. An index of dryness is 7,4. Three vegetation types replace each other in the investigated territory. 1) Type of steppe deserts includes variations of deserted phytocoenoses. They are distributed on a height of 1100-1200 m above s.l. and are connected with ground salinity and active eol processes. These territories are basic pastures for camels and horses. Edificators and coedificators of steppe- deserts – are bushes and semi- dwarf shrubs (12 species). They accumulate up to 80% of total biomass. On a slope of Gurvan-Saikhan ridge (1300-1700 m) are widely distributed phytocoenosis of 2) deserted steppes on brown deserted steppe soils. Edificators and coedificators of deserted steppes – are cespitose grasses, onions and primitive semi-dwarf shrubs (only 8 species). Phytomass is formed mainly by perennial plants, that for bushes – is only 7%. The deserted steppes are a good pastures for sheeps, goats and horses. The significant part of a ridge Gurvan-Saikhan (height 1700-2500 m) is covered by dry steppes. Edificators and coedificators of dry steppes are large cespitose grasses and steppe herbs; participation of bushes in total phytomass is about 10%. Production of dry steppes is 2-3 times higher than in deserted steppes and steppizating deserts. They are good pastures for all kinds of cattle.

For all types of vegetation we developed criteria of an estimation of a modern state of ecosystem. Four degress (weak, average, strong and very strong) of anthropogenic press revealed. It depends on pasture loading and remoteness of ecosystem from economic objects. A map of ecosystems and a map of anthropogenic press were made in a scale 1:200 000. In territory of Somon Bulgan with a weak degree of disturbance prevailed ecosystems of steppizating deserts (83%), with average – dry steppes (72%) and deserted steppes (66%). The strong degree of disturbance (11%) was marked in ecosystems of deserted steppes, and very strong disturbance did not exceed 1%. The results of researches have allowed to allocate ecosystems resistant to pasturing and less resistant and are a scientific basis for rational use, guards and restoration of strongly destroyed vegetation due to pasturing.

G. Lyubatinskaya, Almaty, Kazakhstan

Ecology of Priaralye Aqueous Medium

Water plays a very significant role in the economic life of Priaralye. Intensive irrigative land reclamation using over 80% of water from the Syrdarya river for irrigation of agricultural crops has led the region to a catastrophic ecological and social economic situation for the last two decades. Irrational use of water and land resources resulted not only in depletion, but also in pollution of water resources, soil fecundity reduction, rise of ground waters level and consequently to salinization and bogging of the lands.

Sewage of industrial companies and inhabitated localities and backwaters of irrigated lands are coming to the channel of the Syrdarya river and its inflows of Kazakstan part of Priaralye making up to 40% from the river stream. The situation is worst by the fact that the waters in the Syrdarya river on the territory of bordering states - Uzbekistan and Kazakstan - change their properties at the boarders so that corresponds to the notion of „sewage" by its properties.

Waste waters everywhere have residual concentrations of nitrogen-containing mineral fertilizers and pesticides; nitrate concentrations, nitrites, propanide, saturn and other pesticides exceed critical limits. In separate samples their content is up to 10 critical concentrations. About 2.5 - 4.5 mln tns of salts, around 5 thousand tons of biogenic maters and 250 kg of pesticides come along with collector drainiage waters to the channel of the Syrdarya river.

Further untreated waste water dumpings to the river may break the delicate balance which is still existing; that would result in irreversible degradation processes of all the links of the biological chain: water – soil – aquatic life – plants – human, whereupon rehabilitation (regeneration) of water, land and biological resources would be impossible.

It is necessary to take into account the fact that the majority of inhabited localities of Southern Kazakstan and Kyzylorda regions use water from the Syrdarya river for potable water supply. That water contains residual quantity of toxic matters and high salt contents (1300-1500 mg/l) even after purification.

G. Manske[1], N. Tadesse[2], M. van Ginkel[3], M. Reynolds[3], P.L.G. Vlek[1]
[1] Bonn, Germany, [2] Brookings, SD USA, [3] Mexico, D.F. Mexico

Root Morphology of Wheat Genotypes Grown in Residual Moisture

In the case of late drought, rain-fed wheat (*Triticum aestivum*) is produced on sub-soil stored moisture, accumulated during the rainy season before or at the beginning of the cropping cycle. Under these conditions, the extent of root exploration for the available soil moisture reserves is often a major determinant of drought tolerance. Twelve wheat genotypes representing drought-resistant and -susceptible wheat germplasm were grown under conditions of residual moisture simulating subcontinent-type drought in Northwest Mexico. At hard drought plant-growth stage, distribution of root length density (RLD) was assessed.

Most of the RLD was accumulated in the upper soil layers, however, with genotypic differences. Higher RLD across all soil depths were not responsible for improved water use efficiency. Averaged across soil depth, the largest root fresh weight was observed in a drought susceptible check. Grain yield was negatively correlated with RLD in the upper soil layer, but was not correlated with RLD in the deeper soil. Drought susceptible genotypes had most of their roots restricted to the upper soil, while drought resistant genotypes had high RLD deeper in the soil profile. Genotypes were identified to be used in a breeding program as donor parents to increase RLD for utilizing subsoil moisture and enhance grain yield in late-drought environments.

C. Muradov, Aschchabad, Turkmenia

Activity of the Consulting Center to Combat Desertification in Turkmenistan

The Convention to Combat Desertification stresses the necessity to create the duty of responsibility of those people who are affected by desertification, to make them involved in all different stage of implementation of the Convention, to emphasize the role of local authorities function of which should be oriented towards the mitigation of the risk to lose livelihood and to attract all relevant social groups and structures to direct participation.

For several years the Institute of Desert jointly with German Agency on Technical Cooperation (GTZ) and German firm GEOPLAN has been carrying out consultations and seminars on desertification problems. A number of seminars with a participation of Institute's staff were held to extend the consultative service of Institute in Turkmenistan and in the foreign countries. The new trends of research using GIS-technology have been discovered, the special attention has been payed to socio-economical aspects of desertification in Turkmenistan using PRA (Participatory Rapid/Rural/Relaxed Appraisal) methods.

A number of seminars and competitions among local population has been held in "Erbent" farm association in Central Karakum. The art competition among the pupils has been devoted to nature protection. The interviews of local inhabitants with help of PRA methods have been conducted in "Erbent" f/a. Today the project " Participatory management of natural resources in Central Karakum" is conducting within the precincts of Institute.

In the framework of the project the National Institute of Desert, Flora and Fauna helps to "Erbent" f/a to fix shifting sands around the Bakhardok village, to supply the Yarma settlement (for house lighting) with electricity using wind and sun energy, providing the inhabitants of "Erbent" with drinking water of good quality.

A number of projects of priority on desertification combat in Aral Sea basin has been developed and submitted for consideration to International Fund of Aral Sea joint with the western donors including the Global Ecological Fund, World Bank, etc.

To extend the consultative service of Institute the English version of a book about the main trend of Institute's activity and recommendations on rational use of desert territories for industrial consumers has been prepared for issue. The TV-film of the Institute's activity has been released, the articles of the realization steps of CCD and CB (Convention on Biodiversity) have been frequently published in the newspapers, as well as in the Internet network.

L. Muszkat[1], L. Feigelson[1], L. Bir[1], K.A. Muszkat[2]
[1] Bet Dagan, Israel, [2] Rehovot, Israel

Field studies in Solar Photocatalysis for the Detoxification of Organic Chemicals in Water and Effluents

Groundwater samples from a heavily polluted well were subjected to photocatalytic treatment in the presence of TiO_2 and H_2O_2 (Muszkat et al. 1992; 1993). The polluntants, in the range of 100-200 µg/L, included a variety of aliphatic and aromatic halocarbon solvents, aromatic hydrocarbons, triazine herbicides, acetamides, bromouracils, hydroxybenzonitriles and urea herbicides; phthalate esters, and other industrial organics. Efficient decontamination was achieved by solar photocatalytic treatment. Most of the contaminants were appreciably degraded (ca. 70% of decomposition) within 3.5 hours by natural sunlight while complete solar photodegradation required longer exposure period. They underwent complete solar photodegradation to levels less than 0.1 ppb. Field studies of the polluted well water point to the possibility of inhibition of the photodegradation by some unknown factors. This inhibitory effect is prevented by hydrogen peroxide (Muszkat et al. 1995), which leads to effective solar photodegradation, presumably due to oxidation of inhibitory constituents in the polluted water. In the absence of hydrogen peroxide significant degradation occured only during the first hour, and then the process underwent a strong retardation and the level of pollutants stabilized, owing to system deactivation. The potential of photocatalytic oxidation carried out in the absence of hydrogen peroxide has been examined in the study of purification of rinse water from agricultural spray containers, mainly from aircraft sprayers. These waters are significantly polluted with pesticide formulations, at levels of 10-100 ppm. Thus treatment is required prior to the disposal of such rinse waters. To simulate such conditions, the photocatalytic treatment of pesticides in their formulation mixtures was examined. In the photocatalysis of malathion, an organophosphate pesticide, used in spray treatment of a wide range of crops, 90% decomposition was achieved within less than 5 hours of solar exposure, while sub-ppm level were reached within 18 hours. Satisfactory results have also been obtained in closed systems. Our recent studies (Muszkat et al. 1998) revealed the existence of two different patterns in the substrate-photosensitized oxidation of pesticides, in the absence of the TiO_2 photocatalyst. The specific role of oxygen in some of the reactions has been observed, where a reaction of an excited pesticide (metribuzin) occured with an oxygen molecule. Whereas in other processes the role of hydrogen peroxide was significant (bromacil case). The recognition that several direct photooxidation patterns could be used in the treatment of pollutes water may allow to tailor the exact photooxidation procedure to a specific case of pollutant.

References
Muszkat L., Halmann M., Raucher, D. & Bir, L. *J. Photochem. Photobiol. A:Chem.* 65, 409-417, 1992
Muszkat L., Bir, L., Raucher, D. & Magaritz, M. & Ronen, D. *Ground Water* 31, 556-565, 1993
Muszkat L., Bir, L. & Feigelson, L. *J. Photochem. Photobiol. A:Chem.*87, 85-88, 1995
Muszkat L., Bir, L. Feigelson, L & Muszkat, K.A. *Chemosphere* 36, 1485-1492, 1998
Muszkat, L. „Photochemical Processes" in: Pesticide Remediation in Soils and Water, pp. 307-337, P. Kearney and T. Roberts (eds.) Wiley & Sons, 1988

K. Nadrowski, G. Jetschke, Jena, Germany

Relating patchiness and productivity in desertified shrublands

Desertified shrublands are characterized by a patchy distribution of vegetation, with most of the biomass within 'fertile islands' around shrubs. Estimating the primary productivity is an essential tool to manage sustainable land use. Better insights how productivity can be controlled can help us restore degraded areas.

Our research is focused on the relationship between landscape properties (patchiness, rainfall) and ecological properties (productivity, diversity) of the ecosystem. Our study area is a north-west facing slope in the northern Negev, Israel. Annual precipitation is 200 mm. Shrub patches with an annual understory are situated within a matrix of soil covered by biological crusts. Resources (water, nutrients, soil, and seeds) are transported by runoff water, which is redistributed by the spatial arrangement of patches. There is a source-sink relationship between patches and associated matrix area upslope of the patch ('contributing area').

The spatial arrangement of patches was mapped for an area of 12m x 18m. Patchiness was quantified by image analysis giving number, size, perimeter, orientation of the patches. There were fewer but larger patches downslope. Biomass of annual vegetation was used as an indicator, because it is easy to assess and it produces most of the biomass. Random samples of biomass were taken from patches with a known distance to a dam, acting as a watershed. We asked whether patch productivity is correlated with patch size, with patch distance from the dam or with the size of its contributing area. Since not all of the patches could be sampled, a preliminary analysis of the spatial arrangement was used to categorize patches according to the questions asked.

Our results show that productivity does not vary much with distance to the dam and that variance in productivity is high. The species diversity is higher upslope; the number of species is loglinear correlated with patch size. Landscape productivity varies with the chosen thresholds for categories. More data are needed over a broader range of patch properties to allow a realistic estimation of overall productivity.

We are only at the beginning to understand how patches are efficient in capturing run-on water and how patch vegetation responds to acquired water. Nevertheless, our conceptual framework together with our empirical data served as a starting point to develop a simulation model of the estimation of productivity if a certain landscape structure is given.

V.N. Permitina, Almaty, Kazakstan

Transformation of Soil Cover in the North-East Caspian

Strengthening of the technogenic impact on soils and soil cover at the region of industrial development of north-east Caspian results in disturbances which are often of irreversible nature. Processes taking place in disturbed soils are directed to change the system radically and accompanied by the loss of biological potential which needs much time for restoration.

Technogenic disturbances are caused by uncontrolled movement of transport, construction of additional roads, power lines, water pipes, oil and gas pipes, prospecting surveys and oil and gas fields development. They are associated with formation of ditches, grooves, trenches which are filled with outcropped mineralized water. Evaporation of this water results in formation of the solonchakous surfaces. Surface salt accumulation is accompanied by deflation processes leading to increase of saline areas and formation of blown out, lacking in fertile layer and buried variants of soils.

Analysis of anthropogenic (technogenic) transformation of soils is represented by binomial scheme without recovery stage in case of irreversible transformation exhibited by unstable primary change which is followed by chain of other changes or changes strengthening primary ones. This scheme looks like: initial form of soil type → probable state under technogenic impact (factors determining transformation - disturbance of the soil profile, erosion, salinization). Detailed scheme can take the following shape: impact → primary change of soil type (instant change of the components subject to direct disturbance) → induction and development of the secondary exogenous process or processes → new changed state of the soils. An example of such changes is transformation of meadow solokchakous soils into technogenic solonchakous soils, typical solonchaks and shor solonchaks. At the severely disturbed areas zonal brown soils reveal surfaces with dense carbonate-illuvial and salt horizons and form takyr-like and takyr surfaces. Transformation of brown desert soils into brown desert blown and takyr-like soils is observed.

Restoration of technogenically disturbed soils follows zonal directionality of soil-ecological conditions and depends on pace of natural restoration of vegetation cover.

E.I. Rachkovskaya, Almaty, Kazakstan

Anthropogenic Transformation of Desert Ecosystems in Mongolia

Differential approach should be applied for organization of land use system in the deserts of Mongolia.

Natural diversity of ecosystems should be taken into account as it causes different resistance to natural and anthropogenic desertification as well as different degree of modern anthropogenic transformation.

Ecosystem map of Mongolia of 1 : 1 000 000 scale was made by group of authors including us in 1995. It reflects distribution of natural ecosystems related to climatic, orographic and soil-lithological conditions. Gobi is comprised of the following ecosystems: **semideserts** (47% of the total area of deserts and semideserts) and **deserts** – true deserts (36.9%) and extremely arid deserts (16.1%). Map shows degree of anthropogenic transformation determined by expert assessment for each contour.

Main factors of anthropogenic transformation in Gobi are as follows: grazing by livestock, cutting woody plants for fuel, uncontrolled road network. Analysis of quantitative distribution of the anthropogenic modifications of pastures revealed significant degradation of pastures in semideserts, where only 9% of area is not touched by anthropogenic transformation, 25% is degraded pastures and 3% is severely degraded ones; rest of the area is at the moderate stage of anthropogenic transformation. In the deserts less than 45% of area is not disturbed, 55% is moderately transformed and 5% is significantly transformed. Areas untouched by anthropogenic transformation (91%) prevails in extremely arid deserts. It should be taken into consideration that anthropogenic transformation in the southern regions of Gobi, particularly in extremely arid deserts, can bring serious ecological consequences since restoration processes in deserts of continental Asia go very slowly.

Lon-term studies in Gobi allow us to make the following recommendations: prompt monitoring of pasture conditions and assessment of the degree of their degradation, development of the system for dispersion of the pastoralists' farms, organizations of more frequent livestock migration, prohibition to combine winter and summer grazing at the same pastures, withdrawal of degraded pastures from land use, establishment of livestock migration routes. Ecosystem map can be used for implementation of the monitoring.

Particular land use system should be developed for unique oases ecosystems with rich meadow and woody vegetation. This will prevent negative processes of salt accumulation, desiccation and erosion.

It is not allowed in desert region to plan utilization of all spring water for establishment of irrigated agriculture. It is required to leave part of natural oases for watering wild animals since big desert mammals are national wealth of the country.

Withdrawal of productive pastures by uncontrolled road network is typical for Gobi region. Construction of roads with solid surfacing is required.

One of the protective measures for desert ecosystems is the organization of protected areas.

E.I. Rachkovskaya, S.S. Temirbekov, R.E. Sadvokasov, Almaty, Kazakstan

Application of Remote Sensing Methods for Assessment of the Degree of Anthropogenic Transformation of Rangelands

One of the main directions of the economy of Kazakstan is livestock husbandry. Rangelands occupy 66% of the republic's territory. Intensive exploitation of rangelands leads to their considerable transformation and degradation. Assessment of the degree of their disturbance is one of important tasks of ecological studies in Kazakstan.

Methods for assessment of the stages of anthropogenic transformation of rangelands were developed at the test areas in 1997 within the AMPS (Airborne Multisensor Pod Systems) program of the US Department of Energy using advanced remote sensing technology. Work was implemented within the intermountain Ili depression on two test areas, namely, "Zhalanash" and "Syugaty". This area is under intensive economic exploitation; it includes two climatic types: piedmont steppe deserts (semideserts) on brown soils and piedmont-mountainous desert steppes on light chestnut soils.

Two types of data collected onboard of NRL NP-3D aircraft have been used for analysis of distribution and assessment of the state of vegetation at the test plots: aircraft camera Wild Heerburg RC-30 which is conventionally used for mapping and general tasks such as aerial color photography of 1:14000 scale, multispectral scanner Daedalus (AMS) registering six bands within 0.45-12.05 nm range with 3-5 m resolution.

Digital data were processed using specialized program ENVI 3.0. For determination of the classes, land cover classification has been developed on the basis of field data. Interrelationships between main natural components (relief, soils and vegetation) were necessarily taken into account during classification. In the course of field study, data on vegetation was collected using classic geobotanical methods as well as employing preliminary processed image and GPS instrument for georefencing description sites. Final supervised classification of the digital images was performed using Mahalonobis method. Series of maps for the study areas have been made on the basis of geobotanical systematization of the obtained classes.

Map of actual vegetation shows modern anthropogenic dynamics of plant communities and changes of potential vegetation caused by overgrazing.

Map of potential vegetation reflects pattern of vegetation distribution prior to intensive grazing of the area.

Map of assessment of anthropogenic transformation was made by generalization of the map of actual vegetation. Degrees of anthropogenic transformation were evaluated according to the following criteria: plant community structure, vitality of plant species, change in a degree of coverage, presence of ruderal plant and others. Calculations of areas showed that 2% of the area at both study areas were almost not touched by overgrazing. Prevailing areas (57-59%) are in a stage of moderate (25-35%) and average (22-34%) degree of transformation. These areas can be restored by proper pasture rotation. Areas of strong, very strong and in places of severe transformation occupy 22% at "Syugaty" and 39% at "Zhalanash" study areas. Improvement of these pastures requires much time and efforts and first of all funding for phyto-amelioration.

Thus utilization of new technologies allowed to make prompt qualitative and quantitative assessment of modern state of pasture vegetation in arid region. Further refinement of the methodology at the test areas will allow to minimize field surveys and to respond promptly to unfavorable processes at their initial stages. This will significantly save time and funds required to overcome consequences of desertification and therefore is of great importance for Kazkstan, most territory of which located in the zone of deserts and semideserts.

A. Rau, Almaty, Kazakhstan

Rehabilitation of irrgated land given up in case of secondary salinization in the Aral Sea area

Pedogenesis taking place in the dry climate of the Aral region forwarded accumulation of easily soluble salts in the soil. Salinization process has affected plants. At present strongly salted soils make over 30% of the irrgated Priaralye lands (Priaralye is the Aral region) located in the basin of the Syrdarya river; content of salts in the soil profile is more than 1% in dry residue. Plump solonchak (non-structured white alkali soil) appears on the soil surface and is blown by the wind ascending to the air. However, it is possible to cultivate feeding and cereal crops applying proper agricultural technique and recultivation technology.

In 1998 experiments were carried out for washing of strongly salted soils applying norms 4,000 m^3 / ha, 8,000 m^3 / ha and 12,000 m^3 / ha. Technology of feeding crops and rice cultivation on strongly salted soils was studied.

Washing of strongly salted soils containing salts in soil profile over 2% in dense residue, through norm 4,000 m^3 / ha, provides desalinization only of the upper soil layer 0 to 20 cm up to the admissible level of salt toxicity (0,3% in dense residue). 0 to 100-cm soil layer dissalinizes at washing norm 8,000 m^3 / ha, and 0 to 160-cm soil layer desalinizes at washing norm 12,000 m^3 / ha. To recultivate irrigated lands of Priaralye being derelicted due to high secondary salinization, it should be necessary to wash soils applying norm 8,000 m^3 / ha by four flooding cycles.

Seeds of feeding crops of alfalfa, millet and corn fail in plant in strongly salted soils. Rice seeds after flooding of rice plots by 10 cm water layer give plant, but yield of rice depends on degree of soil salinization. At soil salinization making 2.34% by dry residue the yield of rice has amounted to 1.5 tons / ha, at 1.857% - 2 tons / ha, at 1.567% - 2.9 tons / ha. At the end of irrigating period after rice harvesting at the test plots, the salt content in 100 cm soil layer reduced from 2.34 to 1.529%, from 1.587 to 1.209% from 1.567 to 0.826% of dry residue.

Maximum amount of water filtration from the flooded rice areas is 6 to 8 mm / day; needed separation of salts from the soil is not reached with reduction of filtration; nutrition elements are separated together with salts from the soil when filtration is increased. The yield of rice is reduced in the both cases.

M. Runge, Göttingen, Germany

EU-Project: Ecological Basis for a Sustainable Management of the Indigenous Vegetation in a Central Asian Desert

Participating Institutes:
Albrecht-von-Haller-Institut für Pflanzenwissenschaften der Universität Göttingen, Abteilung Ökologie und Ökosystemforschung.
Institut für Pflanzenphysiologie der Universität Wien, Abteilung Chemische Physiologie.
Institute of Ecology and Geography of the Chinese Academy of Sciences, Urumqi.
State Key Laboratory of Arid Agroecology, Lanzhou University.
Economic Institute of the Xinjiang Academy of Social Sciences, Urumqi.

Objectives:
This project should make a contribution to the development of measures with which an expansion of desertification can be prevented, using a river oasis on the southern margin of the Taklamakan in an exemplary manner. It proceeds from the following:
a) From the observation that the destruction of the indigenous vegetation at the transition from the oases to the sandy desert resulting from its overexploitation as fodder and fuel is the most important factor causing an increase in land degradation.
b) From the necessity of maintaining this vegetation as protection against sand drift, but simultaneously taking the population's exploitation interests into consideration in order to increase their acceptance of these protective measures.
c) From the hypothesis that the indigenous vegetation is particularly well adapted to the local ecological conditions and thus can be regenerated and maintained with the least relative effort.
The general objective is thus to regenerate a vegetation consisting of indigenous species in the foreland of the oasis and to develope a management method which ensures both their use and their preservation.

Research Site and Study Design:
The investigations are to be conducted at the Cele (Qira) Research Station of the Institute of Ecology and Geography of the Chinese Academy of Science in Urumqi. The existence of the Cele Oasis (E 80°41'15'' N 36°55'10'') is due to the influx of water from the Kunlun. The water flux in the rivers is subject to great seasonal oscillations with maxima in July and August at the time of the greatest snow melt in the mountains. The influx peaks generally exceed the capacity of the reservoirs and can be used for controlled irrigation of the forelands of the oases as a control measure against the sandy desert. This results, as has already been determined, in a regeneration of the natural vegetation from diaspores, which were either already present in the soil or which have been carried in. To the extent that overexploitation could be prevented, three vegetation types have developed on areas irrigated under supervision since 1983: each of them is dominated by a single species. They thus represent extremely simply structured ecosystems and are thus typical for the region in that the indigenous vegetation is also generally very species poor.
Five sampling areas have been selected for the investigations:
I. An area, which will be irrigated for the first time at the beginning of these investigations.
II. An area which has been irrigated at three-year intervals since 1983; dominated by *Alhagi sparsifolia* Shap.
III. An area which has been watered at three-year intervals since 1983; dominated by *Tamarix ramosissima* Ldb.
IV. An area with a stand of Populus diversifolia Schrenk. near the river; irrigated at two-year intervals.
V. An area with a planting of Calligonum caput-medusae Schrenk.; irrigated at two-year intervals.
At the beginning of the investigations all areas are to be flooded once in the usual manner

Timetable of Activities:
Summer 1998: Selection of research plots; detailed arrangements over cooperations.
Winter 1998/99: Buying of equipment.
Spring 1999: Installation of measuring devices; instruction in devices and methods; beginning of all measurements and investigations in the field; beginning of inquiries.
Summer 1999: Irrigation of research plots by flooding; continuation of measurements and investigations in irrigated and in non-irrigated plots.
Autumn 1999: End of the first measuring period in the field, except for recording of climatological variables.
Winter 1999/00: Evaluation of the results from the first measuring period; continuation of laboratory work.
Spring 2000: Meeting of all groups (institutes 1-5) at the Cele research station; continuation of measurements and investigations in the field, of socio-economic inquiries, and of vegetation mapping.
Autumn 2000: End of the field work, except for recordings of climatological variables; meeting of the groups which cooperate in vegetation mapping.
Winter 2000/01: Evaluation of the results.
Spring 2001: Meeting of all groups in Göttingen; presentation and discussion of the results and preparation for a synthesis.
Until Autumn 2001: Continuation of the data evaluation and joint development of a management concept that is based on the results; preparation of publications.

Project Coordinator: Prof. Dr. M. Runge, Albrecht-von-Haller-Institut, Abteilung Ökologie und Ökosystem-forschung, Untere Karspüle 2, 37073 Göttingen.

L.L. Stogova*, S. Robinson**, S.A. Govorukhina*
* Almaty, Kazakstan, **Warwick, UK

Peculiarities of Vegetation Dynamics at the Betpak-Dala Desert against the Background of Weather and Social-Economic Conditions

Social-economic changes in Kazakstan in post-soviet period resulted in irreversible processes in livestock sector.

Geobotanical studies conducted at the Betpak-Dala desert in 1998 along with analysis of literature and cartographic materials of the past allowed to trace vegetation dynamics of the pastures and to assess their modern state.

Vegetation cover of the study area is homogenous and thinned. The bulk of the pasture fodder is produced by coenopopulations of *Salsola arbusculiformis* and genus *Artemisia*. Vegetation of this region grows well at the years with high winter and spring precipitations. At present there are almost no any livestock at the study area. Among wild ungulates there are small groups (5-9 animals) of saiga antelope.

Excessive grazing in the past significantly affected the structure and productivity of the Betpak-Dala pastures. As a result of grazing large areas at the study region (especially areas under livestock migration routes and around winter barns) are covered by ephemerous-ruderal aggregations which replaced primary zonal phytocoenoses. At present vegetation is characterized by the tendency of gradual restoration as demonstrated by current vegetation successions proceeding as demutation.

Productivity of semishrub and dwarf semishrub communities is extremely unstable both in time (climatic conditions of different years) and in space (location at different habitats). In addition anthropogenic factor is of great importance (grazing and others). By the way of illustration let us consider productivity of the phytocenose dominated by *Salsola arbusculiformis*: average productivity of complete plant communities - 2.1-3.6 quintals per hectare. Average productivity of incomplete plant communities (1998) located at the depressions - 1.3-1.8 quintals per hectare. Average productivity of complete plant communities (1998) located at the depressions - 4.0-5.0 quintals per hectare.

Large amount of communities with partially (by different extent) died off population of *Salsola arbusculiformis* has been observed in 1998. Their productivity was 0.5-1.0 quintals per hectare. Most probable reason of population destruction was the drought of several previous years.

Thus natural and anthropogenic changes occur simultaneously and have much in common. However both among many interacting factors and among types of dynamics there might be main trends which determine priorities.

K.N. Toderich, A. Wojnicka-Poltorak, W. Prus-Glowacki, E. Chudzinska, E.V. Shuiskay, Samarkand, Uzbekistan; Poznan, Poland

Cytoembryological and genetic variation of introduced and wildspread perennial populations of *Kochia prostrata* (L.) Schrad in desert conditions of Uzbekistan

Kochia prostrata is an euxerophyte, perennial polymorphic semishrub (30-105cm) of Chenopodiaceae, a very promising crop for creation of cattle/sheep pastures and improvement of degraded desert and semidesert lands in Uzbekistan. This species grows in mixed shrub-subshrub and grasslands communities on grey-brown, clay, rarely sandy soils or calcareous skeletal salted slopes and on salt-marshes margins. Its native wildspread populations are often small and isolated. In recent years *Kochia prostrata* shows progressive reduction in size, perhaps, in connection with worsening of environmental state of Kyzylkum Desert. The aim of the study is to investigate the impact of reproduction and genetic variation on the persistence and conservation of various ecoforms of *Kochia* species in drylands of Uzbekistan. Cytoembryological studies of reproductive structures, cytological and genetic diversity were carried out on various populations of two varieties (*griseae* and *virescens*) of *Kochia prostrata*. Bisexual flower is always protogynous, but functional male and female types within individuals of some populations are also observed. Sexual polymorphism is a result of developmental blocks in male or female reproductive organ formation within young bipotential flower buds. The number of viable seeds increases from autogamy and geitenogamy to xenogamy. Some populations show irrregular meiosis with very low pollen fertility, high ovary predation and lower seed-set values. Asiatic introduced and wildspread populations of *Kochia* species differ significantly in values of meiotic index, fertility of pollen, sizes and sculpture of pollen grains. Coefficients of variation and intraclass - correlations were high for characters related to seed productivity and lower for biomass production. A great variability has also been noted in the number of chromosomes within studied populations. The predominant number of chromosomes is 2n=18. The populations of clay and stone ecotype var. *virescens* have both 2n=18 and 2n=36,54,72 sets of chromosomes. The diploid forms, especially *Kochia prostrata var. griseae*, which manifest a low level of phenotypic variability, have a higher stability than tetraploids and a restricted range of distribution. Apparently during evolution they have become mainly adapted to extreme sand desert condition. However, the populations from clay and stone ecotypes with a wide distribution (from plains to foothills and uphill places) are easily polyploid. The appearance of aneuploid and mixoploid plants in some semidesert populations of *Kochia* species may be conditioned by the habitats into which this taxon has been introduced recently and "naturalized". Analyses of chromosome number, haploid chromosome length and karyotype symmetry suggest that the major chromosome mechanism acting in karyotype evolution of *Kochia prostrata* L. is polyploidy, but differences in chromosome morphology may be caused by chromosome rearrangements. Genetic variation in desert *Kochia* species was at the first assessed using starch gel electrophoresis of 8 enzymes systems: DIA, GOT, (AAT), 6PGD, GDH, PGI, PGM. The studied izoenzymatic loci were polymorphic with an exeption of malate dehydrogenase MDH and diaphorase (DIA). Previous results show a significant differentiation of genetic structure within introduced and wildspread perennial clay ecotype populations of *Kochia* species, especially in respect to alleles and genotypes frequencies, observed heterozygosity, genotypic polymorphism index and F coefficient. However the study of genetic structure have yet to be completed.

Thus, the variability both in the reproductive sphere, genome and genetic structure of *Kochia prostrata* (L.) Schrad may be ascribed to different strategies of adaptation of arid plants to extreme environmental condition of a desert.

This study has been financial supported by Polish Mianowskii's Kasa Foundation.

M. Veste[1], S.-W. Breckle[1], T. Littmann[2], J. Kalek[2], A. Yair[3]
[1] Bielefeld, Germany, [2] Halle, Germany, [3] Jerusalem, Israel

The ecology of biological soil crusts on desert sand dunes of the northern Negev (Israel)

Biological soil crusts are important communities in various arid and semi-arid ecosystems. The 'biological crusts' (also called microbiotic, microphytic or cryptogamic crusts) are build up from cyanobacteria, green algae, mosses, fungi and soil lichens as well as several bacteria. Most of the sand dunes on the Israeli side of the large Sinai-Negev sand fields are covered by these biological crusts.

Cyanobacteria colonize the topsoil after a physical loess rain-crust stabilized the sand. Filaments of cyanobacteria and the rhizines and protonema of mosses and the hyphae of soil lichens stick together the upper soil surface. The polysaccharides of the cyanobacteria change the pore structures and physical properties of the soil surface. Due to the hydrophobic conditions of the soil crust, the infiltration is limited and run-off could be observed even in a sandy area when covered with a biological crust. Besides the influence on the hydrological conditions, the biological crust stabilizes the topsoil, reduces soil erosion and influences the establishment of vascular plants. Free-living nitrogen-fixing cyanobacteria (e.g. *Nostoc* spec.) and cyanophilous lichens (e.g. *Collema* spec.) enhance the nitrogen pools under the biological crusts. Composition, distribution, run-off, and photosynthetic activity were investigated along a geo-ecological gradient in the northern Negev desert.

Along the sharp climatical gradient from the northern to the southern margin of the Negev sand fields different types of biological soil crusts can be found. Differences in the microclimate and dewfall can explain the various development of the crusts types on the sand dunes.

D. Vetterlein[1], C. Bergmann[2]
[1] Halle, Germany, [2] Cottbus, Germany

Plant induced spatial variation of soil osmotic potential. Implications for water uptake and plant growth.

Mass flow may result in the accumulation of salts in the rhizosphere. As a consequence gradients of osmotic potential between bulk soil and rhizosphere might be expected. Although such gradients have been predicted theoretically they have not been measured due to technical difficulties.
However a quantification of the extent of such gradients in relation to environmental factors may contribute substantially to the understanding of plant water relations under stress conditions.
In a first experiment such gradients were investigated in a salt rich carboniferous mine spoil, in which the high salt content was a result of secondary processes following pyrite oxidation, and a salt poor non-carboniferous mine spoil. The objective of this study was (i) to measure salt content in relation to spoil pH, (ii) to establish the relationship between the osmotic potential of the spoil solution and its electrical conductivity, (iii) to measure the impact of the plant on the distribution of salts in the spoil and spoil solution, respectively and (iv) to identify the salts responsible for the expected accumulation in the rhizosphere.
It was shown in a pot experiment with *Secale multicaule* that plants caused gradients in spoil salt content and thus spoil osmotic potential and that this gradients were related to plant dry matter production. The gradients were measured in the salt poor spoil, where the salt fraction was dominated by Ca and Cl, as well as in the salt rich spoil where salt fraction was dominated by SO_4, Mg and Ca.
In the salt rich spoil the gradient of spoil osmotic potential increased not to the same extent as the gradient in salt content due to precipitation of gypsum at the root surface. In the rhizosphere spoil solution increased levels of Mg- Cl- and Mn-concentrations were recorded.
From the strong interaction between spoil solution pH and the salt concentrations in the spoil solution observed for the salt rich carboniferous mine spoil it became obvious, that gradients in spoil salt content caused by the activity of growing plants can only be detected if other factors are taken into account. Increasing the pH from 2.4 to 5.9 by the addition of lime resulted in a decrease of the value of spoil solution osmotic potential from 748 kPa to 132 kPa.
The observed relationship of pH and salt content is of special relevance for the comparison of NH_4 and NO_3 fed plants. In the present study NH_4 nutrition resulted in a pH decrease in the rhizosphere as would be expected, however, the value of osmotic potential in the rhizosphere did not increase as compared to the plants fed with NO_3. This lack of response to decreasing pH is most likely related to the smaller shoot size of NH_4 fed plants and thus lower water requirement resulting in a lower rate of mass flow compared to the NO_3 fed plants.
In the present study osmotic potential of spoil solution was always measured at field capacity (-6.3 kPa for sandy soils; pF 1.8) or at water contents above field capacity (-3.5 kPa). Even in the salt poor spoil the value of osmotic potential was tenfold the value for matric potential at field capacity. Plants induced within only 29 days an increase of the value of osmotic potential by a factor of two to four for salt poor and salt-rich spoil, respectively. From these data a strong impact of gradients of soil osmotic potential on plant water uptake can be expected. This will be the subject of further investigations.

W. Wucherer*, A. Aleschkovskii, S.-W. Breckle***
*** Bielefeld, Germany, ** Almaty, Kazakhstan**

Colonization by plants of the dry seafloor of the Small Aral Sea

The sea level of the Small Aral Sea in August 1998 was about 41,6 m a.s.l. In the last few years the level has increased by about 3,5 m. There are two reasons for this new development. The one is the decrease of the area of irrigated paddy fields by almost 40% in the larger Kzylorda-area. The other reason is the construction of a dam between the former islands Kokaral and Kosaral close to the former eastern coastline. The Syrdarya-water is feeding now only the relatively small part of the whole Aral basin, the Small Aral Sea. The hydrological equilibrium of the Small Aral Sea is by these reasons positive and the dam already is almost too low, the level of the Small Aral Sea has to be kept constant by about 42-43 m a.s.l.
This new hydrological situation, opposite to the Great Aral Sea, has influened the colonization of the dry seafloor of the Small Aral Sea in two ways. The therophytic vegetation with *Salicornia europaea, Suaeda salsa* and *Suaeda acuminata* was inundated and is almost lacking now on most parts of the present coastline because of the raid rise of the water level. On some coastal parts also perennial and woody vegetation was inundated. First observations show that the resistance of the various species against inundation differs greatly. On the remnant dry seafloor there are favourable conditions for a second flush of therophytes (with several *Climacoptera-, Salsola-* and *Petrosimonia*-species) as well as for some woody species from the Tugai-vegegation (*Tamarix hispida, T. elongata, Limonium otolepis, L. gmelinii, Aeluropus littoralis*). The overlapping of the ecological amplitudes of several species seem to have become wider. This may result in future in more stochastic processes during formation of vegegation units and a higher interspecific competition.

List of Participants and Authors

Name	Adress	Contribution
Dinara Abieva	Institute of Geography of MS-AS RK, 99, Pushkin Str.,480100 Almaty, Kazakhstan Email: ingeo@usa.net	43
Okmir Agachanjanz	Gamarnikstr. 9-1-31, GUS 220090 Minsk, Weißrußland / Belarus	9
Roland Albert	Institute of Plant Physiology, University of Vienna, A- 1090 Vienna, Austria	45
Anton Aleschkovskii	Institute of Botany and Phytointroduction MS-AS, 44, Timiryasev Str., 480090 Almaty, Kazakhstan	71
V. Alexeev	MSU, Moscow, Russia	14
Christiane Arnft	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany	
W.B. Aparin	Department of Desert Research, Samarkand Divsion of Uzbek´s Academy of Sciences, 703000 Samarkand - Uzbekistan	36
Stefan K. Arndt	Institute of Plant Physiology, University of Vienna, A- 1090 Vienna, Austria Email: sarndt@pflaphy.pph.univie.ac.at	44, 45
A.G. Babaev	National Institute of Deserts, Flora and Fauna of Turkmenistan 15, Bitarap Turkmenistan 744000, Ashgabat, Turkmenistan Email: babaev@desert.ashgabad.su	10
Amos Banin	Seagram Center for Soil,Hebrew University, Faculty of Agricultural, Food and Environmental Quality Sciences The Hebrew University of Jerusalem, Rehovot 76100, Israel	33
Sun Baoping	College of soil water conservation, Bejing Forestry University, 100083 Bejing, China Email: zhtning@beilin.bjfu.edu.cn	46
Gulnora Begbaeva	Botanical Institute and Botanical Garden, 32, F. Khodzhaev Str. 700143 Tashkent, Uzbekistan Email: post@botany.org.uz	49
Charlotte Bergmann	BTU, Cottbus, LS Bodenschutz und Rekultivierung, Postfach 10 13 44, 03013 Cottbus, Germany	70
Wolfram Beyschlag	Universität Bielefeld, Fakultät für Biologie Exp. Ökologie und Ökosystembiologie, Universitätsstr. 25, 33615 Bielefeld, Germany Email: w.beyschlag@biologie.uni-bielefeld.de	39
L. Bir	Agricultural Research Organization (ARO), Volcani Center Institute of Plant Protection, Bet Dagan 50250, Israel	60
Gulbarshyn K. Bizhanova	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan Email: envirc@online.ru	46
N.I. Bobrovskaja	Komarov Botanical Institute of Russian Academy of Sciences Prof. Popova Str. 2, St.-Petersburg 197376, Russia	47
Siegmar-W. Breckle	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: sbreckle@biologie.uni-bielefeld.de	11, 48, 69, 71
Gary Brown	University of Rostock, Department of Botany, Wismarsche Str. 8, 18057 Rostock, Germany Email: gary.brown@biologie.uni-rostock.de	
Taisiya I. Budnikova	Institute of Geography of MS-AS RK, 99, Pushkin Str.,480100 Almaty, Kazakhstan	50
A.A. Butnik	Botanical Institute and Botanical Garden, 32, F. Khodzhaev Str. 700143 Tashkent, Uzbekistan Email: post@botany.org.uz	49
Sean C. Clifford	Horticulture Research International, Efford, UK	45
O. Correia	Departamento de Biologia Vegetal, Faculdade Ciencias Campo Grande, C2, 4 Piso, 1700 Lisboa, Portugal	39
Helmut Dalitz	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: helmut.dalitz@biologie.uni-bielefeld.de	

Name	Adress	Contribution
Liliya A. Dimeyeva	Institute of Botany and Phytointroduction MS-AS, 44, Timiryasev Str., 480090 Almaty, Kazakhstan Email: envirc@online.ru	12, 50
M. Dourikov	Ministry of Nature of Turkmenistan, National Institute of Deserts, Flora and Fauna 15, Bitarap Turkmenistan St., Ashkabad, Turkmenistan 744000 Email: crsp@icctm.org	21
Kerstin Eggert	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: kerstin.eggert@biologie.uni-bielefeld.de	
N.P. Elansky	IAP, Moscow, Russia	14
L. Feigelson	Agricultural Research Organization (ARO), Volcani Center Institute of Plant Protection, Bet Dagan 50250, Israel	60
Peter Felix-Hennigsen	Institut für Bodenkunde und Bodenerhaltung, Wiesenstr. 3-5, 35390 Giessen, Germany Email: peter.felix-h@agrar.uni-giessen.de	13
Klaus Fischer	Dresden University of Technology, Institute of Plant and Wood Chemistry, Pienner Str. 23, 01737 Tharandt, Germany Email: ipc-zell@forst.tu-dresden.de	51
Helmut Freitag	University of Kassel, Biology, Morphology and Systematics of Plants, Heinrich-Plett-Str. 40, 34132 Kassel, Germany Email: hfreitag@hrz.uni-kassel.de	
E.B. Gabunshina	Kalmykian Arid Center, Elista	14
Boris V. Geldyeva	Centre for Remoute Sensing and Geogrpahic Information, Almaty, Kazakhstan Email: geldyyev@hotmail.com	52
Galina V. Geldyeva	Institute of Geography MS-AS RK, 26, Ablai Khan Str., flat 55, 480003 Almaty, Kazakhstan Email: envirc@online.ru	53
Ernst Giese	Institute of Geography, University of Giessen, Senckenbergstr. 1, 35390 Giessen, Germany Email: ernst.giese@geo.uni-giessen.de	
Maarten van Ginkel	International Maize and Wheat Improvement Center (CIMMYT) Ado. Postal 6-641, 06600 Mexico, D.F. Mexico	58
M. Glantz	Environmental and Societal Impacts Group, National Center for Atmospheric Research Box 3000, Boulder CO USA 80307 Email: glantz@ucar.edu	29
Cornelia Gläßer	Martin-Luther-University Halle, Institute of Geography, Domstr. 5, 06108 Halle, Germany Email: glaesser@geographie.uni-halle.de	21, 55
R.I. Goldshtein	Department of Desert Research, Samarkand Divsion of Uzbek´s Academy of Sciences, 703000 Samarkand - Uzbekistan	36
G.S. Golitsyn	IAP, Moscow, Russia	14
Hagen Gottschling	University of Greifswald, Botanical Institute, Grimmer Str. 88, 17487 Greifswald, Germany Email: gottsch@mail.uni-greifswald.de	
Svetlana A. Govoruhkina	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan	67
I. Granberg	IAP, Moscow, Russia	14
Jürgen Groeneveld	UFZ – Centre for Environmental Research, Department of Ecological Modelling, P.O. Box 2, 04301 Leipzig, Germany	
Gerd K. Hartmann	Max-Planck-Institut für Aeronomie, Max-Planckstr. 2, 37191 Katlenburg-Lindau, Germany Email: ghartmann@linmpi.mpg.de	14
Michaela Haverkamp	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: michaela.haverkamp@biologie.uni-bielefeld.de	

Name	Adress	Contribution
Oriel Herrera Bonilla	Empresa Pernambucana de Pesquisa Agropecuaria – IPA Av. Gal. San Martin, 1371 Bonji – Recife, Pernambuco 50761-000, Brazil Email: oriel@ipa.br	15
Joachim Hill	University of Trier, Remote Sensing Department, Faculty of Geography, Behringstr., 54286 Trier, Germany Email: hill@fews05.uni-trier.de	16
Marat S. Ishankulov	National Environmetal Centre for Sustainable Development 81 K. Marks Str., 475000 Kokshetau, Kazakhstan Email: mishankulov@koksh.kz	17
Ulbosyn N. Japakova	Botanical Institute and Botanical Garden, 32, F. Khodzhaev Str. 700143 Tashkent, Uzbekistan Email: post@botany.org.uz	49
Florian Jeltsch	UFZ – Centre for Environmental Research, Department of Ecological Modelling, P.O. Box 2, 04301 Leipzig, Germany Email: flori@oesa.ufz.de	18
Gottfried Jetschke	Institute of Ecology, University of Jena, Dornburger Str. 159, 07743 Jena, Germany Email: gottfried.jetschke@rz.uni-jena.de	61
Norbert Jürgens	Institute of Botany, University of Köln, Gyrhofstr. 15, 50391 Köln, Germany Email: njuerg@biolan.uni-koeln.de	19
Jörg Kalek	Martin-Luther-University Halle-Wittenberg Institute of Geography, Mansfelder Str. 1, 06108 Halle, Germany	69
Martin Kappas	Department of Physic. Geography, University of Mannheim, 68131 Mannheim, Germany Email: kappas@rumms.uni-mannheim.de	54
Lyuba Kapustina	Institute of Botany, 32 Khodzaev Str., Tashkent, Uzbekistan Email: kapl@map.silk.org	54
Kuralay Karibayeva	National Environmental Center for Sust. Dev. RK, 85, Dostyk Av., 480100 Almaty, Kazakhstan Email: biodiv@kaznet.kz; kkaribayeva@neapsd.kz	20
Arnon Karnieli	J. Blaustein Institute for Desert Research, Ben-Gurion University of the Negev Sede-Boker Campus, 84990, Israel Email: karnieli@bgumail.bgu.ac.il	21, 55
Joachim Katzur	Research Institute of Landscape Management, Brauhausweg 2, 03238 Finsterwalde, Germany	51
T.I. Kazantseva	Komarov Botanical Institute of Russian Academy of Sciences Prof. Popova Str. 2, St.-Petersburg 197376, Russia Email: arid@tn4128.spb.edu	56
Dietmar Keyser	Zoologisches Institut und Museum, Martin-Luther-King-Platz 3, 20146 Hamburg, Germany Email: keyser@zoologie.uni-hamburg.de	22
Beatrice Knerr	University of Kassel, Fac. 11, Steinstr. 19, 37213 Witzenhausen, Germany Email: knerr@wiz.uni-kassel.de	23
J.U. Kügler	Eng. Bureau Kügler, Essen, Germany	14
Joachim Kutscher	Project Management Biology, Energy and Ecology for the Federal Ministry for Education and Research National Research Center Jülich, 52425 Jülich, Germany	
Thomas Littmann	Martin-Luther-University Halle-Wittenberg, Institute of Geography, Mansfelder Str. 1, 06108 Halle, Germany Email: littmann@geographie.uni-halle.de	69
Kurt Loris	University of Hohenheim, Institute of Botany, Garbenstr. 30, 70593 Stuttgart, Germany Email: loris@uni-hohenheim.de	
G. Lyubatinskaya	Vodnik Scientific Production Firm, Mira, 24, Almaty 483335 Talgar reg. Kainar, Baiserke, Kasakhstan	57
C. Maguas	Departamento de Biologia Vegetal, Faculdade Ciencias Campo Grande, C2, 4 Piso, 1700 Lisboa, Portugal	39

Name	Adress	Contribution
Günther Manske	Center for Development Research (ZEF), University of Bonn, Walter-Flex-Str. 3, 53113 Bonn, Germany Email: gmanske@uni-bonn.de	58
Christopher Martius	Center for Development Research (ZEF), University of Bonn, Walter-Flex-Str. 3, 53113 Bonn, Germany Email: c.martius@uni-bonn.de	
Galiolla T. Meirman	Priaral Research Institute of Agroecology MS-AS RK 25b, Abai Str., 460007 Kyzylorda, Kazakhstan Email: envirc@online.ru	24
Martina Meyers	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: martina.meyers1@biologie.uni-bielefeld.de	
Sue Milton	Nature Conservation Department, University of Stellenbosch, Private Bag X01 Matieland 7602, South Africa Email: lycium@mweb.co.za	25
Raouf A. Moustafa	Botany Department, Faculty of Science, Suez Canal University, Ismailia, Egypt	26
Vefa Moustafaev	UNESCO Science Sector, 1 rue Miollois 75015, Paris, France Email: v.moustafaev@unesco.org	
C. Muradov	National Institute of Deserts, Flora and Fauna of Turkmenistan 15, Bitarap Turkmenistan 744000, Ashgabat, Turkmenistan Email: babaev@desert.ashgabad.su	59
K.A. Muszkat	Weizmann Institute of Science, Rehovot 76100, Israel	60
Lea Muszkat	Agricultural Research Organization (ARO), Volcani Center Institute of Plant Protection, Bet Dagan 50250, Israel Email: vplmskat@volcani.agri.gov.il	60
Karin Nadrowski	Institute of Ecology, University of Jena, Dornburger Str. 159, 07743 Jena, Germany Email: b5kana@uni-jena.de; bgj@uni-jena.de	61
Mamdouh Nasr	Center for Development Research (ZEF), University of Bonn, Walter-Flex-Str. 3, 53113 Bonn, Germany Email: mnasr@uni-bonn.de	
Nina M. Novikova	Institute of Water Problems, Russian Academy of Sciences 3, Gubkina Str., 117971 Moskow, Russia Email: novikova@novikova.msk.ru	27
Natalya P. Ogar	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan Email: envirc@online.ru	28, 50, 52
Leah Orlovsky	J. Blaustein Institute for Desert Research Ben-Gurion University of the Negev, Sede-Boker Campus, 84990, Israel Email: orlovsky@bgumail.bgu.ac.il	21, 55
Nicolai Orlovsky	J. Blaustein Institute for Desert Research Ben-Gurion University of the Negev, Sede-Boker Campus, 84990, Israel Email: nicolai@bgumail.bgu.ac.il	29
Valeria N. Permitina	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan	62
G. Pfister	IMG/UoG, Graz, Austria	14
Lev Poberezsky	„Vodproject", Victor Malaysov Str. 3, Tashkent, Uzbekistan	33
Andreas Pölking	Fa. Agroplan, Büro für Umwelt- und Agrarplanung, Hildesheimer Str. 103A, 38159 Vechelde, Germany Email: agroplan.poelking@t-online.de	30
Marianne Popp	Institute of Plant Physiology, University of Vienna, A- 1090 Vienna, Austria	44, 45
E. Putz	IMG/UoG, Graz, Austria	14
Ekaterina I. Rachkovskaya	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan	63, 64

Name	Adress	Contribution
G.S. Rashidova	Department of Desert Research, Samarkand Divsion of Uzbek´s Academy of Sciences, 703000 Samarkand – Uzbekistan	36
Alexsei Rau	Kazakh Research Institute of Water Management 1A, Gornay Str., 480051 Almaty, Kazakhstan	65
Rustam M. Razakov	Center of „Ecology of Water Management" 13A, Usman Nosir Str., 700100 Tashkent- Uzbekistan	31
Mathew Reynolds	International Maize and Wheat Improvement Center (CIMMYT) Ado. Postal 6-641, 06600 Mexico, D.F. Mexico	58
Sarah Robinson	Warwick University, UK	67
Everaldo Rocha Porto	Empresa Brasileira de Pesquisa Agropecuaria EMBRAPA, CPATSA, BR 428, Caixa Postal 23, CEP: 56.300-000, Petrolina, PE, Brazil Email: erporto@cpatsa.embrapa.br	15
Bodo Rummel	Institut für Bodenkunde und Bodenerhaltung, Wiesenstr. 3-5, 35390 Giessen, Germany Email: peter.felix-h@arar.uni-giessen.de	13
Michael Runge	Albrecht von Haller-Institut, Universität Göttingen, Untere Karspüle 2, 37073 Göttingen, Germany Email: mrunge@gwdg.de	66
Ravil E. Sadvokasov	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan	64
Martina Sass	Planungsgruppe Ökologie & Umwelt, Kronenstr. 14, 30161 Hannover, Germany E-mail: pouhan@hannover.sgh-net.de	30
Anja Scheffer	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: anja.scheffer@biologie.uni-bielefeld.de	48
Rainer Schiene	Dresden University of Technology, Institute of Plant and Wood Chemistry, Pienner Str. 23, 01737 Tharandt, Germany	51
Othman Sharkas	Birzeit University, Geography Department, Birzeit 14, Palestinian Authority Email: osharkas@arts.birzeit.edu	32
Arieh Singer	Seagram Center for Soil, Hebrew University, Faculty of Agricultural, Food and Environmental Quality Sciences The Hebrew University of Jerusalem, Rehovot 76100, Israel Email: singer@agri.huji.ac.il	33
Sergey Sokolov	Institute of Geography MS-AS RK, 99, Pushkin Str., 480100 Almaty, Kazakhstan Email: ingeo@usa.net	34
Irina Springuel	UESD in Aswan, South Valley University, 81528 Aswan, Egypt Email: irina44@yahoo.com	35
A. Steiner	IMG/UoG, Graz, Austria	14
T. Stephan	UFZ – Centre for Environmental Research, Department of Ecological Modelling, P.O. Box 2, 04301 Leipzig, Germany	18
Larisa L. Stogova	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan	67
Nigatu Tadesse	Plant Science Department, South Dakota State University, Brookings, SD 57007 USA	58
Sayat S. Temirbekov	Institute of Botany and Phytointroduction MS-AS 44, Timiryasev Str., 480090 Almaty, Kazakhstan	64
Fang Tianzong	College of soil water conservation, Bejing Forestry University, 100083 Bejing, China	46
Christina Toderich	Department of Desert Research, Samarkand Divsion of Uzbek´s Academy of Sciences, 703000 Samarkand - Uzbekistan Email: info@rating.samuni.silk.org	36, 68
Sergey E. Treshkin	Institute of Bioecology, 41 Berdacha Prospect, 742000 Nukus- Uzbekistan Email: sergei@bioeco.nukus.silk.org	37

Name	Adress	Contribution
Maik Veste	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: maik.veste@biologie.uni-bielefeld.de	69
Doris Vetterlein	BTU, Cottbus, LS Bodenschutz und Rekultivierung, Postfach 10 13 44, 03013 Cottbus, Germany Email: vetter@tu-cottbus.de	70
Paul L..G. Vlek	Center for Development Research (ZEF), University of Bonn Walter-Flex-Str. 3, 53113 Bonn, Germany Email: p.vlek@uni-bonn.de	58
Yoav Waisel	Department of Plant Sciences, Tel Aviv University, 69978 Tel Aviv, Israel Email: waisel@post.tau.ac.il	38
G.E. Weber	UFZ – Centre for Environmental Research, Department of Ecological Modelling, P.O. Box 2, 04301 Leipzig, Germany	18
K.H. Weiler	Fho-Emden, Germany	14
L. Weissflog	UFZ Leipzig, Germany	14
Christiane Werner	Universität Bielefeld, Fakultät für Biologie Exp. Ökologie und Ökosystembiologie, Universitätsstr. 25, 33615 Bielefeld, Germany Email: christiane.werner@biologie.uni-bielefeld.de	39
Christian Wissel	UFZ-Umweltforschungszentrum Leipzig-Halle GmbH, Permoserstr. 15, 04318 Leipzig, Germany Email: wissel@oesa.ufz.de	
Walter Wucherer	University of Bielefeld, Faculty of Biology, Department of Ecology, P.O. Box 100131, 33501 Bielefeld, Germany Email: walter.wucherer@biologie.uni-bielefeld.de	40, 48, 71
Aaron Yair	Institute for Physical Geography, The Hebrew University -Mount Scopus, Jerusalem, Israel Email: aaron@vms.huji.ac.il	41, 69
Henian Zhang	Xinjang Institute of Ecology and Geography Academy of Sciences, No. 40-3 Beijing South Road, Urumqi Xinjiang, 830011, China	42
Xiaoming Zhang	Xinjang Institute of Ecology and Geography Academy of Sciences, No. 40-3 Beijing South Road, Urumqi Xinjiang, 830011, China	42
Ximing Zhang	Xinjang Institute of Ecology and Geography Academy of Sciences, No. 40-3 Beijing South Road, Urumqi Xinjiang, 830011, China Email: lixm@public.wl.xj.cn	42
Nadja Zier	Dresden University of Technology, Institute of Plant and Wood Chemistry, Pienner Str. 23, 01737 Tharandt, Germany	51

In der Reihe "Bielefelder Ökologische Beiträge" (BÖB) sind bisher die folgenden Bände erschienen. Sie können bezogen werden über:

Universität Bielefeld
Fakultät für Biologie
Abteilung Ökologie
Postfach 100131
D-33501 Bielefeld
Fax: +49-521-106-2963
e-mail: sbreckle@biologie.uni-bielefeld.de

Band 1 (1985): Beiträge des Symposiums "Schwermetalle und Saure Depositionen" (hrsg. S.-W.Breckle & H. Kahle) - 12 Beiträge, insg. 191p.

Band 2 (1986): Beiträge der Abteilung Ökologie zur Dendroökologie (hrsg. S.-W.Breckle & J. Hagemeyer) - 5 Beiträge, insg. 119p.

Band 3 (1988): Beiträge der Abteilung Ökologie zur Ökologie der Halophyten (hrsg. S.-W. Breckle & I. Wattenberg) - 7 Beiträge, insg. 111p.

Band 4 (1989): Beiträge aus dem Symposium "Ecology and Evolution of the Mediterranean Vegetation and Flora" (hrsg. S.-W. Breckle) - 4 Beiträge, insg. 65p.

Band 5 (1989): Beiträge des Symposiums "Komplexschäden an Buchen - Ursachenforschung zum Baumsterben" (hrsg. S.-W.Breckle & H. Kahle) - 19 Beiträge, insg. 238p.

Band 6 (1992): Beiträge aus dem workshop "Stress - auf allen Ebenen / from the molecular to the ecosystems level" im Rahmen der Deutsch-Israelischen Universitätspartnerschaft, Tel Aviv/Bielefeld, im ZiF in Bielefeld, Juli 1992 (hrsg. S.-W. Breckle) - 17 Beiträge, insg. 118p.

Band 7 (1994): Beiträge der Abteilung Ökologie zur Populationsökologie (hrsg. S.-W.Breckle & A. Stockey) - 1 Beitrag: Dissertation Andreas Stockey: Etablierung, Sukzession und Diversität von Bachufervegetation - Eine Untersuchung zur Bedeutung von Samenpotential (Aussaaten) und abiotischen Standortfaktoren, insg. 249p.

Band 8 (1995): Beiträge aus dem workshop "structure and function on all levels - from the molecular to the ecosystems level" im Rahmen der Deutsch-Israelischen Universitätspartnerschaft Tel Aviv/Bielefeld, am Department of Botany der George Wise Life Science Faculty in Tel Aviv, April 1994 (hrsg. S.-W. Breckle & Y.Waisel) -13 Beiträge, insg. 111p.

Band 9 (1995): Contributions from the International Workshop "Sustainable Land-use in the Near East" in Bielefeld (eds. S.-W.Breckle & M. Veste) - 8 abstracts + 6 Beiträge, insg. 77p.

Bd.10 (1997): Beiträge der Abteilung Ökologie zur tropenökologischen Forschung in Costa Rica (rsg. S.-W.Breckle & I. Wattenberg) - 1 Beitrag: Dissertation Ingrid Wattenberg: Struktur, Diversität und Verjüngungsdynamik eines prämontanen Regenwaldes in der Cordillera de Tilarán in Cotsa Rica unter besonderer Berücksichtigung der Rolle der Gaps für die Aufrechterhaltung der Baumartendiversität, insg. 195p.

Bd.11 (1997): Beiträge zur tropenökologischen Forschung in Costa Rica (hrsg. I.Wattenberg & S.-W.Breckle) - 9 Beiträge, insg. 99p.

Bd.12 (1998): Kurzbeiträge zur Tropenökologie. DFG-Abschlußsymposium "Nechanismen der Aufrechterhaltung der tropischen Diversität" (18.-19.02.1998) und 11. Jahrestagung der Deutschen Gesellschaft für Tropenökologie (20.02.-22.02.1998) in Bielefeld (hrsg. H.Dalitz, M.Haverkamp, J.Homeier & S.-W.Breckle) - 149 abstracts, insg. 195p.

Bd.13 (1998): Beiträge zur tropenökologischen Forschung in der Dominikanischen Republik (hrsg. S.-W.Breckle & G.Groß) - 2 Beiträge, insg. 226p.

Bd.14 (1999): Ökophysiologie pflanzlicher Interaktionen. Ergebnisse der 3. Jahrestagung des Arbeitskreises „Experimentelle Ökologie der Pflanzen" in der GfÖ (Bielefeld, 8.-9. Mai 1999) (hrsg. W. Beyschlag & T. Steinlein), insg. 306p.

Weitere Bände sind in Vorbereitung. Sie erscheinen in lockerer Folge.
Additional volumes will be published.