Feddes Repertorium **112** (2001) 1–2, 107–125 Berlin, Juli 2001

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The order Aeluropodetalia littoralis in the flood plain of Atrek River (South West Turkmenia)

With one Map, one Figure and 11 Tables

Summary

Halophytic communities of the hemicryptophytes in the lower part of the Atrek river valley (South-Western Turkmenia) are described in the paper. The characteristic of nine new associations referred to new alliances is given. The new order Aeluropodetalia littoralis ord. nov. has been distinguished for the communities of halophytic hemicryptophytes in the Middle Asia.

Zusammenfassung

Die Ordnung Aeluropodetalia littoralis in den Überschwemmungsflächen im Tal des Flusses Atrek (Südwestturkmenien)

In der Arbeit werden die an Hemikryptophyten reichen Halophyten-Gesellschaften im unteren Abschnitt des Flusses Atrek (Südwestturkmenien) beschrieben. Die neuen Assoziationen werden in zwei neuen Verbänden zusammengefasst. Für die Gesellschaften der Halophyten-Hemikryptophyten in Mittelasien wird die neue Ordnung Aeluropodetalia littoralis ord. nov. vorgeschlagen.

Introduction

This work is dedicated to the study of the plant communities with dominant hemicryptophytes on the salinized habitats in the Atrek delta (South-West Turkmenia). Mainly, these are communities with dominant *Aeluropus littoralis* (Map 1).

Communities with dominant *Aeluropus littoralis* are typical of river valleys and different salinized depressions of Middle Asia. Geobotanists of the former USSR considered these communities to be a characteristic element of the landscape of Middle Asia and termed them "azhrek meadows" ("azhrek" is the local name of *Aeluropus littoralis* and *A. repens*) or "solonchak meadows" (KOROVIN 1934; PAVLOV 1948). It emphasises the characteristic peculiarities of these communities, i.e., their mesophytic meadow like character and at the same time high salinized soils, on which they occur (more often, they grow on solonchaks of chloride or chloride-sulphate salinity type).

However, only the dominant approach has been still used for the description of this element of Middle Asia landscape. The investigations of the hemicryptophyte communities in Middle Asia have not been carried out in the BRAUN-BLANQUET ecological-floristic approach. In our paper, these plant communities are characterised for the first time according to the principles of BRAUN-BLANQUET.

General characteristic of the region

The lower part of the Atrek river valley is a plain with residual islands. The major factors that influenced the plant composition are hot desert climate and high soil salinity, practically in all areas. In addition, regular flooding of the territory by the Atrek River has drastic effects during the flood time. As a result, vegetation has a complex structure in this region. The largest areas are occupied by solonchaks (NARDINA 1954) with hyperhalophytic vegeta-

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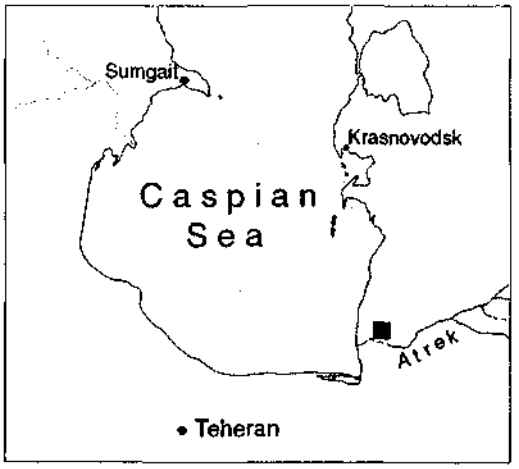

Map 1
■ — Area of investigation

tion of the classes Salicornietea fruticosae and Thero-Salicornietea (Fig. 1). Slopes and tops of the residual islands are covered with the ephemer-ephemeroid vegetation for which the highest syntaxa have not yet been established in the BRAUN-BLANQUET system. Meadow marsh, "meadow like" and shrubby vegetation of the cl. Phragmiti-Magnocaricetea, ord. Aeluropodetalia littoralis, and cl. Nerio-Tamaricetea has a mosaic character in this area, since it occurs in quite rare sites, here, on soil which is wet enough, but not too saline. Sometimes communities of the ord. Aeluropodetalia littoralis occupy fairly large areas.

Material and investigation methods

Methods of material collecting for vegetation classification and its processing corresponds to the ecological-floristic principles of BRAUN-BLANQUET. Due to the high seasonal dynamics, the vegetation observations were carried out on the plots twice: in May–June and September–October. In general, about 300 relévés were made. The size of the relévé plots varied from 25 to 100 m². The main part of the investigations was made in the region of lake Delili, a fresh water reservoir which had its origin in the flooding of the Atrek River. At present time the water level in the lake is artificially supported.

Besides the usually geobotanical characteristics, the soil samples were taken for their further analysis in the most typical and individual plots. The aqueous extracts were examined at a dilution of 1:5 (ARINUSHKINA 1970).

Names of plant species in this paper is given according CHEREPANOV (1995).

Review of the syntaxa

Order Aeluropodetalia littoralis ord. nov.

Table 1

Diagnostic taxa (**Dt**): *Aeluropus littoralis, Limonium meyeri, L. reniforme, Puccinellia gigantea, Juncus arabicus, Suaeda paradoxa, Polypogon monspeliensis, Lactuca serriola, Lolium rigidum, Bromus racemosus.*
Nomenclatural type (**Nt**): Suaedo paradoxae-Aeluropodion littoralis all. nov.

This order is represented by halophytic communities with dominant hemicryptophytes in the Atrek River valley on solonchaks and highly salinized soils of heavy texture content with chloride-sulphate and chloride-salinity type, expressed to regular flooding by the Atrek River waters. These are meadow like communities replacing the cl. Festuco-Puccinellietea in the study area.

Communities occur in relief depressions, on the ecotopes, with soil which is wet enough.

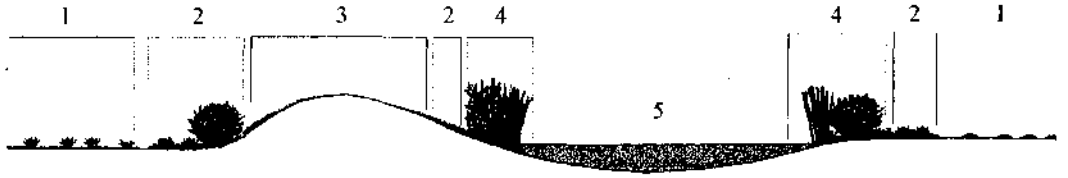

Fig. 1
Geobotanic profile in the region of lake Delili

1 — solonchak vegetation of the cl. Salicornietea fruticosae and Thero-Salicornietea; 2 — communities of the ord. Aeluropodetalia littoralis and cl. Nerio-Tamaricetea; 3 — ephemer-ephemeroid desert communities; 4 — communities of the cl. Nerio-Tamaricetea and cl. Phragmiti-Magnocaricetea; 5 — lake Delili

Soil moisture is the principle factor for communities of the order under desert climatic conditions. On the other hand, communities of this order are quite resistant to high soil salinity. The studied communities occur on soil with a salinity of 0.9–3.5%; the soil is a solonchak; the salinity types are chloride and the chloride-sulphate (EGOROV et al. 1977), and plants in the communities were in good condition (soil samples were taken in September–October).

List of communities of the order Aeluropodetalia littoralis described below

Class?
Order Aeluropodetalia littoralis ord. nov.
Alliance Suaedo paradoxae-Aeluropodion littoralis all. nov.
Suballiance Suaedo-Aeluropodienion suball. nov.
Ass. Polypogono-Aeluropodetum littoralis ass. nov.
Subass. P.-A. l. *typicum* subass. nov.
Subass. P.-A. l. inops subass. nov.
Ass. Lolio rigidi-Aeluropodetum littoralis ass. nov.
Ass. Halostachyo-Aeluropodetum littoralis ass. nov.
Subass. H.-A. l. juncetosum arabici subass. nov.
Subass. H.-A. l. frankenietosum subass. nov.
Suballiance Salicornio-Aeluropodienion littoralis suball. nov.
Ass. Junco arabici-Aeluropodetum littoralis ass. nov.
Subass. J. a.-A. l. *typicum* subass. nov.
Subass. J. a.-A. l. juncetosum maritimi subass. nov.
Ass. Suaedo acuminatae-Aeluropodetum littoralis ass. nov.
Var. S.-A. l. var. *typicum*
Var. S.-A. l. var. *Puccinella gigantea*
Alliance Cynodonto-Juncion gerardii all. nov.
Ass. Juncetum arabici ass. nov.
Ass. Limonio meyeri-Cynodontetum ass. nov.
Ass. Polypogono-Glycyrrhizetum ass. nov.
Ass. Parapholio-Glycyrrhizetum ass. nov.

Alliance Suaedo paradoxae-Aeluropodion littoralis all. nov.

Dt alliance = dt order.
Nt: Polypogono-Aeluropodetum littoralis ass. nov.

Halophytic communities of hemicryptophytes with dominant *Aeluropus littoralis*.

Communities of the alliance have their typically physiognomic form, that is a dense gray-green "carpet" of *A. littoralis*, sometimes too dense with a more or less occasional admixture of other species. The "carpets" high is not very tall (5–30 cm, seldom up to 40 cm). The sprouts of the *A. littoralis* are thickly interlaced, being dead or nearly dead in the lower layer. However, such cover density is only characteristic of the communities which have avoided grazing.

In some communities of the alliance, tall species (*Juncus arabicus, Halostachys belangeriana*) may also grow with greater abundance. Then communities have different layers and their physionomic form sharply changes. But the lower layer has been still formed by *A. littoralis*.

According to the data of NARDINA (1954), communities with dominant *A. littoralis* were widespread in the Lower Atrek and occupied c. 11,500 ha. Thus, the characteristic peculiarity of the landscape of this region are communities of the alliance. According to the data of BERDYEV (1986), in relation to the high degree of stream-flow regulation of the Atrek River, communities of the alliance lack moisture, and so the areas covered by these communities decrease.

The soil salinity in communities of the alliance varies from 1.5% to 3.5%, i.e., communities of the alliance grow on extremely salinized soils and solonchaks. The soil moisture may vary from dry to over moistened (i.e., water exudes when pressing the soil).

Since *Aeluropus littoralis* is a very valuable fodder, the areas occupied with communities of the alliance are intensively used for pasture. Therefore, a significant factor of the community is also the grazing. In plots, where overgrazing is observed, the plants are suppressed, projective cover sharply falls and the communities are apparently reduced and have poor floristic composition. However, most of the communities characterised below, were described near lake Delili, on the Hasan-Kuli area of the Krasnovodskiy Reserve. Till quite recently, grazing in the reserve has been forbidden, and plants in the communities are in good life condition. We distinguish two suballiances: Suaedo paradoxae-Aeluropodienion littoralis and Salicornio-Aeluropodienion littoralis within the alliance Suaedo-Aeluropodion littoralis.

Table 1
Diagnostic table of communities of the order *Aeluropodetalia littoralis*

Syntaxa names	*Polypogono-Glycyrrhizetum*	*Parapholio-Glycyrrhizetum*	*Limonio meyeri-Cynodontetum*	*Juncetum arabici*	*Lolio rigidi-Aeluropodetum littoralis*	*Polypogono-Aeluropodetum littoralis subass. inops*	*Polypogono-Aeluropodetum littoralis subass. typicum*	*Halostachyo-Aeluropodetum littoralis frankenietosum*	*Halostachyo-Aeluropodetum littoralis juncetosum*	*Suaedo acuminatae-Aeluropodetum littoralis var. Puccinellia gigantea*	*Suaedo acuminatae-Aeluropodetum littoralis var. typicum*	*Junco arabici-Aeluropodetum littoralis typicum*	*Junco arabici-Aeluropodetum littoralis var. Juncetosum maritimi*
Number of relevés	5	8	10	10	5	10	10	10	5	5	8	5	7
Dt associations, subassociations and variants													
Parapholis incurva	–	V[1]	II	–	–	–	–	–	–	–	–	–	–
Carthamus oxyacanthus	–	–	III[+]	–	–	–	–	–	–	–	–	–	–
Cirsium incanum	–	–	IV[+]	–	–	–	–	–	–	–	–	–	–
Lotus sergievskiae	–	–	V[1]	III	I	–	–	–	–	–	–	–	–
Lippia nodiflora	–	–	–	V[+]	–	–	–	–	–	–	–	–	–
Rumex halacsyi	–	–	I	V[+]	IV[+]	–	–	–	–	–	–	–	–
Hordeum marinum	–	II	–	I	V[4]	II	–	–	–	–	–	–	–
Phalaris minor	–	II	II	–	IV[+]	–	–	I	I	–	–	–	–
Frankenia hirsuta	–	II	I	–	–	–	I	V[+]	II	–	–	II	II
Artemisia arenicola	I	V[1]	V[+]	II	–	–	I	IV[+]	V[1]	–	I	I	–
Halostachys belangeriana	–	–	I	I	I	I	I	V[+]	V[1]	IV[1]	–	I	–
Phragmites australis	–	IV[+]	IV[+]	III[+]	–	–	–	–	III[1]	–	–	II	V[+]
Tripolium pannonicum	–	–	–	–	IV[+]	–	–	–	IV[1]	–	–	V[+]	III[+]
Juncus maritimus	–	–	–	–	–	–	I	–	–	–	–	I	V[4]
	Dt all. *Cynodonto-Juncion gerardii*												
Juncus gerardii	IV[+]	V[+]	V[3]	V[4]	–	–	II	I	I	–	–	–	–
Cynodon dactylon	V[3]	V[1]	V[3]	V[1]	–	–	–	–	–	–	–	–	–
Carex divisa	II	IV[+]	V[3]	III	–	–	–	–	–	–	–	–	–
Aegilops tauschii	V[1]	IV[1]	II	I	–	–	–	–	–	–	–	–	–
Cardaria draba	I	II	IV[+]	II	–	–	I	–	–	–	–	–	–
Glycyrrhiza glabra	V[5]	V[3]	II	–	–	–	–	–	–	–	–	–	–
Calystegia sepium	–	IV[+]	V[+]	V[–]	–	–	–	–	II	–	–	–	–

Dt ord. *Aeluropodetalia littoralis* = Dt all. *Suaedo-Aeluropodion littoralis*

Aeluropus littoralis	I	II	II	V^1	V^5	V^4	V^5	V^4	V^5	V^5	V^5	V^5	V^+
Limonium meyeri	II	V^3	V^3	II	–	–	V^-	V^-	V^1	II	I	I	–
Limonium reniforme	V^-	IV^+	I	III^+	–	I	II	V^2	V^4	II	I	II	I
Polypogon monspeliensis	V^-	I	I	V^+	IV^-	–	V^+	I	V^-	–	–	–	–
Lactuca serriola	V^-	II	V^+	II	II	I	IV^+	III	IV^+	–	–	–	–
Lolium rigidum	V^-	IV^+	I	I	V^+	I	I	I	–	–	–	–	–
Bromus racemosus	V^2	V^+	V^+	V^+	V^+	I	I	V^1	II	–	–	–	–
Puccinellia gigantea	–	–	I	–	–	I	III^+	V^3	II	IV^-	–	–	–
Suaeda paradoxa	–	–	I	–	I	–	IV^+	III^1	V^+	IV^+	V^-	–	–
Juncus arabicus	I	–	V^+	V^5	–	I	I	–	V^3	–	–	V^5	V^1

Dt suball. *Salicornio-Aeluropodienion*

Salicornia perennans	–	–	–	–	–	I	I	–	IV^+	V^3	V^2	II	V^+
Suaeda acuminata	–	–	–	–	–	–	I	I	V^1	V^3	V^2	I	–
Others													
Alhagi persarum	IV^+	–	V^+	II	–	–	–	I	III^+	–	–	–	–
Polygonum argyrocoleon	–	II	II	–	–	–	II	II	III^+	–	–	–	–
Melilotus indicus	–	IV^+	V^+	–	–	–	–	–	–	–	–	–	–
Tamarix meyeri	–	–	–	II	III^+	–	–	–	II	–	–	–	–
Tamarix hispida	–	–	–	–	II	–	–	–	–	–	–	–	–
Juncus subulatus	–	–	–	III^+	–	–	II	–	–	–	–	–	I
Plantago lanceolata	–	II	II	–	–	–	–	–	–	–	–	–	–
Acroptilon repens	–	II	I	–	–	–	–	–	–	–	–	–	–
Bolboschoenus maritimus	–	–	–	III^+	I	–	I	–	–	–	–	I	–
Phleum paniculatum	–	II	I	–	–	–	–	I	–	–	–	–	–
Lycium ruthenicum	–	–	–	–	–	–	–	II	III^+	–	–	–	–
Xanthoria parietina	–	–	–	–	–	–	–	III	V^+	–	–	–	–
Phalaris paradoxa	–	II	–	I	–	–	–	–	–	–	–	–	–
Torilis nodosa	–	III	–	–	–	–	–	I	–	–	–	–	–
Galium spurium	–	–	–	II	–	–	–	II	–	–	–	–	–
Atriplex aucheri	–	–	–	I	I	–	–	–	II	–	–	–	–

In the all tables:

Dt order — Dt all. — Dt suball. — Dt ass. — Dt subass. and var.

Suballiance Suaedo paradoxae-Aeluropodienion littoralis suball. nov.

Dt suballiance = dt alliance.
Nt: Polypogono-Aeluropodetum littoralis ass. nov.

This alliance may be considered as "typicum" for the alliance. Its characteristics coincide with those of the alliance.

It should be noted that communities of the sub-alliance prefer a not too saline or wet ecotope. However, they are tolerant to both.

Ass. Polypogono-Aeluropodetum littoralis ass. nov.

Dt association = dt alliance.
Nt: relevé no. 6 in Table 2.

We distinguish two sub-associations in this association.

Subass. Polypogono-Aeluropodetum littoralis typicum subass. nov.

Table 2

Dt: subassociation = dt association.

Aeluropus littoralis dominates nearly overall. Communities of the subassociation were described from the protected territory of the reserve. Therefore, ecotopes of the subassociation are not used for pasture, and the plants are in good conditions. *Aeluropus littoralis* has a good projected cover of 100% which forms a solid grey-green carpet with the sprout height of 25–40 cm. Different layers are not marked. Only the sprouts of *Suaeda paradoxa, Juncus subulatus* and *Lactuca serriola* are 0.5–1.2 m high, but they are represented by single specimens with an extremely low projective cover (up to 1%).

Communities of the subassociation occupy a comparatively small area, stretching under residual islands and the shore of lake Delili, in a relief depression, where the soil is quite wet.

The soil is a meadow solonchak. The salinity type is chloride-sulphate. The salt content (mg-equivalent per 100 g of soil) is a soil layer 0–25 cm: HCO_3^-: 0.30; Cl^-: 23.00; SO_4^{2-}: 32.50; Ca^{2+}: 11.00; Mg^{2+}: 17.00; $Na^+ + K^+$: 27.80; sum: 111.6; sum, %: 3.446.

Soil texture content is a heavy-textured loam.

Table 2
Subass. Polypogono-Aeluropodetum littoralis subass. typicum

Relevé number	1	2	3	4	5	6	7	8	9	10	K
Relevé area, m²	100	100	100	100	50	50	50	50	50	50	
Total projective cover, %	100	100	100	100	100	100	100	100	100	100	
Number of species	8	8	7	10	8	10	7	12	9	8	
Dt alliance *Suaedo-Aeluropodion littoralis* = dt ass. *Polypogono-Aeluropodion littoralis* subass. *typicum*											
Aeluropus littoralis (GOUAN) PARL.	5	5	5	5	5	5	5	5	5	5	V
Limonium meyeri (BOISS.) O. KUNTZE	+	+	+	+	1	+	1	+	1	1	V
Polypogon monspeliensis (L.) DESF.	+	+	+	+	+	+	+	+	+	+	V
Suaeda paradoxa (BUNGE) BUNGE	+	+	–	+	+	+	–	+	–	+	IV
Lactuca serriola L.	+	–	+	+	+	+	+	+	–	+	IV
Puccinellia gigantea (GROSSH.) GROSSH.	+	+	–	–	+	+	–	+	–	+	III
Limonium reniforme (GIRARD) LINCZ.	+	–	–	–	–	+	+	+	–	–	II
Others											
Polygonum argyrocoleon STEUD. ex G. KUNZE	+	–	–	+	–	–	–	–	+	–	II
Juncus gerardii LOISEL.	–	–	–	–	–	–	–	+	+	+	II
Juncus subulatus FORSSK.	–	+	–	–	–	+	–	+	+	–	II

In addition, the following species with a constancy of 20 % and less occur: *Artemisia arenicola* KRASCH. ex POLJAK. (4-+, 10-+), *Bromus racemosus* L. (4-+, 6-+), *Bolboschoenus maritimus* (L.) PALLA (8-+, 9-+), *Cardaria draba* (L.) DESV. (4-+), *Frankenia hirsuta* L. (3-+, 9-+), *Halostachys belangeriana* (MOQ.) BOTSCH. (2-+, 7-+), *Juncus maritimus* LAM. (3-+, 8-1), *Juncus arabicus* (ASCHERS. & BUCHENAU) ADAMSON (2-+, 8-+), *Lolium rigidum* GAUDIN (4-+, 5-+), *Psylliostachys spicata* (WILLD.) NEVSKI (9-+, 6-+), *Salicornia perennans* WILLD. (3-+, 5-+), *Suaeda prostrata* PALL. (7-+).

Table 3
Subass. Polypogono-Aeluropodetum littoralis subass. inops

Relevé number	1	2	3	4	5	6	7	8	9	10	K
Relevé area, m²	100	100	100	100	100	100	100	100	100	100	
Total projective cover, %	35	35	25	25	35	40	25	30	30	30	
Number of species	2	4	3	2	3	3	1	1	2	3	
Dt ord. *Aeluropodetalia littoralis* = dt alliance *Suaedo-Aeluropodion littoralis*											
Aeluropus littoralis (GOUAN) PARL.	4	4	3	3	4	4	3	4	4	4	V
Others											
Hordeum marinum HUDS.	–	+	–	–	–	+	–	–	–	+	II

In addition, the following species with a constancy of 20 % and less occur: *Bromus racemosus* (2-+), *Halostachys belangeriana* (1-+), *Juncus arabicus* (10-1), *Hordeum leporinum* (2-+), *Lolium rigidum* (3-+), *Limonium reniforme* (3-+), *Lactuca serriola* (5-+), *Petrosimonia sibirica* (PALL.) BUNGE (6-+), *Psylliostachys spicata* (9-1), *Puccinellia gigantea* (4-+), *Salicornia perennans* (5-+).

The localisation of the relevé plots is represented in Table 2.

Relevés no. 1–10 were made 0.4–1 km southwest and south from the southern shore of lake Delili (25. 06. 1994; 21. 09. 1994). The relevés were made along a transect every 50 m westwards.

Subass. Polypogono-Aeluropodetum littoralis inops subass. nov.

Table 3

This sub-association is differentiated by the absence of other plant species typical of this alliance, except for *Aeluropus littoralis*. This is characterised by a poor floristic composition and represented practically by one single species *Aeluropus littoralis* and with exceptionally rare mixture of other species typical of the alliance and order in general.

The floristic poverty could be explained by the fact that the ecotopes covered by the community are intensively used for pasture. The species *Aeluropus littoralis* is very much suppressed, the sprout height does not exceed 4–5 cm because of grazing by cattle. The total projective cover is low (25–40%). The soil microrelief affected by trampling, has a character of tiny phylogenetic mounds of 1–2 cm (the soil sites exposed to cattle hooves are gradually deepening whereas the soil sites with the specimen *Aeluropus littoralis* are more stable and, eventually, form the mounds).

The community was described near the Karadegisch settlement where it occupied vast territories.

The locality of relevé plots is represented in Table 3.

Relevés no. 1–10 were made 2 km west from the Karadegisch settlement along a transect northwards (26. 06. 1994; 21. 09. 1994). The relevés were made every other 80–100 m.

Ass. Lolio rigidi-Aeluropodetum littoralis ass. nov.

Table 4

Dt: *Hordeum marinum*, *Phalaris minor*.
Nt: relevé no. 2 in Table 4.

Aeluropus littoralis and *Hordeum marinum* dominate in the community.

Since the territory, where stands of the association are described, was near to the area of the reserve, ecotopes of the association were not used for pasture, and plant were in good condition, forming a dense carpet (with the grass stand height of 25–40 cm). Single shrubs of *Tamarix meyeri* and *T. karelinii* of 1–2 m heights and a projective cover of up to 1–15% could be found.

The association was described near the northern edge of the lake Delili, where it occupied small areas, forming patches within communities with dominant *Phalaris minor* and *Bromus racemosus*. Probably it replaces these communities on sites with a higher salinity.

The localisation of the plots is represented in Table 4.

Relevés no. 1–5 were made on the northern edge of lake Delili, 1 km north-east from the lake shore (20. 06. 1994; 22. 09. 1994).

Table 4
Ass. Lolio rigidi-Aeluropodetum littoralis

Relevé number	1	2	3	4	5	K
Relevé area, m²	25	25	25	50	50	
Total projective cover, %	100	100	100	100	100	
Number of species	10	11	11	8	9	
Dt association						
Hordeum marinum HUDS.	3	4	4	5	5	V
Phalaris minor RETZ	+	+	+	+	–	IV
Dt ord. *Aeluropodetalia littoralis* = alliance *Suaedo-Aeluropodion littoralis*						
Aeluropus littoralis (GOUAN) PARL.	5	5	5	4	5	V
Lolium rigidum GAUDIN	1	1	+	+	+	V
Bromus racemosus L.	+	1	2	+	+	V
Polypogon monspeliensis (L.) DESF.	1	+	1	–	+	IV
Lactuca serriola L.	–	+	–	–	+	II
Others						
Rumex halacsyi RECH.	+	+	+	+	–	IV
Tripolium pannonicum (JACQ.) DOBROCZ.	+	+	+	–	+	IV
Tamarix meyeri BOISS.	–	2	+	–	1	III
Tamarix karelinii BUNGE	1	–	–	1	–	II

In addition, the following species with a constancy of 20 % and less occur: *Atriplex aucheri* MOQ. (1-+), *Bolboschoenus maritimus* (L.) PALLA (2-+), *Halostachys belangeriana* (MOQ.) BOTSCH. (3-+), *Lotus sergievskiae* R. KAM. & KOVALEVSK. (4-+), *Xanthium albinum* (WIDD.) H. SCHOLZ (3-+), *Suaeda paradoxa* (BUNGE) BUNGE (5-+).

Ass. Halostachyo-Aeluropodetum littoralis ass. nov.

Table 5

Dt: *Halostachys belangeriana*, *Artemisia arenicola*.
Nt: relevé no. 10 in Table 5.

Subassociations H.-A. l. frankenietosum and H.-A. l. juncetosum were distinguished in this association.

Obviously, these subassociations developed in relation to soil moisture variability, i.e., the community H.-A. l. juncetum occurs in wetter sites and the community H.-A. l. frankenietosum in drier ones.

Stands of the association are differentiated by a relatively large number of species (10–20) in comparison to a considerable number of other plant communities in this region.

Subass. Halostachyo-Aeluropodetum littoralis juncetasum subass. nov.

Table 5

Dt: *Juncus arabicus*, *Tripolium pannonicum*, *Salicornia perennans*, *Suaeda acuminata*, *Phragmites australis*.

Aeluropus littoralis, *Juncus arabicus* and *Limonium reniforme* dominate in the community. The plant specimens of the dominants are in excellent condition, probably, due to being in an ecological optimum here. Densely located ball-shaped tufts of *Juncus arabicus*, forming a typical complex with *Aeluropus littoralis* (see also the ass. Junco arabici-Aeluropodetum littoralis), and the sprouts of *Limonium reniforme*, occurring here with a high projective cover (25–70%), form a dense higher layer of the community (1–1.5 m high). It is also formed by low shrubs of *Halostachys belangeriana* (in a somewhat suppressed condition) and a sparse *Lycium ruthenicum* (up to 2 m high). As for *Limonium reniforme*, it forms a typical complex with the shrubs of *Halostachys belangeriana* and *Lycium ruthenicum*, where the sprouts lie on shrub branches and cover it everywhere. The lower layer is formed by *Aeluropus littoralis* (the sprout height being 15–40 cm, the projective cover being 45–100%). Furthermore, *Limonium meyeri*, *Suaeda acuminata* and *Polypogon monspeliensis* occur in the lower layer.

Table 5
Ass. Halostachyo-Aeluropodetum littoralis

Relevé number	1	2	3	4	5	6	7	8	9	10	K2	11	12	13	14	15	K3	K4
Relevé area, m²	50	50	50	25	25	25	50	50	50	50		25	25	50	50	100		
Total projective cover, %	90	90	90	90	75	95	70	70	80	95		100	100	100	100	100		
Number of species	13	14	11	10	10	11	11	11	15	15		18	15	20	20	16		
Dt subass. *H.-A.l. frankenietosum*																		
Frankenia hirsuta L.	+	1	+	1	1	+	1	+	+	+	V	–	+	–	–	+	II	IV
Bromus racemosus L.	1	+	2	2	1	2	1	3	+	2	V	–	–	+	+	–	II	IV
Puccinellia gigantea (GROSSH.) GROSSH.	3	4	4	4	3	2	3	+	1	1	V	1	–	–	+	–	II	IV
Dt ass. *Halostachyo-Aeluropodetum littoralis*																		
Halostachys belangeriana (MOQ.) BOTSCH.	+	1	+	+	1	+	+	1	1	2	V	+	+	2	1	3	V	V
Artemisia arenicola KRASCH. ex POLJAK.	+	+	1	–	1	+	–	2	+	+	IV	+	+	2	2	1	V	V
Dt subass. *H.-A.l. juncetosum*																		
Juncus arabicus (ASCHERS. & BUCHENAU) ADAMSON	–	–	–	–	–	–	–	–	–	–	–	5	5	3	3	2	V	II
Suaeda acuminata (C. A. MEY.) MOQ.	+	–	–	+	–	–	–	–	–	–	I	1	1	+	1	+	V	III
Tripolium pannonicum (JACQ.) DOBROCZ.	–	–	–	–	–	–	–	–	–	–	–	–	1	2	+	1	IV	II
Salicornia perennans WILLD.	–	–	–	–	–	–	–	–	–	–	–	+	+	1	+	–	IV	II
Phragmites australis (CAV.) TRIN. ex STEUD.	–	–	–	–	–	–	–	–	–	–	–	–	–	1	1	1	III	I
Dt alliance *Suaedo paradoxae-Aeluropodion littoralis* = dt ord. *Aeluropodetalia littoralis*																		
Aeluropus littoralis (GOUAN) PARL.	4	4	4	4	3	5	3	3	3	4	V	5	5	5	5	4	V	V
Limonium meyeri (BOISS.) O. KUNTZE	4	4	4	3	3	4	4	2	2	4	V	1	1	1	2	1	V	V
Limonium reniforme (GIRARD) LINCZ.	1	1	2	2	2	1	1	3	4	3	V	3	3	5	4	5	V	V
Suaeda paradoxa (BUNGE) BUNGE	+	–	+	+	–	+	–	–	+	+	III	+	1	+	+	1	V	IV
Others																		
Xanthoria parietina (L.) TH. FR.	–	+	–	–	+	–	–	+	+	+	III	+	+	+	+	+	V	IV
Lactuca serriola L.	–	–	+	–	–	+	–	1	1	1	III	+	+	–	+	+	IV	III
Polypogon monspeliensis (L.) DESF.	–	+	–	–	–	–	+	–	–	–	I	+	+	+	+	+	V	III
Lycium ruthenicum MURR.	–	+	–	–	–	+	–	–	–	+	II	+	–	+	+	–	III	II
Polygonum argyrocoleon STEUD. ex G. KUNZE	–	+	+	–	–	–	–	–	–	+	II	+	–	+	+	–	III	II
Alhagi persarum BOISS. & BUHSE	+	–	–	–	–	–	–	–	–	–	I	+	+	+	–	–	III	II

Table 5
(continued)

Relevé number	1	2	3	4	5	6	7	8	9	10	K2	11	12	13	14	15	K3	K4
Relevé area, m^2	50	50	50	25	25	25	50	50	50	50		25	25	50	50	100		
Total projective cover, %	90	90	90	90	75	95	70	70	80	95		100	100	100	100	100		
Number of species	13	14	11	10	10	11	11	11	15	15		18	15	20	20	16		
Galium spurium L.	–	–	–	+	–	–	–	–	+	+	II	–	–	–	–	–	–	I
Atriplex aucheri Moq.	–	–	–	–	–	–	–	–	–	–	–	–	–	+	–	+	II	I
Tamarix meyeri Boiss.	–	–	–	–	–	–	–	–	–	–	–	–	–	1	–	1	II	I
Calystegia sepium (L.) R. Br.	–	–	–	–	–	–	–	–	–	–	–	–	–	+	+	–	II	I

In addition, the following species with a constancy of 20 % and less occur: *Asparagus persicus* Baker (11-+), *Eremopyrum triticeum* (Gaertn.) Nevski (2-+), *Hordeum leporinum* Link (5-+), *Juncus gerardii* Loisel. (2-+, 7-+, 14-+), *Lolium rigidum* Gaudin (1-+), *Petrosimonia sibirica* (Pall.) Bunge (7-+), *Phalaris minor* Retz (9-+, 11-+), *Phleum paniculatum* Huds. (1-+), *Plantago coronopus* L. (8-+, 9-+), *Psylliostachys spicata* (Willd.) Nevski (7-+), *Sphenopus divaricatus* (Gouan) Reichenb. (10-+), *Torilis nodosa* (L.) Gaertn. (9-+).

The distribution of the subassociation stand has a dotted character in relief depressions, where the soil moisture is available for the community. The soil texture content is a heavy textured loam. The soil salinity level is very high, the salinity type is chlorid-sulphate. The salt content (mg-equivalent per 100 g of soil) in a soil layer from 0–25 cm: HCO_3^-: 0.40; Cl^-: 12.10; SO_4^{2-}: 12.50; Ca^{2+}: 19.75; Mg^{2+}: 2.00; $Na^+ + K^+$: 3.25; sum: 50.00; sum, %: 1.542.

The localisation of relevé plots is represented in Table 5.

The relevés no. 11–15 were carried out 300–400 m south from the southern shore of the lake Delili (22. 06. 1994; 20. 09. 1994).

Subass. Halostachyo-Aeluropodetum littoralis frankenietosum subass. nov.

Table 5

Dt: *Frankenia hirsuta*, *Bromus racemosus*, *Puccinellia gigantea.*

Aeluropus littoralis, *Puccinellia gigantea*, *Limonium meyeri* dominate. *Limonium reniforme* also grow with high abundance. The total projective cover of the stands of this subassociation is lower than those of the preceding one (75–95%). A sparse upper layer is formed by a few, somewhat suppressed, *Halostachys belangeriana* shrubs combined with *Limonium reniforme* (as in the previous subassociation) and individual specimens of *Artemisia arenicola* (the upper layer high being 1–2 m). A sparse middle layer, 40–80 cm high, is mainly formed by the sprouts of *Puccinellia gigantea*. The lower layer, 5–30 cm high, is formed by *Aeluropus littoralis* and *Limonium meyeri*.

In the studied area communities of the subassociation occupy small sites, stretching under residual islands and artificial shore of lake Delili, in relief depressions, where the soil was wetter than on the plain. However, in relation to the previous subassociation, the habitats of this community were significantly drier.

The localisation of the relevé sites is represented in Table 5.

Relevé no. 1–10 were carried out 0.4–1 km south-west from the southern shore of lake Delili (22. 06. 1994; 20. 06. 1994). The relevés were carried out along a transect every other 50 m further the west.

Suball. Salicornio-Aeluropodienion littoralis suball. nov.

Dt: *Salicornia perennans*, *Suaeda acuminata*.
Nt: Suaedo acuminatae-Aeluropodetum littoralis ass. nov.

Communities of the alliance occur in the lower part of the Atrek valley, at depressed sites, where the water is stagnating for a long time. This is an extreme case of the community distribution of the alliance on the salinity and moisture axes: the given suballiance may be considered to be transitional from the ord. Aeluropodetalia littoralis to the cl. Thero-Salicornietea and Salicornietea fruticosae.

The soil salt content reaches 2.0–3.5%. The salinity type is chloride-sulphate. The soil is often extremely wet.

Ass. Suaedo acuminatae-Aeluropodetum littoralis ass. nov.

Table 6

Dt association = dt suballiance.
Nt: relevé no. 3 in Table 6.

Aeluropus littoralis dominates in the community. *Suaeda acuminata* and *Salicornia perennans* grow with quite a high projective cover. The total projective cover comprises 90–95%. Layers protrude slightly, although, on the average, the sprouts of *Suaeda acuminata* are somewhat higher (30–50 cm) than those of *Salicornia perennans* and *Aeluropus littoralis* in the association.

Two variants of S. a.-A. l. var. *typicum* and S. a.-A. l. var. *Puccinellia gigantea* were distinguished in the association.

S. a.-A. l. var. *Puccinellia gigantea* differs from S. a.-A. l. var. *typicum* by the presence of the species *Halostachys belangeriana* and *Puccinellia gigantea* with a low projective cover, and also by a high abundance of *Suaeda acuminata* and *Salicornia perennans*.

Communities of the association in the study area occupied small plots, stretching under residual islands in a relief depression of lake Delili, where the soil was wet enough (in September–October).

This association occupies ecotopes with higher soil salinity than it is typical for the alliance in general, and it may be considered to be transitional from communities of the described order to communities of the cl. Thero-Salicornietea and Salicornietea fruticosae.

The localisation of the relevé plots is represented in Table 6.

Relevés no. 1–8 were made 0.5–1 km south-west from the southern shore of lake Delili along a transect to the west (27. 06. 1994; 24. 09. 1994). The relevés were made every 50 m. Relevés no. 9–13 were made 0.4 km south-west from the southern shore of lake Delili (23. 06. 1994; 24. 09. 1994).

Ass. Junco arabici-Aeluropodetum littoralis ass. nov.

Table 7

Dt: *Juncus arabicus*, *Tripolium pannonicum*.
Nt: relevé no. 1 in Table 7.

We distinguish two subassociations, J. a.-A. l. subass. *typicum* and J. a.-A. l. subass. juncetosum maritimi.

Subass. Junco arabici-Aeluropodetum littoralis typicum subass. nov.

Table 7

Dt subassociation = dt association.

Juncus arabicus and *Aeluropus littoralis* dominate in the stands of the subassociation. Numerous sprouts of *Juncus arabicus*, resembling the high ball-shaped tufts, reach the height of 1–1.5 m and form a rather dense upper layer. The projective cover of *Juncus arabicus* is higher than 50%. The second dominant of the community, *Aeluropus littoralis*, forms the lower layer with a projective cover up to 100% and a sprout height of 25–40 cm.

The projective cover of *Aeluropus littoralis* is up to 100%. The species has sprouts of 24–40 cm high. Moreover, *Aeluropus littoralis* can grow within tufts of *Juncus arabicus*, where it may reach a height of 1–1.5 m, lying on the *Juncus* stalks. This complex (a high ball shaped tuft of *Juncus arabicus* and grasses within) is characteristic of all the communities where *Juncus arabicus* occur (see below).

The location of communities of the subassociation has a dotted character, i.e., they occur in small plots in relief depressions, where the water has been stagnant for a long period. The soil under the community is extremely moisten. Soil content is heavy textured loam.

Table 6
Ass. Suaedo acuminatae-Aeluropodetum littoralis

Relevé number	1	2	3	4	5	6	7	8	K1	9	10	11	12	13	K2	K3
Relevé area, m²	25	25	25	50	50	25	25	25		50	50	25	25	25		
Total projective cover, %	90	95	95	90	90	90	90	95		90	95	95	95	90		
Number of species	4	5	5	5	5	4	5	4		6	7	8	8	5		
Dt variants	**Dt *S.a.-A.l. var. typicum***									**Dt *S.a.-A.l. var. Puccinellia gigantea***						
Halostachys belangeriana (MOQ.) BOTSCH.	–	–	–	–	–	–	–	–	–	1	1	+	1	–	IV	II
Puccinellia gigantea (GROSSH.) GROSSH.	–	–	–	–	–	–	–	–	–	+	–	+	+	+	IV	II
Dt association																
Suaeda acuminata (C. A. MEY.) MOQ.	2	2	2	2	2	2	3	3	V	3	3	3	3	2	V	V
Salicornia perennans WILLD.	2	2	2	2	2	2	1	3	V	3	3	3	4	3	V	V
Dt alliance *Suaedo-Aeluropodion littoralis*																
Aeluropus littoralis (GOUAN) PARL.	5	5	5	5	5	5	5	4	V	4	5	5	3	5	V	V
Suaeda paradoxa (BUNGE) BUNGE	+	1	+	+	+	1	1	+	V	–	+	+	+	+	IV	V
Limonium reniforme (GIRARD) LINCZ.	–	–	+	–	–	–	–	–	I	–	+	+	–	–	II	II
Limonium meyeri (BOISS.) O. KUNTZE	–	–	–	–	–	–	+	–	I	+	–	–	+	–	II	II

In addition, the following species with a constancy of 20 % and less occur: *Artemisia arenicola* KRASCH. ex POLJAK. (2-+), *Sphenopus divaricatus* (GOUAN) REICHENB. (5-+, 12-+), *Suaeda prostrata* PALL. (4-+, 10-+), *Halocnemum strobilaceum* (PALL.) BIEB. (11-+).

Table 7
Ass. Junco arabici-Aeluropodetum littoralis

Relevé number	1	2	3	4	5	K1	6	7	8	9	10	11	12	K2	K3
Relevé area, m²	50	50	50	50	50		16	16	16	16	16	16	9		
Total projective cover, %	100	100	100	100	95		45	45	65	40	30	65	40		
Number of species	6	4	5	7	4		6	6	6	6	7	6	5		
Dt subass. *J.a.-A.l. juncetosum maritimi*															
Juncus maritimus LAM.	–	–	–	–	–	–	4	4	4	4	3	5	4	V	IV
Phragmites australis (CAV.) TRIN. ex STEUD.	–	+	–	+	–	II	+	+	+	1	+	+	+	V	IV
Dt association															
Juncus arabicus (ASCHERS. & BUCHENAU) ADAMSON	5	5	5	4	5	V	+	1	3	1	1	+	+	V	V
Tripolium pannonicum (JACQ.) DOBROCZ.	+	+	+	+	+	V	–	+	+	–	+	+	–	III	IV
Dt suballiance Salicornio-Aeluropodienion littoralis															
Salicornia perennans WILLD.	+	–	+	–	–	II	1	+	+	+	+	1	+	V	IV
Dt alliance Suaedo paradoxae-Aeluropodion littoralis															
Aeluropus littoralis (GOUAN) PARL.	5	5	5	5	4	V	2	+	1	+	+	+	1	V	V
Others															
Frankenia hirsuta L.	–	–	+	+	–	II	+	–	–	+	–	–	–	II	I
Limonium reniforme (GIRARD) LINCZ.	+	–	–	+	–	II	–	–	–	–	+	–	–	–	I

In addition, the following species with a constancy of 20 % and less occur: *Juncus subulatus* FORSSK. (4-+), *Limonium meyeri* (BOISS.) O. KUNTZE (5-+), *Suaeda acuminata* (C. A. MEY.) MOQ. (1-+).

The localisation of the relevés is represented in Table 7.

Relevés no. 1–5 were made 300 m south of the southern shore of lake Delili in the relief depression behind the artificial shore of the lake (20. 06. 1994; 27. 09. 1994).

Subass. Juncus arabici-Aeluropodetum littoralis juncetosum maritimi subass. nov.

Dt: *Juncus maritimus, Phragmites australis.*

Dominant is *Juncus maritimus*. The sprouts of *Juncus maritimus* with a projective cover of 25–60%, 50–90 cm high, and with rare sprouts of *Phragmites australis* of up to 1 m high form the upper layer of the community. A sparse lower layer is formed by both *Salicornia perennans* (the sprout height 10–40 cm) and *suppressed rare sprouts of Aeluropus littoralis* (5–20 cm high).

The community distribution of the subassociation has a dotted character. The communities occupy the very bottom of the relief depressions, where the stagnant water accumulates, and the soil, being extremely wet, is inundated locally. Stands of this subassociation are probably rare here due to the fact that such depressions (with the soil moistened well enough for this community) are not numerous in the study area.

Apparently, the preceding subassociation is replaced to the subass. J. a.-A. l. juncetosum maritimi as the soil moisture increases, and it may be seen as the extreme case of community distribution of the alliance Suaedo-Aeluropodion littoralis, according to the moisture gradient.

The soil is solonchak, the salinity type is chloride-sulphate. The salt content (mg-equivalent per 100 g of soil) in a soil layer 0–25 cm: HCO_3^-: 0.40; Cl^-: 22.50; SO_4^{2-}: 25.00; Ca^{2+}: 17.50; Mg^{2+}: 16.25; $Na^+ + K^+$: 14.15; sum: 95.8; sum, %: 2.881.

Soil texture content is lighter than in the previous community (medium textured loam).

The localisation of relevé plots is represented in Table 7.

Relevés no. 6–12 were made 300 m south of the southern shore of lake Delili in the relief depression behind the artificial shore of the lake (20. 06. 1994; 27. 09. 1994).

Alliance Cynodonto-Juncion gerardii all. nov.

Dt: *Juncus gerardii, Cynodon dactylon, Carex divisa, Cardaria draba, Calystegia sepium, Aegilops tauschii, Glycyrrhiza glabra.*

Nt: Polypogono-Glycyrrhizetum ass. nov.

Halophytic communities of hemicryptophytes with the polydominant structure of communities occur in a desert where species of the genera *Juncus, Limonium, Carex,* as well as grasses, usually dominate. Stands of this alliance are confined to less salinized sites (0.9–2.0%) than those of the previous one.

In the study area communities of the alliance have a dotted "oasis" distribution, rigidly confined to infrequent ecotopes with sufficiently moistened but not too salinized soil.

Ass. Juncetum arabici ass. nov.

Table 8

Dt: *Lippia nodiflora, Rumex halacsyi.*
Nt: relevé no. 5 in Table 8.

Juncus arabicus and *J. gerardii* dominate in the community. The plant dominants are in good condition, probably due to being here in ecological optimum. Species richness (13–20 species) is typical of the association, compared to the other plant communities of this region.

The stands have a peculiar physiognomic character owing to the thick ball shaped tufts of *Juncus arabicus* (the tuft height and diameter reaching 1.5 m). These tufts are located close to each other and form the upper layer of the community. Under their canopy and between them, the sprouts of *Juncus gerardii* (up to 30–40 cm high and with a high projective cover) and *Bromus racemosus, Carex divisa* and *Lotus sergievskiae* in low abundance can be found. They all form the lower layer of the community. In addition, such grasses as *Cynodon dactylon* and *Aeluropus littoralis* may occur within the tufts of *Juncus arabicus* forming a complex with them. These grasses reach up to 1.5 m along the *Juncus arabicus* needles. The sprouts of *Calystegia sepium*, occurring here in low abundance, lie on tufts of *Juncus arabicus* as well.

The soil is a heavy textured loam, the salinity type is chloride, the salinity level is extremely high. The salt content (mg-equivalent per 100 g soil) in a soil layer from 0–25 cm is: HCO_3^-: 0.50; Cl^-: 10.60; SO_4^{2-}: 5.00; Ca^{2+}: 3.25; Mg^{2+}: 4.75; $Na^+ + K^+$: 8.10; sum: 32.2; sum, %: 0.95.

Stands of the association have formed patches near the Delili lake shore on the ecotopes where the soil is wet. The salt concentration

Table 8
Ass. Juncetum arabici

Relevé number	1	2	3	4	5	6	7	8	9	10	K
Relevé area, m²	25	25	25	25	25	25	25	25	25	25	
Total projective cover, %	100	100	90	100	100	95	100	100	100	95	
Number of species	13	17	18	20	12	16	18	16	13	13	
Dt association											
Lippia nodiflora (L.) MICHX.	+	1	+	+	+	+	+	1	+	+	V
Rumex halacsyi RECH.	1	+	1	1	+	–	+	1	+	+	V
Dt alliance *Cynodonto-Juncion gerardii*											
Juncus gerardii LOISEL.	2	4	4	5	4	5	5	5	5	3	V
Calystegia sepium (L.) R. BR.	2	1	+	1	2	+	–	+	+	+	V
Cynodon dactylon (L.) PERS.	1	1	1	1	1	1	1	1	1	+	V
Carex divisa HUDS.	–	–	+	+	+	–	–	–	+	3	III
Cardaria draba (L.) DESV.	–	+	–	–	–	+	–	+	–	–	II
Dt order *Aeluropodetalia littoralis*											
Aeluropus littoralis (GOUAN) PARL.	+	+	+	1	1	1	1	1	+	1	V
Juncus arabicus (ASCHERS. & BUCHENAU) ADAMSON	5	5	4	5	5	3	4	5	5	5	V
Bromus racemosus L.	+	+	+	+	1	+	+	+	+	+	V
Limonium reniforme (GIRARD) LINCZ.	+	+	.	1	.	+	+	–	.	+	III
Lactuca serriola L.	.	–	–	–	+	+	+	–	–	–	II
Limonium meyeri (BOISS.) O. KUNTZE	.	.	+	–	.	.	+	–	–	+	II
Others											
Phragmites australis (CAV.) TRIN. ex STEUD.	–	+	+	–	+	–	+	+	+	–	III
Bolboschoenus maritimus (L.) PALLA	+	+	+	+	–	–	–	+	+	–	III
Juncus subulatus FORSSK.	+	1	1	1	–	–	+	+	–	–	III
Lotus sergievskiae R. KAM. & KOVALEVSK.	–	–	–	+	1	+	1	–	–	+	III
Alhagi persarum BOISS. & BUHSE	+	–	+	–	–	+	+	–	–	–	II
Galium spurium L.	–	–	–	+	–	–	+	–	–	+	II
Tamarix meyeri BOISS.	+	–	+	–	–	–	–	+	–	–	II
Artemisia arenicola KRASCH. ex POLJAK.	–	–	+	+	–	–	+	–	–	–	II

In addition, the following species with a constancy of 20% and less occur: *Aegilops tauschii* COSS. (1-+), *Alopecurus arundinaceus* POIR. (2-+, 4-+), *Althaea armeniaca* TEN. (6-1,7-+), *Asparagus persicus* BAKER (3-+, 7-+), *Atriplex aucheri* MOQ. (2-+, 9-+), *Karelinia caspia* (PALL.) LESS. (6-1,8-2), *Halostachys belangeriana* (MOQ.) BOTSCH. (4-+), *Hordeum leporinum* LINK (3-+, 6-+), *Hordeum marinum* HUDS. (2-+, 8-+), *Lolium rigidum* GAUDIN (2-+, 4-+), *Phalaris paradoxa* L. (4-+, 9-+), *Samolus valerandi* L. (8-+), *Spergularia diandra* (GUSS.) BOISS. (6-+).

may be considered to be low though the soil salinity level is extremely high for this region where all soils are salinized.

The location of the relevé plots is represented in Table 8.

Relevés no. 1–5 were made on the south-eastern shore of lake Delili (26. 06. 1994; 22. 09. 1994). Relevés 6–10 were made on the southern edge of the Delili shoreline (26. 06. 1994; 22. 09. 1994).

Ass. Limonio meyeri-Cynodontetum ass. nov.

Table 9

Dt: *Carthamus oxyacanthus, Cirsium incanum, Lotus sergievskiae.*
Nt: relevé no. 5 in Table 9.

Stands of the association are polydominant, i.e. *Limonium meyeri, Cynodon dactylon, Carex divisa, Juncus gerardii* jointly dominate. A high species richness (15–22 species) is typi-

Table 9
Ass. Limonio meyeri-Cynodontetum

Relevé number	1	2	3	4	5	6	7	8	9	10	K
Relevé area, m²	25	25	25	50	50	25	50	50	25	25	
Total projective cover, %	90	95	100	100	90	90	90	100	100	95	
Number of species	22	17	15	22	18	15	21	19	20	21	
Dt association											
Lotus sergievskiae R. KAM. & KOVALEVSK.	+	3	2	2	+	2	+	1	1	1	V
Cirsium incanum (S. G. GMEL.) FISCH.	–	–	–	1	2	1	1	+	+	+	IV
Carthamus oxyacanthus BIEB.	–	–	+	+	–	–	+	+	+	+	III
Dt alliance *Cynodonto-Juncion gerardii*											
Juncus gerardii LOISEL.	3	3	4	3	3	3	2	4	4	4	V
Calystegia sepium (L.) R. BR.	+	+	+	1	+	1	+	1	1	1	V
Carex divisa HUDS.	3	1	3	4	3	3	4	+	+	+	V
Cynodon dactylon (L.) PERS.	3	1	3	3	3	2	4	3	3	3	V
Cardaria draba (L.) DESV.	+	+	–	–	+	–	1	1	1	1	IV
Glycyrrhiza glabra L.	–	–	+	–	–	–	–	+	+	+	II
Aegilops tauschii COSS.	–	+	–	+	–	–	–	–	+	+	II
Dt order *Aeluropodetalia littoralis*											
Limonium meyeri (BOISS.) O. KUNTZE	3	3	3	2	3	3	3	3	3	3	V
Juncus arabicus (ASCHERS. & BUCHENAU) ADAMSON	1	1	+	1	1	+	1	+	+	+	V
Aeluropus littoralis (GOUAN) PARL.	–	+	–	–	+	+	–	–	–	–	II
Bromus racemosus L.	1	2	1	1	+	+	+	+	+	+	V
Lactuca serriola L.	+	+	–	+	+	+	+	+	+	+	V
Others											
Alhagi persarum BOISS. & BUHSE	2	2	1	+	1	1	+	+	+	+	V
Melilotus indicus (L.) ALL.	+	+	+	+	+	+	+	+	+	+	V
Artemisia arenicola KRASCH. ex POLJAK.	1	–	+	+	+	+	+	+	+	+	V
Phragmites australis (CAV.) TRIN. ex STEUD.	+	–	–	+	+	+	+	+	+	+	IV
Plantago lanceolata L.	–	+	–	–	–	–	–	+	+	1	II
Parapholis incurva (L.) C. E. HUBB.	–	+	–	–	+	–	–	–	+	+	II
Phalaris minor RETZ	+	–	–	+	–	–	+	–	–	–	II
Polygonum argyrocoleon STEUD. ex G. KUNZE	+	–	–	+	–	–	+	–	–	–	II

In addition, the following species with a constancy of 20 % and less occur: *Acroptilon repens* (L.) DC (4-+), *Alopecurus arundinaceus* POIR. (1-+, 7-+), *Bupleurum semicompositum* L. (1-+, 3-+), *Frankenia hirsuta* L. (7-+), *Halostachys belangeriana* (MOQ.) BOTSCH. (8-+, 10-+), *Hordeum leporinum* LINK (1-+, 2-+), *Limonium reniforme* (GIRARD) LINCZ. (1-+, 4-+), *Lolium rigidum* GAUDIN (4-+), *Phleum paniculatum* HUDS. (1-+), *Polypogon monspeliensis* (L.) DESF. (1-+), *Puccinellia gigantea* (GROSSH.) GROSSH. (3-+, 7-+), *Rumex halacsyi* RECH. (5-+), *Suaeda paradoxa* (BUNGE) BUNGE (4-+).

cal. Different layers are almost not present. Only the sprouts of *Alhagi persarum, Cirsium incanum, Artemisia arenicola, Carthamus oxyacanthus* and *Phragmites australis* in low abundance are 0.5–1.5 m high and may form something similar to the upper layer. The height of the major grass stand, formed by plant co-dominants, is 10–40 cm.

The association is striking seasonal dynamics. In autumn, the vegetation cover almost completely disappear on account of burning under the sun or grazing by cattle. In particular, at the end of September, we found only the sprouts of *Limonium meyeri* on the relevé plots, made in June. In the place of other species, only hardly recognised individuals have

remained. The community had changed so much that it could scarcely by recognised. The habitats of the community are significantly drier than those of the previous association and, apparently, it was because of the high seasonal variability.

The soil is much more salinized (than in the ass. Juncetum arabici), it is a solonchak, the salinity type is chloride-sulphate. Its soil texture content is clay. The salt content (mg-equivalent per 100 g of soil) in the soil layer from 0–25 cm is: HCO_3^-: 0.40; Cl^-: 15.00; SO_4^{2-}: 17.50; Ca^{2+}: 7.75; Mg^{2+}: 19.50; $Na^+ + K^+$ 15.65; sum: 65.8; sum, %: 2.018.

Stands of the association occupied a small area forming patches near a temporal freshwater reservoir in the relief depression.

The localisation of the relevé plots is represented in Table 9.

All relevés were made 400–500 m south of the south-eastern edge of lake Delili, near the temporal water reservoir (24. 06. 1994; 21. 09. 1994).

Ass. *Polypogono-Glycyrrhizetum* ass. nov.

Table 10

Dt association = dt alliance.
Nt: relevé no. 1 in Table 10.

Glycyrrhiza glabra dominates in the community. *Cynodon dactylon* and *Bromus racemosus* can also grow with great abundance. The species number is 9–14. The sprouts of *Glycyrrhiza glabra* (40–80 cm high) form a striking upper layer. *Cynodon dactylon*, *Bromus racemosus* and *Aegilops tauschii* and others jointly form the lower layer (10–40 cm high) of the community.

Stands of the association neighbour the association Juncetum arabici. Therefore, they have much in common floristically and the ecotopes, on which they occur, are also similar; the soil on the ecotopes of both associations (on the Delili lake shore) is well moistened and plants do not lack moisture.

Table 10
Ass. Polypogono-Glycyrrhizetum

Relevé number	1	2	3	4	5	K
Relevé area, m^2	25	25	25	25	25	
Total projective cover, %	100	100	100	95	95	
Number of species	14	12	8	10	10	
Dt association = dt alliance *Cynodonto-Juncion gerardii*						
Cynodon dactylon (L.) PERS.	3	2	2	4	4	V
Glycyrrhiza glabra L.	5	5	5	4	4	V
Aegilops tauschii COSS.	1	2	1	+	1	V
Juncus gerardii LOISEL.	+	+	–	+	+	IV
Carex divisa HUDS.	+	–	–	–	+	II
Dt order *Aeluropodetalia littoralis*						
Polypogon monspeliensis (L.) DESF.	+	+	+	+	1	V
Lactuca serriola L.	+	+	+	+	+	V
Limonium reniforme (GIRARD) LINCZ.	+	+	+	1	1	V
Bromus racemosus L.	1	2	2	2	3	V
Lolium rigidum GAUDIN	1	+	+	2	1	V
Limonium meyeri (BOISS.) O. KUNTZE	+	+	–	–	–	II
Others						
Alhagi persarum BOISS. & BUHSE	+	+	+	–	+	IV

In addition, the following species with a constancy of 20 % and less occur: *Aeluropus littoralis* (GOUAN) PARL. (1-+), *Artemisia arenicola* KRASCH. ex POLJAK. (2-+), *Cardaria draba* (L.) DESV. (2-+), *Hordeum leporinum* LINK (1-+), *Juncus arabicus* (ASCHERS. & BUCHENAU) ADAMSON (4-+).

Table 11
Ass. Parapholio-Glycyrrhizetum

Relevé number	1	2	3	4	5	6	7	8	K
Relevé area, m²	25	25	25	25	25	25	25	25	
Total projective cover, %	80	80	80	70	70	70	85	80	
Number of species	19	12	18	15	16	14	17	16	
Dt association									
Parapholis incurva (L.) C. E. HUBB.	3	3	2	2	1	1	+	+	V
Dt alliance *Cynodonto-Juncion gerardii*									
Glycyrrhiza glabra L.	3	3	3	3	3	3	3	3	V
Juncus gerardii LOISEL.	1	1	+	+	2	2	3	3	V
Cynodon dactylon (L.) PERS.	2	2	1	1	1	+	2	2	V
Aegilops tauschii COSS.	–	1	1	–	–	1	2	2	IV
Carex divisa HUDS.	–	–	+	–	2	3	+	1	IV
Calystegia sepium (L.) R. BR.	+	+	+	–	+	+	–	+	IV
Cardaria draba (L.) DESV.	–	–	+	–	–	–	–	+	II
Dt order *Aeluropodetalia littoralis*									
Limonium meyeri (BOISS.) O. KUNTZE	2	3	3	3	3	3	3	3	V
Bromus racemosus L.	+	2	+	1	+	+	2	1	V
Lolium rigidum GAUDIN	+	–	+	+	–	+	+	–	IV
Limonium reniforme (GIRARD) LINCZ.	+	–	–	+	+	+	–	+	IV
Aeluropus littoralis (GOUAN) PARL.	+	–	1	1	–	–	–	–	II
Others									
Artemisia arenicola KRASCH. ex POLJAK.	2	2	3	2	1	+	+	1	V
Melilotus indicus (L.) ALL.	+	+	–	–	+	+	+	–	IV
Phragmites australis (CAV.) TRIN. ex STEUD.	–	+	+	+	–	–	+	+	IV
Torilis nodosa (L.) GAERTN.	1	+	–	–	+	–	–	+	III
Lactuca serriola L.	–	–	–	–	+	–	+	–	II
Acroptilon repens (L.) DC.	–	–	–	–	–	+	1	+	II
Phalaris paradoxa L.	–	–	+	+	+	–	–	–	II
Frankenia hirsuta L.	+	–	+	–	–	–	–	–	II
Hordeum marinum HUDS.	–	–	+	+	–	–	–	–	II
Phalaris minor RETZ	–	–	–	–	+	–	+	–	II
Phleum paniculatum HUDS.	+	–	1	–	–	–	–	+	II
Plantago lanceolata L.	+	–	–	+	–	–	–	–	II
Polygonum argyrocoleon STEUD. ex G. KUNZE	+	–	–	–	+	–	+	–	II

In addition, the following species with a constancy of 20 % and less occur: *Medicago minima* (L.) BARTALINI (1-+), *Plantago coronopus* L. (1-+), *Polypogon monspeliensis* (L.) DESF. (4-+), *Sphenopus divaricatus* (GOUAN) REICHENB. (7-+).

In the study area stands of this association occupied small sites forming strips of different length along the Delili lake shore.

The localisation of the relevé plots is represented in Table 10.

Relevés no. 1–5 were made in the south-western shore of lake Delili (26. 06. 1994; 21. 09. 1994).

Ass. Parapholio-Glycyrrhizetum ass. nov.

Table 11

Dt: *Parapholis incurva*.
Nt: relevé no. 3 in Table 11.

Glycyrrhiza glabra and *Limonium meyeri* dominate in the community. *Parapholis in-*

curva and *Artemisia arenicola* may also have a significant projective cover. The total projective cover is 70–85%. The species number fluctuates within 13–20. The dominant *Glycyrrhiza glabra*, 40–70 cm high, and also the sprouts of *Artemisia arenicola* form a striking upper layer of the community. *Limonium meyeri, Parapholis incurva, Melilotus indicus, Cynodon dactylon, Juncus gerardii* and others jointly form the lower layer (10–40 cm high).

Stands of this association have much in common with the ass. Limonio meyeri-Cynodontetum. The community habitats are also similar: they are wet, compared to most of the surrounding ecotopes, but considerably drier than those of the ass. Juncetum arabici and Polypogono-Glycyrrhizetum.

The localisation of relevé plots is represented in Table 11.

All relevés were made 400–500 m south of the south-eastern edge of lake Delili, near the temporal water reservoir (24. 06. 1994; 21. 09. 1994).

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Manuscript received: September 06th, 2000.

Buchbesprechung

M. MOSER; F. BELLÚ; A. HAUSKNECHT & U. PEINTNER: Farbatlas der Basidiomyceten. Lieferung 18. 110 S., 118 Farbaufn. auf 59 Tafeln. Spektrum Akademischer Verlag, Berlin, 2000. ISBN 3-8274-0793-1. Preis: DM 148,–.

Die 18. Lieferung des mittlerweile fünf Ordner umfassenden Sammelwerkes erschien unter veränderter Autorenschaft. Anstelle des ausgeschiedenen WALTER JÜLICH werden jetzt FRANCESCO BELLÚ, ANTON HAUSKNECHT und URSULA PEINTNER als Mitautoren von MEINHARD MOSER genannt. Die neue Lieferung stellt 100 Arten vor, wobei die Gattungen *Cortinarius* (mit 20 Arten), *Tephrocybe*, *Agaricus* und *Tricholoma* überwiegen. Damit wird auch die Dominanz der Agaricales weiter fortgesetzt und es wird noch zahlreicher Lieferungen bedürfen, um die Aphylloporales ähnlich stark zu repräsentieren. Von den selteneren Arten der 18. Lieferung seien hier stellvertretend nur wenige Beispiele genannt. *Agaricus lutosus* (MOELL.) MOELL. zählt zu den weniger bekannten Egerlingen; *Flammulina populicola* und *F. rossica* sind erst jüngst durch REDHEAD & PETERSEN abgegrenzt worden und warten auf genauere Untersuchung ihrer Verbreitung und Ökologie; *Pholiota elegans* ist von JACOBSSON aus Nordeuropa beschrieben worden (ob der abgebildete Fund aus Mitteleuropa stammt?); *Crepidotus sinuosus* haben HESLER & A. H. SMITH aus Nordamerika beschrieben, bei SENN-IRLET (1995) wird die Art für Europa noch nicht genannt; schließlich befinden sich natürlich unter den (insgesamt nun bereits über 100) *Cortinarius*-Arten zahlreiche wenig bekannte; hervorzuheben auch die mit *Endoptychum agaricoides*, *Gyrophragmium dunalii*, *Montagnea radiosa* und *Torrendia pulchella* stattliche Ansammlung secotioider Arten.

Mit 25 Gattungen wird die Reihe der sog. Gattungsdiagnosen fortgesetzt, einer kurzen Charakteristik in deutscher, englischer, französischer und italienischer Sprache: *Athelopsis*, *Auricularia*, *Baeospora*, *Battarrea*, *Cerrena*, *Delicatula*, *Exidia*, *Exobasidium*, *Fistulina*, *Geastrum*, *Lentaria*, *Macrotyphula*, *Melanogaster*, *Mucronella*, *Myriostoma*, *Nidularia*, *Osteina*, *Peniophora*, *Pycnoporus*, *Resinicium*, *Sarcodontia*, *Trechispora*, *Tulostoma*, *Typhula*, *Xylobolus*.

Es hat sich so eingebürgert, dass die neuen Lieferungen des Farbatlas jeweils kurz vor Weihnachten erscheinen. Vielleicht auch, um den Weihnachtsmann als Helfer beim Vertrieb der ja nicht ganz billigen Lieferungen bemühen zu können? Wir dürfen uns jedenfalls schon auf das nächste Weihnachtsfest freuen!

D. BENKERT, Berlin