3 GERMAN TAMARISK-PIONEER VEGETATION (GTPV), EUROPE

Contributed by Franz Essl, Environment Agency Austria, University of Vienna.

CLASSIFICATION

International: Habitat Directive habitats of the Annex I: 3230 Alpine rivers and their ligneous vegetation with Myricaria germanica (Romao 1996)
Phytosociological units (according to Essl et al. 2002, Willner & Grabherr 2009): Salici-Myricarietum Moor 1958, Myricario-Chondrilletum Br.-Bl. In Volk 1933 pro parte, Epilobio-Myrcarietum Aichinger 1933
IUCN Habitats Classification Scheme: 5. Wetlands /5.11 Alpine Wetlands
Biogeographic Realm: Central, Western and Sub-mediterranean Europe
Key references: GTPV is defined as an ecosystem of European community interest in the EU Habitat Directive (Romao 1996). Detailed information on plant species composition, essential ecosystem processes, and ecology are e.g. provided in Müller & Bürger (1990), Romao (1996), Kudrnovsky (2005), Mülller (2005), and Willner & Grabherr (2009).

ECOSYSTEM DESCRIPTION

Characteristic native biota

GTPV is characterized by low to very low vegetation cover composed of herbs and shrubs, large fractions of bare gravel and sandy substrate, and high spatio-temporal heterogeneity between microsites regarding flooding regime, substrate grain size, and vegetation cover. The dominating vascular plant species is the low shrub German tamarisk (*Myricaria germanica*), whose European distribution is closely related to this ecosystem (Figs 1 - 3). *Myricaria* produces light small hairy seeds, which are spread by wind and water, and can readily colonize new sites, provided that sandy, wet microsites are available. Other characteristic plant species predominantly occurring in GTPV are the chamaephytes *Epilobium dodonaei* and *E. fleischeri*, and the grass *Calamagrostis pseudophragmites*. Albeit vegetation cover is low, plant species richness may be high, as many species of adjacent vegetation communities occur in low densities. This mostly includes species of screes, grasslands, ruderal habitats and riverine forests. Often young growth of willows (*Salix purpurea, S. alba, S. eleagnos, S. daphnoides*) is interspersed, which will, in absence of a disturbance event, within several years to few decades transform GTPV into the next successional stage, i.e. willow forest. Across its European range, accompanying species pools vary considerable. A full characteristic plant species list of the Central European range is provided in Ellmauer (2005) and Willner & Grabherr (2009).

Characteristic animal species include a range of taxa largely restricted to this ecosystem. These include beetles (e.g. Carabids: *Cicindela* spp., *Bembidion* spp.) and grasshoppers (e.g. *Bryodema tuberculata, Chorthippus pullus*) (Ellmauer 2005).

Abiotic environment

GTPV colonizes periodically flooded gravel and sand banks, predominantly along braided rivers which transport high sediment loads and show pronounced hydro-morphological dynamics (Billi et al. 1992). Suitable sites are subject to periodically heavy flooding, which relocate the substrate and reset the succession to vegetation free bare gravel and sand banks.

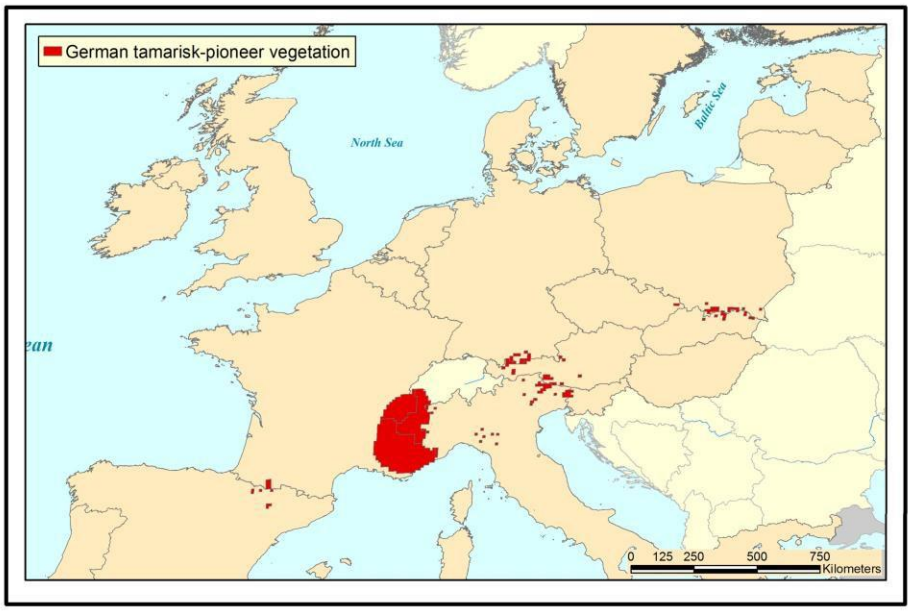

Figure S3. 1. Distribution of German tamarisk-pioneer vegetation (EEA 2009) within the conservation areas nominated for the Habitats Directive within the member states of the European Union. Note, that occurrences outside conservation areas nominated for the Habitats Directive are not shown. Outside the European Union, this ecosystem also occurrs in South-eastern Europe and Switzerland (distribution not shown).

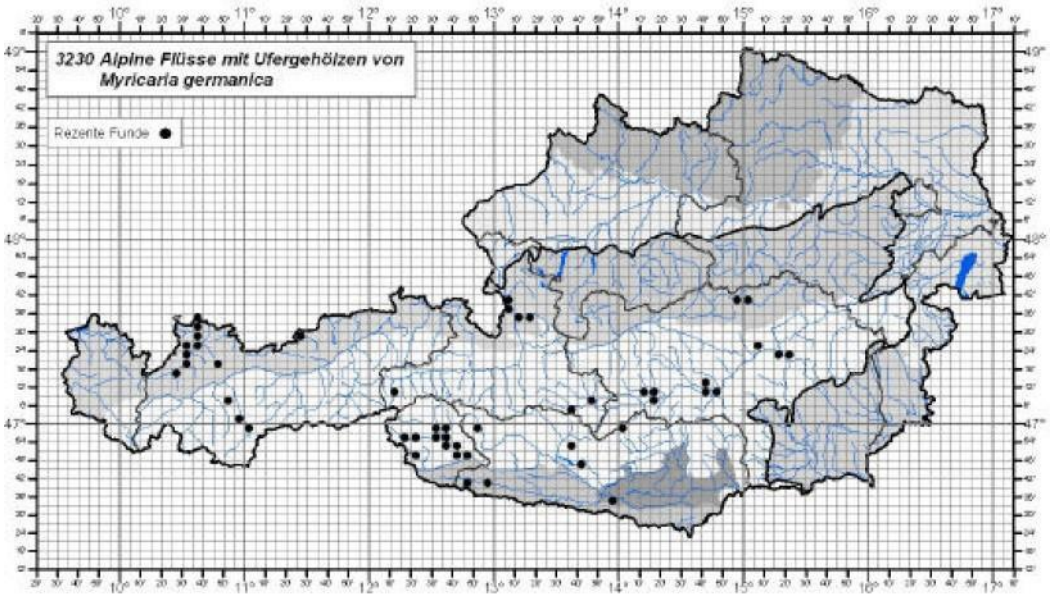

Figure S3. 2. Example of the current national distribution of the German tamarisk-pioneer vegetation within a country in the centre of its range (Austria, Central Europe). Distribution is presented as a grid-distribution map (3x5 geogr. minutes = ca. 35 km^2). Former occurrences, which have been lost before ca. 1990, are not shown in the map (Ellmauer 2005).

Figure S3. 3. An inflorescence of Myricaria germanica (left) and a patch of German tamarisk-pioneer vegetation (right) on a dynamic gravel bank along the Inn river in Tyrol (Austria). Grey-green Myricaria germanica shrubs dominate the vegetation. (c) Wikimedia commons.

Distribution

GTPV is restricted to mountain ranges and their foothills, i.e the Alps, Carpathians, Balkan Mountain ranges, and the Pyrenees (Fig. S3.1). It colonizes riverine habitats ranging from small streams to large rivers, with the largest stands being located in braided river systems, which can be > 1 km wide in places (e.g. rivers Piave and Tagliamento in northern Italy, Müller 2005). The total mapped area of GTPV within the European Union (excluding south-eastern Europe) is estimated to be ca. 60 km^2, with the largest occurrences in France and northern Italy (> 50 km^2). In all other countries the total mapped distribution never exceeds 1 km^2 (EEA 2009). For south-eastern Europe, no comprehensive quantitative data are available. However, there are significant occurrences in the Carpathians (Romania, western Ukraine), as well as on the Balkan Peninsula (e.g. Bulgaria, Albania). Based on available data, the combined mappable area of GTPV there is cautiously estimated to be 10-30 km^2 (Table 1). GTPV has lost parts of its former range, e.g. it is now absent from the Danube and most sections of the Rhine, where it still covered a significant fraction of riverine habitats in the mid-19th century.

Threatening Processes

Most of GTPV has been lost due to wide-spread alterations of hydro-morphological processes of running waters in Europe. From the mid-19t^{h} to the mid-20th centuries, losses were mainly driven by the effects of river channelization. In the last decades, the construction of hydro-electric power plants has emerged as a second main threatening factor. Both threats alter vital hydro-morphological processes, reduce river gravel dynamics and affect flood pulses, all being essential features for this ecosystem to develop and persist. Under altered, particularly reduced, floods and sediment loads, more competitive, but less disturbance-tolerant species of successional serial ecosystems (e.g. willow species) are able to invade and outcompete tamarisk and its allies. Recently, regional distribution has been stabilized or even moderately increased due to nature conservation activities.

GTPV is listed in the Annex I of the Habitats Directive (Romao 1996), hence EU member states are obliged to protect this ecosystem by establishing conservation areas and manage existing occurrences appropriately. Available data suggest that more than 50% of existing

stands are located in nature conservation areas. Since listing in the Habitats Directive, many European countries have increased the level of legal protection for this ecosystem.

Ecosystem collapse

For assessment of criteria A and B, we assumed GTPV to have collapsed when the mapped distribution declines to zero, either as a consequence of channelisation, or when the characteristic native biota including tamarisk is replaced by species such as willow.

ASSESSMENT

Summary

Criterion	A	B	C	D	E	overall
subcriterion 1	EN(VU-EN)	LC	NE	DD	DD	EN
subcriterion 2	DD	EN	NE	DD		
subcriterion 3	EN	LC	NE	DD		

Criterion A

Current decline. Historic maps, habitat mapping data and floristic records of Myricaria germanica indicate substantial losses in geographic extent during the last 50 years. In Austria, GTPV has been lost completely or nearly so along a number of rivers (e.g. Gurk, Mur, Salza, Inn, Salzach) during this time period (Petutschnig 1994, Essl et al. 2002, Ellmauer 2005). In Germany, GTPV completely disappeared during the last 50 years from the Lech River, where it formerly had its largest national occurrences (Müller & Bürger 1990). In Croatia and Slovenia, the significant occurrences along the Drava River (Trinajstic 1992) have been nearly totally lost. In northern Italy and southern France, losses were on average less severe (e.g. Müller 2005). Across its range, available data indicate that losses in geographic distribution during the last 50 years probably were over 50%, with the midpoint of estimated area-weighted loss being around 51%, with lower and upper boundaries of 37 to 65% (Table 2). Endangered (plausible range Vulnerable-Endangered) under criterion A1.

Table S3. 1. Estimated share of global distribution of GTPV in European countries, estimated decline in GTPV distribution per country since 1750 and during the last 50 years.

Country	estimated % of global distribution 50 years ago	estimated decline in distribution over past 50 years	estimated % of global distribution in 1750	estimated decline in distribution since 1750	Source
Albania	3	20-40	2	30-50	Horvath et al. (1998), A. Mohl ined.
Austria	5	40-70	13	90-98	Essl et al. (2002), Ellmauer et al. (2005), Kudrnovsky (2005)
Bulgaria	2	40-70	1	70-90	Horvath et al. (1998), A. Mohl ined.
Croatia	2	60-80	2	90-98	Trinajstic (1992), A. Mohl ined.
France	28	40-70	20	70-90	Martinet & Dubost (1992), Pautou et al. (1997), EEA (2009)

Country	estimated % of global distribution 50 years ago	estimated decline in distribution over past 50 years	estimated % of global distribution in 1750	estimated decline in distribution since 1750	Source
Germany	3	40-70	12	90-98	Müller (1995), Riecken et al. (2006), Lang & Walentowski (2010)
Italy	30	40-70	23	60-80	Müller & Bürger (1990), EEA (2009)
Poland	2	40-70	2	?	EEA (2009)
Romania	12	20-40	10	50-70	A. Mohl (ined.)
Serbia & Montenegro	2	?	2	80-90	Horvath et al. (1998)
Slovakia	3	?	3	90-98	EEA (2009)
Slovenia	2	60-80	2	90-98	N. Jogan (pers. comm.)
Spain	1	?	1	?	EEA (2009)
Switzerland	2	40-70	5	90-98	Martinet & Dubost (1992), Gallandat et al. (1993), Lachat et al. (2010)
Ukraine	3	20-40	2	50-70	F. Essl (ined.), A. Mohl (ined.)

Table S3. 2. Estimates of minimum, average and maximum rates of decline of GTPV during the last 50 years and since 1750, shown for individual countries and as area-weighted total for the total range. Baseline figures have been calculated from Table 1.

	national declines (last 50 yrs)			**contribution to global decline**			**national declines (> 1750)**			**contribution to global decline**		
Country	lower bound	mid point	upper bound	lower bound	mid point	upper bound	lower bound	mid point	upper bound	lower bound	mid point	upper bound
Albania	20	30	40	0.6	1.0	1.3	30	40	50	0.6	0.8	1.0
Austria	40	55	70	2.1	2.9	3.7	90	94	98	12.1	12.6	13.1
Bulgaria	40	55	70	0.9	1.2	1.5	70	80	90	0.7	0.8	0.9
Croatia	60	70	80	1.3	1.5	1.7	90	94	98	1.9	1.9	2.0
France	40	55	70	11.9	16.4	20.9	70	80	90	14.4	16.5	18.6
Germany	40	55	70	1.3	1.8	2.2	90	94	98	11.1	11.6	12.1
Italy	40	55	70	12.8	17.6	22.3	60	70	80	14.2	16.6	19.0
Poland	40	55	70	0.9	1.2	1.5	?	?	?	?	?	?
Romania	20	30	40	2.6	3.8	5.1	50	60	70	5.2	6.2	7.2
Serbia & Montenegro	?	?	?	?	?	?	90	94	98	1.9	1.9	2.0
Slovakia	?	?	?	?	?	?	90	94	98	2.8	2.9	3.0
Slovenia	60	70	80	1.3	1.5	1.7	90	94	98	1.9	1.9	2.0
Spain	?	?	?	?	?	?	?	?	?	?	?	?
Switzerland	40	55	70	0.9	1.2	1.5	90	94	98	4.6	4.8	5.1
Ukraine	20	30	40	0.6	1.0	1.3	50	60	70	1.0	1.2	1.4
total decline (%)				**37.0**	**50.9**	**64.7**				**72.4**	**80.0**	**87.5**

Future decline: No projections of future distributions exist. Data Deficient under criterion A2.

Historic declines. Comparisons of current distribution with historic maps and floristic records of Myricaria germanica from the mid-18th century (before large-scale river channelization started in Europe) indicate average losses of over 90% within the last 250 years. Several river systems (e.g. Danube, large sections of Rhone, Rhine, Lech, Inn), where some of the largest occurrences had been, have totally lost GTPV occurrences, particularly since the mid-19th century (e.g. Müller & Bürger 1990, Essl et al. 2002). In several countries (e.g. Austria, Croatia, Germany, Slovenia, Switzerland), losses are highly probably > 95% of original AOO. In south-eastern Europe, the Balkan Peninsula, in Italy and France losses have been less severe and are estimated to be on average at about 70% (Table 1). Area-weighted estimates of total decline of GTPV since 1750 indicate that losses of AOO have been around 80%, with lower and upper boundaries of 72 to 88% (Table 2). Endangered under Criterion A3.

Criterion B

Extent of Occurrence. A minimum convex polygon enclosing all occurrences of GTPV exceeds 100,000 km^2, and hence the ecosystem does not qualify for a threat category under the criterion B1., i.e. Least Concern.

Area of Occupancy. Based on near-European wide data from the Habitats Directive (EEA 2009), GTPV is still present in more than 100 grid cells (10 x 10 km). However, in the majority of these cells, the mapped area of GTPV does not exceed 1 km^2 (1% of cell area). In Austria, for example, GTPV currently occupies approximately 31 10 x 10 km cells, yet it is unlikely that any of these cells contain more than 1 km^2 of the ecosystem. In Italy and France, it is estimated that 6 - 10 cells include more than 1 km^2 of GTPV, while Romania may have a further three. Therefore GTPV may occupy 6 - 13 10 x 10 km grid cells across the total distribution of the ecosystem, excluding those with less than 1% occupancy. Continuing declines of GTPV are occurring in many river systems (criterion B2a) due to the joint effects of river channelization and hydroelectric power plant construction on vital hydro- morphological processes, which may also affect occurrences downriver (criterion B2b). Elsewhere, declines have been recently stopped or even reversed due to river restoration projects (e.g. rivers Lech and Drau in Austria). Based on the number of occupied grid cells continuing declines and future threats, GTPV is Endangered under criterion B2.

Locations. GTPV occurs in several main river catchments across a relatively large geographic range. As threats are hydrologically based there are more than 10 locations and GTPV is Least Concern under criterion B3.

Criterion C

There is evidence of widespread and severe alterations in gravel sedimentation and erosion regimes, in flood pulses and discharge volumes (Lehner et al. 2011). Further, there are indications that water eutrophication and pollution may affect substrate quality. It is likely that these modifications affect more than 50% of current occurrences, but the scale and impact is insufficiently analysed for assessing this criterion, hence the Not Evaluated category is appropriate.

Criterion D

There is some evidence of recent increases in invasive alien woody plants (e.g. Amorpha fruticosa, Buddleja davidii, e.g. Müller 2005) in GTPV in occurrences located in warm-temperate to sub-mediterranean climates. This may negatively affect characteristic biota due to increased competition and changed vegetation structure. However, the scale and impact of this phenomenon is currently poorly understood, and TPV is assigned to Data Deficient under criterion D.

Criterion E

No modelling of risks has been carried out, hence GTPV is Data Deficient under criterion E.

REFERENCES

Billi P, Hey RD, Thorne CR & Tacconi P. 1992. Dynamics of gravel-bed rivers. Chichester: Wiley.

EEA. 2009. Habitats Directive Article 17 Reporting. http://eea.eionet.europa.eu/Public/irc/eionet-circle/habitats- art17report/library?l=/datasheets/habitats. accessed 2011-10-14.

Egger G & Theiss M. 2000. Typisierung der Auen Österreichs. Literaturauswertung der auenspezifischen Pflanzengesellschaften österreichischer Fließgewässer. Unveröffentlichte Studie, Institut für Ökologie und Umweltplanung, Klagenfurt.

Ellmauer T. 2005. Entwicklung von Kriterien, Indikatoren und Schwellenwerten zur Beurteilung des Erhaltungszustandes der Natura 200-Schutzgüter. Band 3: Lebensraumtypen des Anhangs I der Fauna-Flora-Habitat-Richtlinie. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/naturschutz/Berichte_GEZ/Band_3_FFH-Lebensraumtypen.pdf. accessed 2011-10-14. .

Essl F, Egger G., Ellmauer T & Aigner S. 2002. : Rote Liste gefährdeter Biotoptypen Österreichs. Wälder, Forste, Vorwälder. Umweltbundesamt, Wien.

Gallandat JD, Gobat JM & Roulier C. 1993. Kartierung der Auengebiete von nationaler Bedeutung. Schriftenreihe Umwelt 199, Bundesamt für Umwelt, Wald und Landschaft, Bern.

Horvat I, Glavac V, Ellenberg H. 1998. Vegetation Südosteuropas. Urban & Fischer, München.

Kudrnovsky H. 2005. Die Deutsche Tamariske. Myricaria germanica. und ihre FFH-Ausweisung in Österreich. http://www.wasser-osttirol.at/media/studie_tamariske.pdf. (accessed 2011-10-14).

Lachat T, Pauli D, Gonseth Y, Klaus G, Scheidegger C, Vittoz P, Walter T. 2010. Wandel der Biodiversität in der Schweiz seit 1900. Haupt Verlag, Bern.

Lang A, Walentowski H. 2010. Handbuch der Lebensraumtypen nach Anhang I der Fauna Flora-Habitat-Richtlinie in Bayern. Bayerisches Landesamt für Umwelt, Augsburg.

Lehner B, Liermann C, Revenga C, Vörösmarty C, Fekete B, Crouzet P, Döll P, Endejan M, Frenken K, Magome J, Nilsson C, Robertson JC, Rödel R, Sindorf N, Wisser D. 2011. High resolution mapping of the world's reservoirs and dams for sustainable river flow management. Frontiers in Ecology and the Environment. doi:10.1890/100125.

Martinet F, Dubost M. 1992. : Die letzten natumahen Alpenflusse. CIPRA Kleine Schriften 11/92: 6-60.

Müller N. 1995. Wandel von Flora und Vegetation nordalpiner Wildflusslandschaften unter dem Einfluss des Menschen. Berichte der ANL 19: 125-187.

Müller N. 2005. Die herausragende Stellung des Tagliamento. Friaul, Italien. im Europäischen Schutzgebietssystem NATURA 2000. Jahrbuch des Vereins zum Schutze der Bergwelt 70: 19-35.
Müller N, Bürger A. 1990. Flußbettmorphologie und Auenvegetation des oberen Lech im Bereich der Forchacher Wildflußlandschaft. Oberes Lechtal, Tirol. . Jahrbuch des Vereins zum Schutze der Bergwelt 55: 43-74.
Pautou G, Peiry JL, Girel J, Blanchard E, Hughes F, Richards K, Harris T, El-Hames A. 1997. Space-time units in floodplains: the example of the Drac River upstram of Grenoble. Global Ecology and Biogeography Letters 6: 311-319.
Petutschnig W. 1994. Die Deutsche Tamariske in Kärnten. Carinthia II 184/104: 19-30.
Riecken U, Finck P, Raths U, Schröder E, Ssymank A. 2006. Rote Liste der gefährdeten Biotoptypen Deutschlands – zweite fortgeschriebene Fassung 2006. Naturschutz und Biologische Vielfalt 34, 318 pp.
Romao C. 1996. Interpretation manual of European Union habitats. European Commission DG XI, Brussels.
Trinajstic I. 1992. Salici-Myricarietum Moor 1958. Salicion eleagni. in the vegetation of Croatia. Thaiszia 2: 67-74.
Willner W, Grabherr G. 2009. Die Gebüsche und Wälder Österreichs. Spektrum Verlag, Heidelb erg.