

美国湿地植物指示指标由来及应用

张立*, William J. Mitsch

(美国俄亥俄州立大学湿地研究中心, 美国 俄亥俄州 43202)

摘要: 该文略述美国湿地植物指示指标由来并以俄亥俄州立大学湿地研究园人工实验湿地为例, 详细地列出了该人工湿地建成 15 年后的植物及美国湿地植物指示。这个实例有助于中国的湿地恢复及保育。

关键词: 湿地植物; 指示指标; Olentangy River Wetland Research Park

中图分类号: Q948.119 **文献标识码:** A **文章编号:** 1000-3142(2010)06-0736-06

Concept and application for US national wetland vegetation inventory

ZHANG Li*, William J. Mitsch

(Olentangy River Wetland Research Park, The Ohio State University, OH 43202, USA)

Abstract: This paper describes the concept for US national wetland vegetation inventory briefly and its application. It is shown that the wetland vegetation inventory after wetlands created in 15 years is as a case study. The created experimental wetlands were located in the Olentangy River Wetland Research Park—a Ramsar Wetland of international importance site, USA. This method for US wetland vegetation inventory may be useful to wetland creations and restorations in China.

Key words: wetland vegetation; inventory; Olentangy River Wetland Research Park

湿地是由特殊的生态环境构成, 即集水文、湿地植物、土壤、景观及与之相应的生物地球化学过程为一体的生态系统。近十年来, 湿地生态服务功能即净化水体、涵养水源(地表及地下)、生物多样性、生态游憩、固碳等在全球得到愈来愈深刻的认识(IPCC, 2007; Mitsch 等, 2010)。美国对湿地生态服务功能研究的关注早于中国, 特别是 1972 年美国联邦对环境立法, 美国首次为保护湿地、溪流和其他水域立法, 这就是著名的联邦控制水污染法(Clean Water Act)。这一联邦法的第 404 条规定了对湿地保护及补偿政策。美国科学界及政府将恢复湿地提到了国家环境法律的重要位置, 建立了一系列湿地保护法规及政策, 美国补偿湿地的产生及补偿湿地

银行的建立是其中重要部分, 由之而产生出美国湿地植物指示指标, 起源于 1988 年, 由美国内务部提出的国家湿地植物名录, 主要通过植物在特定区域出现概率来指示湿地状态(表 1)。这对定义及划分湿地, 特别是对补偿湿地及补偿湿地银行评估起着重要的指示作用。同时, 这一指标也用来评价湿地重建及探寻湿地植物演变和更替规律。

俄亥俄州立大学校内湿地研究园, 全称为 The Olentangy River Wetland Research Park, 位于美国中西部俄亥俄州首府, 约有 70 多万人口的哥伦布市区(图 1, 图 2)。湿地研究园由实验湿地、季节性湿地、河滩林湿地、暴雨汇集湿地、滩槽湿地、水中花园、生物库湿地、微型湿地等类型齐全的湿地示范区

收稿日期: 2010-10-08 修回日期: 2010-11-10

基金项目: 国家自然科学基金(41071203)[Supported by the National Natural Science Foundation of China(41071203)]

作者简介: 张立(1958-), 女, 博士, 研究员, 主要研究领域为湿地水文及湿地系统、生态工程及恢复、生态系统动态模型及地理信息系统、GIS 空间分布模型, 具有从事国际不同湿地生态系统的研究经验, 目前担任国际期刊《Ecological Indicators》编委, 是 11 个 SCI 国际期刊审稿组成员。

* 通讯作者(Author for correspondence, E-mail: zhang.326@osu.edu)

及研究和教学楼组成为一体,其面积约为 21 hm²。其中实验湿地、季节性湿地和河滩林湿地更为重要,大量的科学研究集中在这里(Mitsch 等,2005;Anderson & Mitsch,2005;Zhang 等,2007)。

湿地研究园中两个形为肾状的各为 1 hm² 实验湿地,建于 1993 年。实验湿地有深水区 and 浅水区,抽取河水为水源,等量的水同时输入到两个实验湿地中。建设初期(1994 年),仅在实验湿地 1(W1)人工种植了 13 种本地水生植物;实验湿地 2(W2)为对照。15 年后,根据美国湿地植物指示指标及土壤和水文,两个实验湿地已形成了典型淡沼湿地,表 2 列出了这两个实验湿地(W1,W2)所有的植物及植物指示指标。至今,美国俄亥俄州立大学湿地研究园已经历 16 年,这 16 年的研究成果大大丰富和开拓了美国和全球的湿地生态科学、生态工程学,特别为美国湿地恢复和创建的基础数据提供了佐证。这个湿地研究园于 2008 年 6 月,被列入世界湿地公约标示的国际重要湿地。

表 1 美国国家湿地植物名录的指示码、
湿地类型及指示码的解释

Table 1 Indicator categories of US national wetland plant list(indicator code,wetland type,comment)

指示码 Indicator code	湿地类型 Wetland type	解释 Comment
OBL	极现湿地	在湿地自然条件下,所出现的概率为 99%
FACW	多现湿地	通常出现在湿地的概率为 67%~99%, 偶而也出现于非湿地
FAC	均现湿地 和高地	通常出现在湿地和非湿地概率相同为 34%~66%
FACU	多现高地	通常出现在非湿地,概率为 67%~99%, 偶而也出现于湿地,概率为 1%~33%
UPL	极现高地	99%总出现该区域的非湿地自然条件 下,而会出现另一区域湿地
NA	待定	区域对该种未能达成一致
NI	未定	无足够的信息确定
NO	不发生	该种不出现该区域

注：出自 1988 美国内务部国家湿地植物名录 Note: 1998 National List of Vascular Plant Species that Occur in Wetlands

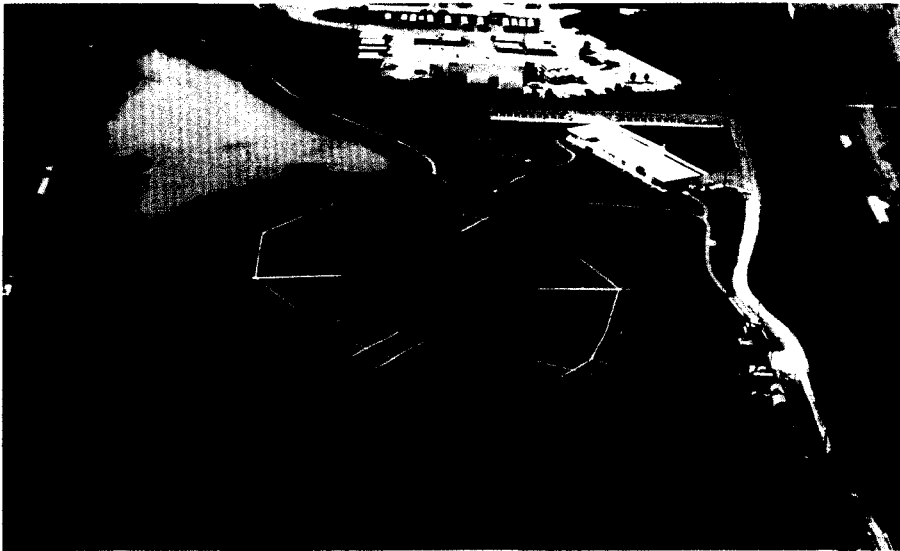


图 1 俄亥俄州立大学校湿地研究园及两个肾型实验湿地的位置
Fig. 1 Experimental wetlands,the Olentangy River Wetland Research Park,Ohio State University

表 2 美国俄亥俄州立大学湿地研究中心两个实验湿地(W1,W2)
建成 15 年后湿地植物名录及湿地指示指标和植物类型

Table 2 Checklist of wet land vegetation, wetland indicator code and plant type in the two experimental wetlands of the Olentangy River Wetland Research Park after wetlands created in 15 years

编号 No.	学名 Scientific name	俗名 Common name	湿地指示指标 Wetland indicator code	植物类型 Plant type
1	<i>Abutilon theophrasti</i>	velvet-leaf	UPL	Herb
2	<i>Acer negundo</i>	boxelder	FACW-	Tree
3	<i>A. rubrum</i>	red maple	FAC	Tree



图 2 俄亥俄州立大学校湿地研究园——肾型实验湿地的秋色（杨小平摄于 2010 年 10 月 21 日）
Fig.2 Autumn view of experimental wetlands at Olentangy River Wetland Research Park,
the Ohio State University (Photo by Yang Xiao-Ping in October 21,2010)

续表 2

编号 No.	学名 Scientific name	俗名 Common name	湿地指示指标 Wetland indicator code	植物类型 Plant type
4	<i>Acorus calamus</i> *	sweet flag, myrtle grass	OBL	Herb
5	<i>Agrostis tenuis</i>	colonial bent grass	NL	Herb
6	<i>Alisma plantago-aquatica</i>	water plantain	OBL	Herb
7	<i>Alliaria petiolata</i>	garlic mustard	FACU—	Herb
8	<i>Amaranthus cruentus</i>	purple amaranth	NL	Herb
9	<i>Ambrosia artemisiifolia</i>	common ragweed	FACU	Herb
10	<i>Apocynum cannabinum</i>	indian hemp	NL	Herb
11	<i>Asclepias incarnata</i>	swamp milkweed	OBL	Herb
12	<i>A. syriaca</i>	common milkweed	NL	Herb
13	<i>A. tuberosa</i>	milkweed	NL	Herb
14	<i>Asimina triloba</i>	common pawpaw	FACU+	Tree

续表 2

编号 No.	学名 Scientific name	俗名 Common name	湿地指示指标 Wetland indicator code	植物类型 Plant type
15	<i>Aster ericoides</i>	white heath aster	FACU	Herb
16	<i>A. novae-angliae</i>	new england aster	FACW	Herb
17	<i>A. prenanthoides</i>	crooked stemmed aster	FAC	Herb
18	<i>A. simplex</i>	panicled aster	FACW	Herb
19	<i>Atriplex patula</i>	halberd-leaf saltbush	FACW-	Herb
20	<i>Barbarea orthoceras</i>	American winter cress	OBL	Herb
21	<i>Bidens cernua</i>	nodding beggars-tick	OBL	Herb
22	<i>B. comosa</i>	leafy-bract beggars-tick	FACW	Herb
23	<i>B. connata</i>	swamp beggar ticks	OBL	Herb
24	<i>B. frondosa</i>	devil's beggars-tick	FACW	Herb
25	<i>B. laevis</i>	brook sunflower, bur marigold	OBL	Herb
26	<i>Boehmeria cylindrica</i>	false nettle	OBL	Herb
27	<i>Bouteloua curtipendula</i>	sideoats grama	NL	Herb
28	<i>Callitriche terrestris</i>	terrestrial water-starwort	NL	Herb
29	<i>Carex tribuloides</i>	blunt broom sedge	FACW+	Herb
30	<i>C. vulpinoidea</i>	brown fox sedge	OBL	Herb
31	<i>Cassia fasciculata</i>	showy partridge pea	FACU	Herb
32	<i>Chenopodium capitatum</i>	strawberry blite, indian paint, blite goosefoot	NL	Shrub
33	<i>Cichorium intybus</i>	chicory	NL	Herb
34	<i>Cirsium altissimum</i>	tall thistle	NL	Herb
35	<i>C. arvense</i>	canada thistle, creeping thistle	FACU	Herb
36	<i>Convolvulus sepium</i>	hedge bindweed	NL	Vine
37	<i>Conyza canadensis</i>	common horseweed	UPL	Herb
38	<i>Cyperus esculentus</i>	yellow nutsedge	FACW	Herb
39	<i>C. strigosus</i>	straw color flat sedge, umbrella sedge	FACW	Herb
40	<i>Daucus carota</i>	queen anne's lace, wild carrot	NL	Herb
41	<i>Desmanthus illinoensis</i>	prairie bundle flower	FAC	Herb
42	<i>Dipsacus fullonum</i>	Fuller's teasel	NL	Herb
43	<i>Echinochloa crusgalli</i>	barnyard grass	FACU	Herb
44	<i>Eleocharis obtusa</i>	blunt spikerush	OBL	Herb
45	<i>Epilobium coloratum</i>	purple-leaved willow herb	OBL	Herb
46	<i>E. glandulosum</i>	fringed willow-herb	NL	Herb
47	<i>Equisetum hyemale</i>	horsetail	FACW-	Herb
48	<i>Erigeron canadensis</i>	horseweed	NL	Herb
49	<i>Eupatorium perfoliatum</i>	common boneset	FACW+	Herb
50	<i>E. serotinum</i>	white snake root	FAC-	Herb
51	<i>Euphorbia corollata</i>	flowering spurge	NL	Herb
52	<i>E. nutans</i>	eyebane broomspurge	FACU-	Herb
53	<i>Fraxinus pennsylvanica</i>	green ash	FACW	Tree
54	<i>Galium trifidum</i>	small bedstraw	FACW+	Herb
55	<i>Glyceria striata</i>	fowl meadow grass	OBL	Herb
56	<i>Hypericum boreale</i>	northern St. Johnswort	OBL	Herb
57	<i>H. punctatum</i>	spotted St. Johnswort	FAC-	Herb
58	<i>Impatiens capensis</i>	orange touch-me-not, jewelweed	FACW	Herb
59	<i>Ipomoea purpurea</i>	common morning glory	UPL	Vine
60	<i>Juglans cinerea</i>	butternut	FACU+	Tree
61	<i>Juncus acuminatus</i>	taper-tip rush	OBL	Herb
62	<i>J. canadensis</i>	Canadian rush	OBL	Herb
63	<i>J. dudleyi</i>	Dudley's rush	NL	Herb
64	<i>J. effusus</i> *	soft rush	FACW+	Herb
65	<i>J. torreyi</i>	torrey's rush	FACW	Herb
66	<i>Leersia oryzoides</i>	rice-cut grass	OBL	Herb
67	<i>Lemna minor</i>	lesser duckweed	OBL	Herb
68	<i>Lespedeza intermedia</i>	wandlike bush cover	NL	Herb
69	<i>Leucospora multifida</i>	narrowleaf paleseed	NL	Herb
70	<i>Lindernia dubia</i>	yellow-seed false pimpernel	OBL	Herb

续表 2

编号 No.	学名 Scientific name	俗名 Common name	湿地指示指标 Wetland indicator code	植物类型 Plant type
71	<i>Lobelia cardinalis</i>	cardinal flower	OBL	Herb
72	<i>L. siphilitica</i>	great lobelia	FACW+	Herb
73	<i>Lonicera maackii</i>	honeysuckle	NL	Shrub
74	<i>Lycopus americanus</i>	american bugleweed	OBL	Herb
75	<i>L. asper</i>	rough bugleweed	OBL	Herb
76	<i>Lysimachia nummularia</i>	creeping jennie	FACW+	Herb
77	<i>L. terrestris</i>	swamp loosestrife	OBL	Herb
78	<i>Lythrum hyssopifolia</i>	hyssop loosestrife	OBL	Herb
79	<i>L. salicaria</i>	purple loosestrife	NL	Herb
80	<i>Melilotus officinalis</i>	yellow sweetclover	FACU-	Herb
81	<i>Mentha arvensis</i>	field mint	FACW	Herb
82	<i>Mimulus ringens</i>	allegheny monkey flower	OBL	Herb
83	<i>Nelumbo lutea</i> *	yellow lotus, American lotus	OBL	Herb
84	<i>Nuphar lutea</i>	yellow pond-lily	OBL	Herb
85	<i>Nymphaea odorata</i> *	white water lily	OBL	Herb
86	<i>Oenothera biennis</i>	evening primrose	FACU-	Herb
87	<i>Oxalis europaea</i>	upright yellow woodsorrel	UPL	Herb
88	<i>O. stricta</i>	yellow wood sorrel	NL	Herb
89	<i>Panicum capillare</i>	witchgrass	FAC-	Herb
90	<i>P. virgatum</i>	hamelin dwarf switchgrass	FAC	Herb
91	<i>P. virginicum</i>	heavy metal switchgrass	NL	Herb
92	<i>Parthenocissus quinquefolia</i>	Virginia creeper	FACU	Vine
93	<i>Pastinaca sativa</i>	wild parsnip	NL	Herb
94	<i>Penthorum sedoides</i>	ditch stonecrop	OBL	Herb
95	<i>Phalaris arundinacea</i>	reed canary grass	FACW+	Herb
96	<i>Phragmites australis</i>	common reed	FACW+	Herb
97	<i>Phytolacca americana</i>	pokeweed, joe pie weed	FACU+	Herb
98	<i>Plantago major</i>	common plantain	FACU	Herb
99	<i>Plantanus occidentalis</i>	Eastern sycamore	FACW	Tree
100	<i>Polygonum hydropiper</i>	water pepper	OBL	Herb
101	<i>P. hydropiperoides</i>	mild water pepper	OBL	Herb
102	<i>P. lapathi folium</i>	nodding smartweed	FACW+	Herb
103	<i>P. pennsylvanicum</i>	pink knotweed, pennsylvania smartweed	FACW+	Herb
104	<i>P. persicaria</i>	lady's thumb	FACW	Herb
105	<i>Pontederia cordata</i> *	pickerel weed	OBL	Herb
106	<i>Populus deltoides</i>	eastern cottonwood	FAC+	Tree
107	<i>P. tremuloides</i>	quaking aspen	FACU	Tree
108	<i>Potamogeton foliosus</i>	bushy pondweed	OBL	Herb
109	<i>P. natans</i>	floating leaf pondweed	OBL	Herb
110	<i>P. pectinatus</i> *	sago pondweed	OBL	Herb
111	<i>Prunella vulgaris</i>	heal all	FAC	Herb
112	<i>Rhus radicans</i>	poison ivy	FACU	Herb
113	<i>Rorippa palustris</i>	marsh yellow cress	OBL	Herb
114	<i>R. sylvestris</i>	creeping yellow cress	OBL	Herb
115	<i>Rosa multiflora</i>	multiflora rose	FACU	Shrub
116	<i>R. palustris</i>	swamp rose	OBL	Shrub
117	<i>Rudbeckia hirta</i>	black-eyed susan	FACU-	Herb
118	<i>R. triloba</i>	thin-leaved coneflower	FACU	Herb
119	<i>Rumex crispus</i>	curly dock	FAC+	Herb
120	<i>R. verticillatus</i>	swamp dock	OBL	Herb
121	<i>Sagittaria latifolia</i> *	broad-leaf arrowhead	OBL	Herb
122	<i>Salix alba</i>	white willow	FACW	Tree
123	<i>S. amygdaloides</i>	peachleaf willow	FACW	Tree
124	<i>S. babylonica</i>	weeping willow	FACW-	Tree
125	<i>S. exigua</i>	sandbar willow	OBL	Tree
126	<i>S. nigra</i>	black willow	OBL	Tree

续表 2

编号 No.	学名 Scientific name	俗名 Common name	湿地指示指标 Wetland indicator code	植物类型 Plant type
127	<i>Samolus parviflorus</i>	water pimpernel	OBL	Herb
128	<i>Saururus cernuus</i> *	lizard's tail	OBL	Herb
129	<i>Schoenoplectus tabernaemontani</i> *	soft-stem bulrush	OBL	Herb
130	<i>Scirpus cyperinus</i>	woolgrass	OBL	Herb
131	<i>S. fluviatilis</i> *	river bulrush	OBL	Herb
132	<i>Setaria viridis</i>	foxtail	NL	Herb
133	<i>Solanum carolinense</i>	horse nettle	UPL	Herb
134	<i>Solidago altissima</i>	tall goldenrod	FACU-	Herb
135	<i>Sonchus oleraceus</i>	common sow thistle	UPL	Herb
136	<i>Sorghum halepense</i>	johnson grass	FACU	Herb
137	<i>Sparganium eurycarpum</i> *	giant bur-reed, common bur-reed	OBL	Herb
138	<i>Spartina pectinata</i> *	freshwater cordgrass	FACW+	Herb
139	<i>Spirodela polyrhiza</i>	greater duckweed	OBL	Herb
140	<i>Symplocarpus foetidus</i>	skunk cabbage	OBL	Herb
141	<i>Taraxacum officinale</i>	common dandelion	FACU-	Herb
142	<i>Toxicodendron radicans</i>	poison ivy	FAC	Herb
143	<i>Trifolium dubium</i>	suckling clover	UPL	Herb
144	<i>T. hybridum</i>	alsike clover	FACU-	Herb
145	<i>T. pratense</i>	red clover	FACU-	Herb
146	<i>Typha angustifolia</i>	narrow-leaved cattail	OBL	Herb
147	<i>T. latifolia</i>	wide-leaved cattail	OBL	Herb
148	<i>Ulmus procera</i>	english elm	NI	Tree
149	<i>U. pumila</i>	chinese elm	NI	Tree
150	<i>Verbena hastata</i>	blue vervain	FACW+	Herb
151	<i>V. urticaefolia</i>	white vervain	FACU	Herb
152	<i>Vernonia fasciculata</i>	prairie ironweed	FAC	Herb
153	<i>Vitis vulpina</i>	wild grape	FACW-	Vine
154	<i>Xanthium strumarium</i>	rough cocklebur	FAC	Herb

注：Herb=草本, Tree=木本, Shrub=灌木, Vine=藤本；带 * 号为 1994 年种植的植物。

参考文献：

Anderson CJ, Mitsch WJ. 2006. Sediment, carbon, and nutrient accumulation at two 10-year-old created riverine marshes [J]. *Wetlands*, **26**: 779--792

IPCC. 2007. Climate Change 2007: The Physical Science Basis [M]. Cambridge University Press, Cambridge, UK

Mitsch JW, Nahlik AM, Wolski P, et al. 2010. Tropical wetlands: Seasonal hydrologic pulsing, carbon sequestration, and methane emissions[J]. *Wetlands Ecology and Management*, **18**: 573—586

Mitsch WJ, Zhang L, Anderson CJ, et al. 2005. Creating riverine wetlands: Ecological succession, nutrient retention, and pulsing effects[J]. *Ecological Engineering*, **25**: 510—527

Zhang L, Mitsch WJ. 2007. Sediment chemistry and nutrient influx in a hydrologically restored bottomland hardwood forest in Midwestern USA[J]. *River Research and Applications*, **23**: 1 026—1 037

(上接第 911 页 Continue from page 911)

点与研究成果,进一步促进我国植物学事业的繁荣
昌盛,并由此推动刊物的向前发展。

参考文献：

梁光铁. 1997. 《右江民族医学院学报》发展前瞻[J]. 右江民族
医学院学报, (4): 672—674

Jiang QY(蒋巧媛), Li ZQ(李振乾), Jin DJ(金代钧). 1998. Re-
view and expectation of Guihaia that was originated for eighteen
years(《广西植物》创办十八年: 回顾与展望)[J]. *Guihaia*(广
西植物), **18**(4): 390—394

Jiang QY(蒋巧媛), Chen Q(陈泉), Lu YF(陆媛峰). 2008. A-
nalysis of academic influence of GUIHAIA based on CJCR and
CAJCCR(基于 CJCR 和 CAJCCR 的《广西植物》学术影响力分
析)[J]. *Guihaia*(广西植物), **28**(2): 273—277