10.1071/MF14173_AC

Supplementary Material: *Marine and Freshwater Research* **65**, 934–941.

Supplementary Material

How much wetland has the world lost? Long–term and recent trends in global wetland area

Nick C. Davidson

Institute for Land, Water and Society, Charles Sturt University, Albury, NSW, Australia; and Chemin des Jordils 18, 1261 Le Vaud, Switzerland.

Email: arenaria.interpres@gmail.com

This publication provides listings of the published sources of records of wetland area change, and a summary of their geographical distribution, included in the analyses.

Each record was categorised as follows:

i. For broad wetland types: inland natural wetlands; coastal natural wetlands; human–made wetlands; unspecified wetland type(s).

ii. For geographical regions (*sensu* the regional categorisation under the Ramsar Convention on Wetlands – see Ramsar Resolution XI.19 on: http://www.ramsar.org/pdf/cop11/res/cop11–res19–e.pdf): Africa; Asia; Europe; Neotropics (Central and South America and the Caribbean); North America; Oceania (including Australasia).

iii. For year periods: records were allocated to one of five time–periods of their start year: 'long–term' – before 1900 AD; 1900 to 1944; 1945 to 1974; 1975 to 1989; or 1990 and later.

The precision of the total percentage change estimates is as provided in the published sources, or to two decimal places if the published data permitted a more precise calculation. Percentage change per year was calculated as the average annual rate of change for the overall year period. Percentage rate of change figures in italics below are approximate, for imprecisely reported year periods.

In total, 189 records (64 ‘long–term’ and 125 20th/early 21st century records) are included in the analyses. Table A1 summarises the geographical scale of each record. Records include those at individual wetland site, sub–national region, national and supra–national region and global scales. Those record allocated to the ‘wetland site’ scale include any system that is a discrete functional wetland unit, regardless of its sise or whether it is in one or more countries. This includes, for example, systems such as Lake Chad and the Wadden Sea. But where a record is for all types of wetland in a whole river basin, these are treated as 'sub–national region' records.

Table A1. Geographical scale of wetland area change records

A. ‘long–term’ records

	No. of records	**% of records**			
Wetland type:		Wetland site	Sub–national region	National	Supra–national region/global
Inland natural wetlands	25	4	40	48	8
Coastal natural wetlands	31	42	29	23	6
Human–made wetlands	1	0	0	100	0
Unspecified wetland type(s)	7	0	29	71	0
Geographical region:					
Africa	3	0	33	67	0
Asia	7	0	0	86	14
Europe	43	28	33	35	4
Neotropics	0	0	0	0	0
North America	4	0	100	0	0
Oceania	6	17	50	33	0
Global	1	–	–	–	100
Total	**64**	**22**	**33**	**39**	**6**

B. 20th/early 21st century records

	No. of records	**% of records**			
Wetland type:		Wetland site	Sub–national region	National	Supra–national region/global
Inland natural wetlands	62	25	41	17	17
Coastal natural wetlands	45	33	9	38	20
Human–made wetlands	8	38	12	25	25
Unspecified wetland type(s)	10	0	0	90	10
Geographical region:					
Africa	10	40	0	30	30
Asia	31	32	13	48	7
Europe	53	26	32	30	12
Neotropics	6*	17	33	0	50*
North America	16*	12	31	45	12*
Oceania	4	25	25	0	2
Global	6	–	–	–	100
Total	**125**	**26**	**25**	**31**	**18**

* one record covers both geographical regions

Table A2 lists the records of long–term wetland area change i.e. records with a start year prior to 1900 AD. Table A3 lists the records for the 20th and early 21st centuries, with a start year of 1900 AD or later.

Table A2. Records of long–term change in wetland area
'Long–term' is a record with a start year before 1900 AD

Wetland type(s)	Geographical region(s)	Location/area/site	Year period	Year period category	No. of years	% change	% change yr^{-1}	Source
Unspecified natural type(s)								
Unspecified type(s)	Asia	Indonesia	up to 1982	Long–term	–	–31	–	Scott (1993), citing Silvius *et al.* (1986)
Unspecified type(s)	Europe	Italy	Roman times (c. 750 BC) – 1980s	Long–term	c. 1230	–93.6	*–0.035*	Jones and Hughes (1993)
Unspecified type(s)	Europe	Spain	Up to mid–1980s	Long–term	–	>–60	–	Jones and Hughes (1993), citing Bifani *et al.* (1991)
Unspecified type(s)	Europe	Spain	1800–1990	Long–term	190	–60	–0.316	Perennou *et al.* (2012), citing Casado and Montes (1995)
Unspecified type(s)	North America	Coterminous USA	1780s–1980s	Long–term	200	–52.9	–0.265	Dahl (1990)
Unspecified type(s)	North America	Non–coterminous USA	1780s–1980s	Long–term	200	–30.1	–0.151	Dahl (1990)
Unspecified type(s)	Oceania	New Zealand	Pre–European settlement (18th C)–1970s	Long–term	c. 270	–85 to –90	*–0.324*	Ministry of the Environment (1997)
Inland natural wetlands								
Inland wetlands	Africa	Tunisia	1881–1987	Long–term	106	–28	–0.264	Maamouri and Hughes (1992)
Inland wetlands	Africa	South Africa: Mfolozi catchment	Pre–European settlement (1650) – 1980s	Long–term	c. 330	–58	*–0.171*	Kotze *et al*. (1995)
Tropical peatswamp forest	Asia	South–east Asia	To 2000	Long–term	–	–43	–	Page *et al*. (2009)
Lowland raised bogs	Europe	NW England/S Scotland	1840–1978	Long–term	138	–87	–0.630	Lindsay and Immirzi (1996)
Lowland raised bogs	Europe	Great Britain	To 1994	Long–term	–	–94.5	–	Lindsay and Immirzi (1996)
Wet grasslands	Europe	UK	To 1980s	Long–term	–	–40	–	RSPB (1993)
Peatlands	Europe	Great Britain	To 1980s	Long–term	–	–45	–	Jones and Hughes (1993), citing Baldock (1990)

Peatlands	Europe	Ireland	To 1980s	Long–term	–	–55	–	Ryan and Cross (1984)
Inland wetlands	Europe	Portugal: Algarve	To mid–1980s	Long–term	–	–70	–	Jones and Hughes (1993), citing Pullan (1988)
Inland saline wetlands	Europe	Spain	1800–1990	Long–term	190	–23	–0.121	Perennou *et al.* (2012), citing Casado and Montes (1995)
Inland freshwater wetlands	Europe	Spain	1800–1990	Long–term	190	–68	–0.358	Perennou *et al.* (2012), citing Casado and Montes (1995)
Floodplain wetlands	Europe	Spain	1800–1990	Long–term	190	–80	–0.421	Perennou *et al. (*2012), citing Casado and Montes (1995)
Peatlands	Europe	Germany: northern part	To 1990s	Long–term	–	–50	–	European Commission (1995)
Raised bogs (undamaged)	Europe	UK	To 1990s	Long–term	–	–94	–	European Commission (1995)
Shallow lakes, bogs and wet meadows	Europe	Denmark	1780s–1980s	Long–term	200	–66	–0.330	Moller (1992)
Floodplains	Europe	Germany: the Rhine	1815–1874	Long–term	59	c. –60	*–1.017*	Dugan and Jones (1993)
Floodplains	Europe	Danube	To 2010	Long–term	–	–68	–	WWF (2010)
Peatlands	Europe	Finland	To 1990	Long–term	–	–65	–	Jones and Hughes (1993)
Freshwater marshes	Europe	Italy: Po delta	1870s–1960s	Long–term	c. 90	–98	*–1.089*	Airoldi and Beck (2007)
Riverine forest	Europe	Germany: the Rhine	1830–1990	Long–term	160	–21.25	–0.133	European Commission (1995)
Prairie potholes and sloughs	North America	Canada	Pre–European settlement (c. 1500)–1980s	Long–term	c. 480	c. –71	*–0.147*	National Wetlands Working Group (1988)
Inland wetlands	North America	Canada: southern Ontario	Pre–European settlement (c. 1500)–2002	Long–term	c. 500	–72	*–0.150*	Ducks Unlimited (2010)
Shoreline marshes and swamps	North America	Canada: Lower Great Lakes and St. Lawrence River	Pre–European settlement (c. 1500)–1980s	Long–term	c. 480	–70	*–0.146*	National Wetlands Working Group (1988)
Freshwater marshes	North America	Canada: Lake Ontario	1789–1979	Long–term	190	–43	–0.226	Whillans (1982)
River/floodplains	North America	USA: Missouri River	1879–1954	Long–term	75	–50	–0.667	Brinson and Malvarez (2002)
Coastal natural wetlands								
Seagrass beds	Global	Global	1879–2006	Long–term	127	–29	–0.228	Waycott *et al.* (2009)
Mangroves	Asia	Singapore	To 1980s	Long–term	–	–97	–	Scott (1993), citing Scott (1989)
Seagrasses	Asia	Indonesia	To 2000	Long–term	–	–30 to –40	–	UNEP (2004)

Seagrasses	Asia	Philippines	To 2000	Long–term	–	–30 to –50	–	UNEP (2004)
Seagrasses	Asia	Thailand	To 2000	Long–term	–	–20 to –30	–	UNEP (2004)
Seagrasses	Asia	Vietnam	To 2000	Long–term	–	–40 to –50	–	UNEP (2004)
Intertidal flats and marshes	Europe	UK: The Wash	1000–1980	Long–term	980	–61.2	–0.062	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Severn Estuary	1000–1980	Long–term	980	–32.1	–0.033	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Dee Estuary	1730–1980	Long–term	250	–31.6	–0.126	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Humber Estuary	1600–1850	Long–term	250	–25.4	–0.102	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Tees Estuary	1720–1980	Long–term	260	–87.5	–0.337	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Portsmouth Harbour	1540–1980	Long–term	440	–33.7	–0.077	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Ribble Estuary	1800–1980	Long–term	180	–17.9	–0.099	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Morecambe Bay	1200–1900	Long–term	700	–3.8	–0.005	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Southampton Water	1830–1980	Long–term	150	–33.4	–0.223	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Suffolk estuaries	1200–1980	Long–term	780	–68.543	–0.088	Davidson *et al.* (1991)
Intertidal flats and marshes	Europe	UK: Poole Harbour	1807–1969	Long–term	162	–74.25	–0.159	Davidson *et al.* (1991)
Coastal wetlands	Europe	Spain	c. 1800–1985	Long–term	c. 185	–59.24	*–0.320*	Casado *et al.* (1992)
Coastal marshes	Europe	Italy: Friuli–Venezia Giulia	1877–1990	Long–term	103	–85.94	–0.761	Musi, Perco and Utmar (1992)
Mudflats	Europe	Italy: Friuli–Venezia Giulia	1877–1990	Long–term	103	–7.69	–0.068	Musi, Perco and Utmar (1992)
Saltmarshes	Europe	Italy: Friuli–Venezia Giulia	1877–1990	Long–term	103	–80.00	–0.708	Musi, Perco and Utmar (1992)
Saltmarshes	Europe	Italy: Po delta	1870s–1960s	Long–term	c.90	–70	*–0.778*	Airoldi and Beck (2007)
Saltmarshes	Europe	Portugal: west Algarve	To 1988	Long–term	–	–70	–	Airoldi and Beck (2007)
Estuarine habitats	Europe	Germany/Netherlands: Wadden Sea – Ems/Dollard	To 2000	Long–term	–	c. –67	–	Talke and de Swart (2006)
Intertidal flats and salt marshes	North America	Canada: Atlantic coast	Pre–European settlement (c. 1500) –1980s	Long–term	c. 480	–65	*–0.135*	National Wetlands Working Group (1988)
Estuarine wetlands	North America	Canada: Pacific coast	Pre–European settlement (c. 1500)–1980s	Long–term	c. 480	–80	*–0.167*	National Wetlands Working Group (1988)
Seagrasses	Oceania	Australia: Gulf of	To 2000	Long–term	–	–20	–	UNEP (2004)

		Carpentaria						
Seagrasses	Oceania	Australia: Cockburn Sound	To 2000	Long–term	–	–70	–	UNEP (2004)
Saltmarshes	Oceania	Australia: south–east	To 2000s	Long–term	–	–70	–	Crooks *et al*. (2011), citing Saintilan and Rogers (2009)
Intertidal marshes and mangroves	Oceania	Australia: Victoria	Mid–19th century – 2010	Long–term	c. 160	–5 to –20	*–0.078*	Sinclair and Boon (2012)
Mangroves	Oceania	Fiji	To 1985	Long–term	–	–6	–	Scott (1993)
Human–made wetlands								
Reservoirs	Africa	Tunisia	1881–1987	Long–term	106	+17.20	+0.162	Maamouri and Hughes (1992)

Table A3. Records of change in wetland area during the 20th and early 21st centuries

Wetland type(s)	Geographical region(s)	Location/area/site	Year period	Year period start category (onwards)	No. of years	% change	% change.yr^{-1}	Source
Unspecified natural type(s)								
Unspecified type(s)	Africa	Libya	2005–2010	1990	5	–3	–0.600	Perennou *et al.* (2012), citing Anon (2012)
Unspecified type(s)	Africa	Algeria	c. 1900–1985	1900	c. 85	–6.5	*–0.076*	Chalabi (1992)
Unspecified type(s)	Europe	Netherlands	1950–1985	1945	35	–55	–1.570	EC (1995)
Unspecified type(s) (excluding marshes)	Europe	West Germany	1950–1985	1945	35	–57	–1.629	EC (1995)
Unspecified type(s)	Europe	Mediterranean	1900–2000	1900	100	c. –50	*–0.500*	Perennou *et al.* 2012
Unspecified type(s)	Europe	France	c. 1900–1990	1900	c. 90	–67	*–0.744*	EC (1995)
Unspecified type(s)	Europe	Spain	1948–1990	1945	42	–60	–1.446	EC (1995)
Unspecified type(s)	Europe	Italy	1938–1984	1900	46	–66	–1.467	EC (1995)
Unspecified type(s)	Europe	Greece	1920–1991	1900	71	–63	–0.908	EC (1995)
Unspecified type(s)	Europe	Bulgaria	1945–1989	1945	44	–94.5	–2.148	Wilson and Moser (1994)
Inland natural wetlands								
Peatlands	Global	Global	1990–2008	1990	18	–0.966	–0.054	Joosten (2009)
Inland open waters (natural and artificial)	Global	Global	1993–2007	1990	14	–6	–0.429	Prigent *et al.* (2012)
Peatlands	Antarctica/sub–Antarctic	Antarctica/sub–Antarctic	1990–2008	1990	18	–0.001	–0.001	Joosten (2009)
Peatlands	Africa	Africa	1990–2008	1990	18	0.008	<0.001	Joosten (2009)
Lakes	Africa	Lake Chad	1983–2005	1975	22	–94.6	–4.300	UNEP (2007)
Inland wetlands	Africa	Morocco	1978–1998	1975	20	–25	–1.250	Green *et al.* (2002)
Freshwater wetlands	Africa	Zambia: Kafue Flats	1984–1994	1975	10	–13.43	–0.134	Munyati (2000)
Lakes and marshes	Africa	Kenya: Lake Baringo	1986–2000	1975	14	–13.95	–0.996	Kiagi *et al.* (2007)
Open water	Africa	Niger/Mali: River Niger Basin	1987–2000	1975	13	–13.04	–1.003	Yaw and Edmund (2007)
Peatlands	Asia	Asia	1990–2008	1990	18	<–0.001	–0.001	Joosten (2009)
Freshwater swamps	Asia	Israel: Hula Swamp	1900–1970	1900	70	–83	–1.186	Scott (1993), citing Carp (1980)
Lakes	Asia	China	1950–2000	1945	50	–16	–0.320	An *et al.* (2007)
Lakes	Asia	China	1950s–1980s	1945	c. 30	–11	*–0.362*	Scott (1993)
Inland wetlands	Asia	China	1978–2008	1975	20	–37.757	–1.888	Niu *et al.* (2012)
Freshwater swamps	Asia	China	1950–2000	1945	50	–23	–0.460	An *et al.* (2007)
Rivers	Asia	China	1950–2000	1945	50	–15	–0.300	An *et al.* (2007)
Marshes	Asia	China: West Songnen	1954–2008	1945	54	–74	–1.370	Wang *et al.* (2011)

		Plain						
Tropical peatswamp forest	Asia	Indonesia: Central Kalimantan	1973–2003	1945	30	–78	–2.600	Page *et al*. (2009)
Oases	Asia	Jordan: Azraq Oasis	1985–2005	1975	20	–23.91	–1.195	ESA (2013)
Inland wetlands	Asia	Iraq: Mesepotamian Marshes	1973–76 – 2000	1975	c. 25	–85.5	*–3.420*	Partow (2001)
Saline lakes	Asia	I.R. Iran: Lake Urmia	1969–2011	1945	42	–60.57	–1.442	UNEP (2012)
Inland Lakes	Asia	India: Lake Kolleru	1990–2004	1900	14	–42	–3.000	Rao, Khrisna and Malini (2004); UNEP (2010)
Inland Lakes	Asia	China: Yangtze & Han River basins	1950s–1989	1945	c. 39	–68	*–1.744*	Hu and Cui (1990)
Inland Lakes	Asia	I.R. Iran: Lake Hamoun	1971–1982	1945	11	c.–83	*–7.545*	Ashianti–Zarandi (1990)
Lakes	Asia	India: Najafgarh Lake	1960s–1990	1945	30	–100	*–3.333*	Menon (1993)
Peatlands	Europe	Europe	1990–2008	1990	18	–4.924	–0.274	Joosten (2009)
Inland marshes	Europe	Greece: Macedonia	1930–mid 1980s	1900	c. 55	–94	*–1.709*	Jones and Hughes 1993, citing Psilovikos (1990)
Lakes	Europe	Greece: Macedonia	1930–mid 1980s	1900	c. 55	>–33	*>–0.600*	Jones and Hughes 1993, citing Psilovikos (1990)
Lakes	Europe	Russia: Aral Sea	1960–2007	1945	47	–75.6	–1.609	JAXA (2007); Micklin (2007)
Lakes and related wetlands	Europe	Turkey: Lake Amik	1965–1987	1945	22	–100	–0.045	Kilic *et al*. (2006)
Inland vegetated wetlands	Europe	Europe	1990–2006	1990	16	–2.7	–0.168	EEA (2010)
Bogs and marshes	Europe	Europe	1990–2000	1990	10	–3.5	–0.335	EEA (2007)
Inland wetlands	Europe	Belgium: Flanders	1960s–mid 1980s	1945	c. 25	–90	*–3.600*	Jones and Hughes 1993, citing Kuijken (1988)
Raised bogs	Europe	The Netherlands	1900s–1990s	1900	c. 90	–90	*–1.000*	European Commission (1995)
Lowland mires	Europe	Scotland	1947–1988	1945	41	–44	–1.005	Mackey *et al*. (1998)
Blanket mires	Europe	Scotland	1947–1988	1945	41	–21	–0.537	Mackey *et al*. (1998)
Peatlands	Europe	Scotland: Flow Country	1970–1987	1945	17	–15.20	–0.894	Stroud et al. (1988)
Lochs (lakes)	Europe	Scotland	1947–1988	1945	41	–9.64	–0.235	Mackey *et al*. (1998)
Rivers	Europe	Scotland	1947–1988	1945	41	–2.18	–0.053	Mackey *et al*. (1998)
Inland wetlands	Europe	Romania: Danube Delta	1983–1990	1975	7	–23	–3.286	Munteau and Toniuc (1992)
Inland wetlands	Europe	Spain: Castille–La Mancha region	c.1960–1985	1945	c. 25	–45	–1.800	Hollis (1992), citing Montes and Bifani (1989)
Inland wetlands	Europe	Greece: Peleponnese	c. 1900 – c. 1985	1900	c. 85	–33.72	*–0.397*	Handrinos 1992
Inland wetlands	Europe	Greece: Sterea Hellas	c. 1900 – c. 1985	1900	c. 85	–63.53	*–0.747*	Handrinos (1992)
Inland wetlands	Europe	Greece: Thessaly	c. 1900 – c. 1985	1900	c. 85	–94.77	*–1.115*	Handrinos (1992)
Inland wetlands	Europe	Greece: Epirus	c. 1900 – c. 1985	1900	c. 85	–39.56	*–0.465*	Handrinos (1992)
Inland wetlands	Europe	Greece: Macedonia	c. 1900 – c. 1985	1900	c. 85	–73.27	*–0.862*	Handrinos (1992)

Inland wetlands	Europe	Greece: Thrace	c. 1900 – c. 1985	1900	c. 85	–56.51	*–0.665*	Handrinos (1992)
Inland wetlands	Europe	Spain: Coto Donana	1900–2005	1900	105	–82	–0.781	Kettle *et al.* (2011)
Peatlands	Europe	Estonia	1950s–1990s	1945	c. 40	–63.50	*–1.587*	Kimmel *et al.* (2010)
Floodplains	Europe	Estonia	1950s–1990s	1945	c. 40	–75.90	*–1.898*	Kimmel *et al.* (2010)
Peatlands	Americas (Neotropics & N America)	Americas	1990–2008	1990	18	<–0.001	<0.001	Joosten (2009)
All inland types	Neotropics	Colombia: Canca River valley	1950s–1980s	1945	c. 30	–88	*–2.930*	Maltby (2009), citing Scott and Carbonell (1986)
Inland wetlands	Neotropics	Colombia: Cauca River Valley	1950s–1989	1945	c. 34	–88	*–2.588*	Naranjo (1993)
Freshwater vegetated wetlands	North America	USA	1974–2004	1945	30	–5.360	–0.179	Dahl (2006)
Prairie potholes	North America	Canada: Dakota	1970s/80s – 2011	1975	c. 30	–8.12	*–0.28*	Johnston (2013)
Prairie potholes	North America	Canada: Dakota	2001–2011	1990	10	–3.5	–0.35	Johnston (2013)
Inland wetlands	North America	USA	mid–1970s – mid–1980s	1975	c. 10	–2.5	–0.128	Dahl and Johnson (1991)
Inland wetlands	North America	Canada: Quebec (St Lawrence Lowlands)	1993–2001	1990	8	–11.59	–1.449	Jobin *et al*. (2009)
Inland wetlands	North America	Canada: Quebec Appalachians)	1993–2001	1990	8	0	0	Jobin *et al*. (2009)
Inland wetlands	North America	Canada: prairies	1985–2001	1990	16	–5	–0.222	Watmough and Schmoll (2007)
Peatlands	Oceania	Australasia/Pacific	1990–2008	1990	18	–0.001	–0.001	Joosten (2009)
Freshwater wetlands	Oceania	New Zealand: North Island	1979–1983	1975	4	–15	–3.750	MoE (1997)
Coastal natural wetlands								
Mangroves	Global	Global	1980–2005	1975	25	–18.96	–0.758	FAO (2007)
Deltas	Global	Global	1980s–2000s	1975	c. 20	–52	*–0.743*	Coleman *et al.* (2008)
Mangroves	Africa	Africa	1980–2005	1975	25	–13.90	–0.556	FAO (2007)
Coastal lagoons	Africa	Egypt: Lake Burullus	1913–1974	1900	61	–21.60	–0.354	Hollis 1992, citing Meininger 1990)
Mangroves	Asia	Phillippines	1918–1987	1900	69	–78	–1.130	Scott (1993)
Mangroves	Asia	Asia	1980–2005	1975	25	–24.60	–0.984	FAO (2007)
Intertidal wetlands	Asia	Republic of Korea	1987–2005	1975	18	–20.4	–1.133	Republic of Korea (2009)
Coastal wetlands	Asia	China: Yellow Sea coast	1950–2006	1945	56	–27.0	–0.482	UNDP/GEF (2007)
Coastal wetlands	Asia	China	1990–2000	1990	10	–16.0	–1.600	Gong *et al*. (2010)
Coastal wetlands	Asia	China	1978–2008	1975	30	–39.79	–1.326	Niu *et al.* (2012)
Coastal wetlands	Asia	China	1950–2000	1945	50	–51	–1.020	An *et al.* (2007)
Intertidal wetlands	Asia	DPRKorea (includes	c. 1995 – c. 2005	1990	10	–10.5	–1.072	Mackinnon, Verkeuil and

		China part of Yalu Jiang estuary)						Murray (2012)
Tidal flats	Asia	Japan	1978–1990	1975	22	–7.34	–0.334	Takahashi (1993)
Kelp beds	Asia	Japan	1978–1990	1975	22	–3.08	–0.140	Takahashi (1993)
Mangroves	Asia	Thailand	1961–1979	1945	18	–22	–1.242	Scott (1993)
Coastal wetlands	Asia	Sri Lanka: Muthrajawela marsh–Negombo lagoon	1987–2002	1975	14	–24.96	–1.783	Nagabhatla, Finlayson and Seneratna Sellamuttu (2012)
Estuarine intertidal	Europe	United Kingdom (6 estuaries)	1900–1990	1900	90	–10.952	–0.121	Davidson *et al.* (1991)
All Coastal	Europe	France: Brittany	1960–1990	1945	30	–40	–1.333	Dugan (1993)
All Coastal	Europe	Europe	1990–2000	1990	10	–1	–0.100	EEA (2007)
Coastal grazing marshes	Europe	UK: south–east coast	1930–1990	1900	60	–57.40	–1.080	Thornton and Kite (1990)
Saltmarshes	Europe	Wadden Sea	1950–1984	1945	34	–33	–0.971	European Commission (1995)
Saltmarshes	Europe	France: Rhone delta	1942–1984	1900	42	–56.5	–1.310	European Commission (1995)
Coastal delta	Europe	France: Camargue	1942–1974	1900	32	–30.9	–0.965	Tamisier (1992)
Coastal lagoons	Europe	Albania	c. 1945 – c. 1985	1945	40	–78.6	–1.964	Gjiknuri and Peja (1992)
Coastal delta	Europe	Russian Federation: Don Delta (Sea of Azov)	c. 1980 – c. 1990	1975	c. 10	–21.65	*–2.165*	Wilson and Moser (1994)
Coastal delta	Europe	Russian Federation: Kuban Delta (Sea of Azov)	1930– mid–1970s	1900	c. 45	–47.47	*–1.055*	Wilson and Moser (1994)
Coastal wetlands	Europe	Finland	1950–1985	1945	35	–22.8	–0.651	Airoldi and Beck (2007)
Saltmarshes	Europe	Wadden Sea	1950–1984	1945	34	–33.3	–0.980	Airoldi and Beck (2007)
Seagrasses	Europe	Denmark	1900–1990s	1900	c. 90	–77.5	*–0.861*	Airoldi and Beck (2007)
Seagrasses	Europe	Netherlands: Wadden Sea	1919–1971	1900	52	–96.9	*–1.864*	Airoldi and Beck (2007)
Coastal grasslands	Europe	Estonia	1950s–1990s	1945	c. 40	–37.39	*–0.935*	Kimmel *et al*. (2010)
Estuarine habitats	Europe	Germany/Netherlands: Wadden Sea – Ems/Dollard	1922–2000	1900	78	c. –17.36	*–0.223*	Talke and de Swart (2006)
Intertidal flats and marshes	Europe	Wadden Sea	1950–1997	1945	47	c. –8.75	*–0.186*	Lydie (1999)
Mangroves	Neotropics	South America	1980–2005	1975	25	–10.981	–0.439	FAO (2007)
Mangroves	Neotropics	Colombia: Magdalena River delta	1970s – 1987	1975	c. 17	–80	*–4.706*	Naranjo (1993)
Coral reefs (live coral)	Neotropics	Caribbean	1970s–2010	1975	c. 40	–84	*–2.100*	IUCN (2012)

Mangroves	North America	North and Central America	1980–2005	1975	25	–23.31	–0.933	FAO (2007)
Estuarine intertidal	North America	USA	1922–2004	1900	82	–24.30	–0.296	Gosselink and Baumann (1980); Dahl (2006)
Coral reefs	North America	Mexico: Veracruz Port	1907–2007	1900	100	–41.03	–0.410	Valadez–Rocha and Ortis–Lozano (2013)
Saltmarshes	North America	USA	Mid 1970s–mid 1980s	1975	c. 10	–1.5	*–0.150*	Dahl and Johnson (1991)
Saltmarshes	North America	USA	1998–2004	1975	16	–0.7	–0.117	Dahl (2006)
Saltmarshes	North America	USA: Mississippi Delta	1956–2004	1945	48	–50	–1.042	Bernier *et al.* (2006)
Oyster reefs	North America	USA	1885–1915 to 2000–2011	1900	c. 105	–64	*–0.610*	Ermgassen *et al.* (2012)
Mangroves	Oceania	Oceania	1980–2005	1975	25	–9.583	–0.383	FAO (2007)
Estuarine vegetated wetlands	Oceania	Australia: Hawkesbury Nepean River	1940s–2000s	1945	60	–6.8	–0.113	Williams and Thiebaud (2007)
Human–made wetlands								
Rice paddy	Global	Global	1961 – 2012	1945	51	+41.5	+0.814	FAOSTAT: http://faostat.fao.org/ (accessed 10 July 2014)
Artificial wetlands	Asia	China	1978–2008	1975	20	+122.07	+6.102	Niu *et al.* (2012)
Aquaculture ponds (coastal)	Asia	Vietnam: Xuan Thuy	1992–2002	1990	10	+25	+2.500	Seto and Fragakis (2007)
Aquaculture ponds (coastal)	Asia	Vietnam: Tien Hai	1992–2002	1990	10	+28	+2.800	Seto and Fragakis (2007)
Inland open waters	Europe	Europe	1990–2006	1990	16	+4.4	+0.275	EEA (2010)
Reservoirs	Europe	Scotland	1947–1988	1945	41	+115	+2.805	Mackey *et al.* (1998)
Rice fields	Europe	Spain: Coto Donana	1942–2010	1900	68	+1750	+25.735	Ramo *et al.* (2013)
Restored and created ponds	North America	USA	1985–2004	1975	19	+12	+1.200	Dahl (2006)

References

Airoldi, L. and Beck, M.W. (2007). Loss, status and trends for coastal marine habitats of Europe. *Oceanography and Marine Biology: An Annual Review*,**45**, 345–405.

An, S., Li, H., Guan, B., Zhou, C., Wang, Z. *et al.* (2007). China's Natural Wetlands: Past Problems, Current Status, and Future Challenges. *Ambio* **36**, 335–342.

Ashianti–Zarandi, M.A. (1990). The current status of waterfowl and wetland conservation in the Islamic Republic of Iran. Pp. 81–84 in Matthews, G.V.T. (ed.), Managing Waterfowl Populations. Proc. IWRB Symposium, Astrakhan 1989. *IWRB Special Publication* No. 12. (IWRB, Slimbridge, UK)

Bernier, J.C., Morton, R.A. and Barras, J.A. (2006). Constraining rates and trends of historical wetland loss, Mississippi River Delta Plain, south–central Louisiana. Pp. 371–382 in Y.J. Xu and V.P. Singh (eds.), Coastal Environment and Water Quality. (Water Resources Publications: Highlands Ranch, USA)

Brinson, M. and Malvarez, A.I. (2002). Temperate freshwater wetlands: types, status, and threats. *Environmental Conservation* **29**, 115 – 133.

Casado, S., Florin, M., Molla, S. and Montes, C. (1992). Current status of Spanish wetlands. Pp. 56–58 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. IWRB Special Publication No. 20. (IWRB, Slimbridge, UK)

Chalabi, B. (1992). The status of wetlands and waterbirds in Algeria. Pp. 79–82 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. IWRB Special Publication No. 20. (IWRB, Slimbridge, UK)

Coleman, J.M., Huh, O.K. and Braud, D. (2008). Wetland loss in world deltas. *Journal of Coastal Research* **24**, 1–14.

Crooks, S., Herr, D., Tamelander, J., Laffoley, D. and Vandever, J. (2011). Mitigating climate change through restoration and management of coastal wetlands and near–shore marine ecosystems: challenges and opportunities. Environment Department Paper 121. World Bank, Washington, DC.

Dahl, T.E. (1990). Wetland losses in the United States 1780's to 1980's. (U.S. Department of the Interior, Fish and Wildlife Service: Washington, D.C.)

Dahl , T.E. and Johnson, C.R. (1991). Status and trends of wetlands in the Coterminous United States mid–1970s to mid–1980s. (US Department of the Interior, Fish and Wildlife Service: Washington, D.C.)

Dahl, T.E. (2006). Status and trends of wetlands in the coterminous United States 1998 to 2004. (U.S. Department of the Interior, Fish and Wildlife Service: Washington, D.C.)

Davidson, NC, Laffoley, Dd'A, Doody, JP, Way, LS, Gordon, J, Key, R, Drake, CM, Pienkowski, MW, Mitchell, RM, Duff, KL. (1991). Nature conservation and estuaries in Great Britain. (Nature Conservancy Council: Peterborough, UK).

Ducks Unlimited. (2010). Southern Ontario Wetland Conversion Analysis. (Ducks Unlimited: Memphis, USA.)

Dugan, P. (ed.). (1993). Wetlands in Danger. (Mitchell Beazley: Auckland, Melbourne, Singapore and Toronto.)

Dugan, P.J. and Jones, T. (1993). Ecological change in wetlands: a global overview. Pp. 34–38 in Moser, M., Prentice, C. and van Vessem, J. (eds.), *Waterfowl and Wetland Conservation in the 1990s: a Global Perspective. IWRB Special Publication 26.* (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

Ermgassen, P.S.E., Spalding, M.D., Blake, B., Coen, L.D., Dumbauld, B., Geiger, S., Grabowski, J.H., Griszle, R., Luckenbach, M., McGraw, K., Rodney, W., Ruesink, J.L., Powers, S.P. and Brumbaugh, R. (2012). Historical ecology with real numbers: past and present extent and biomass of an imperiled estuarine habitat. *Proceedings of the Royal Society of London B*. doi: 10.1098/rspb.2012.0313

European Commission. (1995). Wise use and conservation of wetlands. Communication from the Commission to the Council and the European Parliament. COM (95) 189 final, 29 May 1995. (European Commission: Brussels.)

EEA, (2007). Europe's environment – The fourth assessment. (European Environment Agency: Copenhagen, Denmark)

EEA. (2010). The European environment – state and outlook 2010. (European Environment Agency: Copenhagen.)

European Space Agency. (2013). Watching wetlands from space. http://www.esa.int/Our_Activities/Observing_the_Earth/Watching_wetlands_from_space (accessed 19 January 2014)

FAO. (2007). The world's mangroves 1980–2005. FAO Forestry Paper No. 153. (Food and Agriculture Organisation: Rome.)

Goeldner, L. (1999). The German Wadden Sea coast: reclamation and environmental protection. *Journal of Coastal Conservation* **5**, 23–30.

Gong, P., Niu, Z.G., Cheng, X., Zhao, K.Y., Zhou, D.M., *et al.* (2010). China's wetland change (1990–2000) determined by remote sensing. Science China Earth Sciences, **53**, 1036–1042. doi: 10.1007/s11430–010–4002–3

Gjiknuri, L. and Peja, N. (1992). Albanian lagoons: their importance and economic development. Pp. 130–133 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. IWRB Special Publication No. 20. (IWRB, Slimbridge, UK)

Gosselink, J.G. and Baumann, R.H. (1980). Wetland inventories: wetland loss along the United States' coast. *Zeitschrift für Geomorphologie N.F. Suppl.–BD*. **34**, 173–187.

Green, A.J., El Hamzaoui, M., El Agbani, M.A. and Franchimont, J. (2002). The conservation status of Moroccan wetlands with particular reference to waterbirds and changes since 1978. *Biological Conservation* **104**, 71–82.

Handrinos, G. (1992). Wetland loss and wintering waterfowl in Greece during the 20th century: a first approach. Pp. 183–187 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. IWRB Special Publication No. 20. (IWRB, Slimbridge, UK)

Hollis, T. (1992). Pp83–90 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. IWRB Special Publication No. 20. (IWRB, Slimbridge, UK)

Hu, H. and Cui, Y. (1990). The effect of habitat destruction on the waterfowl of lakes in the Yangtze and Han River Basins. Pp. 189–193 in Matthews, G.V.T. (ed.), Managing Waterfowl Populations. Proc. IWRB Symposium, Astrakhan 1989. IWRB Special Publication No. 12. (IWRB, Slimbridge, UK)

IUCN (2012). Tropical Americas coral reef resilience workshop, 29 April – 5 May 2012, Panama City. Available on: http://cmsdata.iucn.org/downloads/caribbean_coral_report_jbcj_030912.pdf

JAXA. (2007). South Aral Sea shrinking but north Aral Sea expanding. http://www.eorc.jaxa.jp/en/imgdata/topics/2007/tp071226.html (accessed 8 December 2013).

Jobin, B., Latendresse, C., Grenier, M. *et al.* (2010). Recent landscape change at the ecoregion scale in Southern Québec (Canada), 1993–2001. *Environmental Assessment and Monitoring* **164**, 631–647.

Johnston, C.A. (2013). Wetland losses due to row crop expansion in the Dakota Prairie Pothole region. *Wetlands* **33**, 175–182.

Jones, T.J. and Hughes, J.M.R. (1993). Wetland inventories and wetland loss studies: a European perspective. Pp. 164–169 in Moser, M., Prentice, C. and van Vessem, J. (eds.), *Waterfowl and Wetland Conservation in the 1990s: a Global Perspective. IWRB Special Publication 26.* (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

Joosten, H. (2009). The Global Peatland CO2 Picture. Peatland status and drainage related emissions in all countries of the world. (Wetlands International, Ede, The Netherlands.)

Kettle, A.J., Vollestad, A. and Wibig, J. (2011). Where once the eel and the elephant were together: decline of the European eel because of changing hydrology in southwest Europe and northwest Africa? *Fish and Fisheries* **12**, 380–411.

Kiage, L.M., Liu, K.–B., Walker, N.D., Lam, N. and Huh, O.K. (2007). Recent land–cover/use change associated with land degradation in the Lake Baringo catchment, Kenya, East Africa: evidence from Landsat TM and ETM+. *International Journal of Remote Sensing*, **28**, 4285 – 4309.

Kılıç, S., Evrendilek, F., Berberoğlu, S. and Demirkesen, A.C. (2006). Environmental monitoring of land–use and land–cover changes in a Mediterranean region of Turkey. *Environmental Monitoring and Assessment* **114**, 157–168.

Kimmel, K., Kull, A., Salm, J.–O. *et al.* (2010). The status, conservation and sustainable use of Estonian Wetlands. *Wetlands Ecology and Management* **18,** 375–395.

Kotze, D.C., Breen, C.M. and Quinn, N. (1995). Wetland losses in South Africa. Pp. 263–272 in Cowan,G. (ed.), Wetlands of South Africa. (Ministry of the Environment: Republic of South Africa.)

Lindsay, R.A. and Immirzi C.P. (1996). *An inventory of lowland raised bogs in Great Britain.* Scottish Natural Heritage Research, Survey and Monitoring Report. No 78. (Scottish Natural Heritage: Edinburgh.)

Maamouri, F. and Hughes, J. (1992). Prospects for wetlands and waterfowl in Tunisia. Pp. 47–52 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. IWRB Special Publication No. 20. (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK)

Mackey, E.C., Shewry, M.C. & Tudor, G.J. (1998). Land Cover Change: Scotland from the 1940s to the 1980s. (The Stationery Office: Edinburgh.)

MacKinnon, J., Verkuil, Y.I. and Murray, N. (2012). IUCN situation analysis on East and Southeast Asian intertidal habitats, with particular reference to the Yellow Sea (including the Bohai Sea). Occasional Paper of the IUCN Species Survival Commission No. 47. (IUCN: Gland, Switzerland and Cambridge, UK.)

Maltby, E. (2009). Chapter 1. The Changing Wetland Paradigm. Pp 3–42 in E. Maltby and T. Barker (eds.), *The Wetlands Handbook.* (Blackwell Publishing: Oxford.)

Menon, V. (1993). Status of wetland systems in and around Delhi, North India. P. 50 in M.E. Moser and J. van Vessem (eds.), Wetland and Waterfowl Conservation in South and West Asia. Proceedings of an International Symposium, Karachi, Pakistan, 14–20 December 1991. IWRB *Special Publication* No. 25. (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

Micklin, P. (2007). The Aral Sea disaster. *Annual Review of Earth and Planetary Sciences* **35**, 47–72.

Ministry of the Environment. 1997. State of New Zealand's Environment 1997. (MoE: Wellington, New Zealand.)

Moller, H.S. (1992). Conservation of wetlands in Denmark – legislation and administration. Pp. 243–248 in Proceedings of the Wetland Forum, Hokkaido, Japan.

Moser, M., Prentice, C. and Frazier, S. (1996). A global overview of wetland loss and degradation. Technical Sessions B and D: reports and presentations. Proceedings of the 6th Meeting of the Conference of the Contracting Parties, Brisbane, Australia, 19–March 1996. (Ramsar Convention Bureau: Gland, Switzerland.)

Munteau, D. and Toniuc, N. (1992). The present and future state of the Danube Delta. Pp. 43–46 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. *IWRB Special Publication* No. 20. (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

Munyati, C. (2000) Wetland change detection on the Kafue Flats, Zambia, by classification of a multitemporal remote sensing image dataset. *International Journal of Remote Sensing* **21**, 1787 – 1806.

Musi, F., Perco, F. and Utmar, P. (1992). Loss, restoration and management of wetlands in Friuli–Venezia Giulia, north–eastern Italy. Pp. 257–261 in M. Finlayson, T. Hollis and Tim Davis (eds), Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. *IWRB Special Publication* No. 20. (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

Nagabhatla, N., Finlayson, C.M. and Seneratna Sellamuttu, S. (2012). Assessment and change analyses (1987–2002) for tropical wetland ecosystem using earth observation and socioeconomic data. *European Journal of Remote Sensing* **45**, 215–232.

Naranjo, L.G. (1993). Ecological change in Colombian wetlands. Pp. 67–70 in Moser, M., Prentice, C. and van Vessem, J. (eds.), *Waterfowl and Wetland Conservation in the 1990s: a Global Perspective. IWRB Special Publication 26.* (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

National Wetlands Working Group. (1988). Wetlands of Canada. *Ecological Land Classification Series* No. 24. (Environment Canada and Polyscience Publications Inc.: Montreal, Canada.)

Niu, Z.G., Zhang, H.Y., Wang, X.W., Yao, W.B., Zhou, D.M. *et al.* (2012). Mapping wetland changes in China between 1978 and 2008. *Chinese Science Bulletin*, doi: 10.1007/s11434–012–5093–3.

Olhan, E., S. Gün, Y. Ataseven and H. Arisoy. 2010. Effects of agricultural activities in Seyfe Wetland. *Scientific Research and Essay* **5(1),** 9–14.

Page, S., Hoscilo, A., Wosten, H., Jauhiainen, J., Silvius, M., *et al.* (2009). Restoration Ecology of Lowland Tropical Peatlands in Southeast Asia: Current Knowledge and Future Research Directions. *Ecosystems* **12**, 888–905.

Partow, H. (2001). The Mesopotamian Marshlands: Demise of an Ecosystem. Early Warning and Assessment Technical Report, UNEP/DEWA/TR.01–3 Rev. 1. (Division of Early Warning and Assessment, United Nations Environment Programme: Nairobi, Kenya.)

Perennou, C., Beltrame, C., Guelami, A., Tomas Vives, P. and Caessteker, P. (2012). Existing areas and past changes of wetland extent in the Mediterranean region: an overview. *Ecologia Mediterranea* **38**, 53–66.

Prigent C., Papa F., Aires F., Jimenez C., Rossow W.B. and Matthews E. (2012). Changes in land surface water dynamics since the 1990s and relation to population pressure. *Geophysical Research Letters* **39**, L08403, doi: 10.1029/2012GL051276.

Rao, N., Krishna, G., Malini, B. (2004). Kolleru lake is vanishing – a revelation through digital processing of IRS–1D LISS–III sensor data. Current Science 86 (9):1312–1316.

Republic of Korea. (2009). Fourth National Report to the Convention on Biological Diversity. Available on: http://www.cbd.int/doc/world/kr/kr–nr–04–en.pdf

RSPB. (1993). *Wet Grasslands – What Future?* (Royal Society for the Protection of Birds: Sandy, Bedfordshire, UK.)

RYAN, J.B. and CROSS, J.R. (1984). The conservation of peatlands in Ireland. Pp. 388–406 in Proceedings of the International Peat Congress, Dublin. (Irish National Peat Committee: Dublin.)

Scott, D.A. (1993). Wetland Inventories and the Assessment of Wetland Loss: A Global Overview. Pp 154–163 in Moser, M., Prentice, C. and van Vessem, J. (eds.), Waterfowl and Wetland Conservation in the 1990s: a Global Perspective. *IWRB Special Publication* No. 26. (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

Seto, K.C. and Fragakis, M. (2007). Mangrove conversion and aquaculture development in Vietnam: A remote sensing–based approach for evaluating the Ramsar Convention on Wetlands. *Global Environmental Change* **17**, 486–500.

Sinclair,S. and Boon, P. (2012). Changes in the area of coastal marsh in Victoria since the mid 19th century. *Cunninghamia* **12**, 153–176.

Stroud, D.A., Reed, T.M., Pienkowski, M.W. and Lindsay, R.A. (1988). Birds, bogs and forestry – The peatlands of Caithness and Sutherland. (Nature Conservancy Council: Peterborough, UK.)

Talke, S.A. and de Swart, H.E. (2006). Hydrodynamics and Morphology in the Ems/Dollard Estuary: Review of Models, Measurements, Scientific Literature, and the Effects of Changing Conditions. IMAU Report No. R06–01. (Institute for Marine and Atmospheric Research Utrecht (IMAU): Utrecht, The Netherlands.)

Tamisier, A. (1992). The Camargue: a model of environmental decline. Pp.106–108 in M. Finlayson, T. Hollis and Tim Davis (eds). Managing Mediterranean Wetlands and Their Birds. Proc. Symp. Grado, Italy, 1991. *IWRB Special Publication* No. 20. (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

Thornton, D. and Kite, D.J. (1990). Changes in the extent of the Thames Estuary grazing marshes. (Nature Conservancy Council: London.)

UNDP/GEF (2007). The Yellow Sea: Analysis of Environmental Status and Trends, Volume 3: Regional Synthesis Reports. UNDP/GEF Yellow Sea Project, Ansan, Republic of Korea.)

UNEP. (2004). *Seagrass in the South China Sea.* UNEP/GEF/SCS Technical Publication No. 3. (United Nations Environment Programme: Nairobi, Kenya.)

UNEP. (2007). Atlas of our changing environment. (United Nations Environment Programme: Nairobi, Kenya.)

UNEP. (2010). Carp Aquaculture Overwhelms Lake Kolleru, Andhra Pradesh, India. . UNEP Global Environmental Alert Service (GEAS). http://na.unep.net/geas/getUNEPPageWithArticleIDScript.php?article_id=68 (accessed 20 January 2014.)

UNEP. (2012). The drying of Iran's Lake Urmia and its environmental consequences. UNEP Global Environmental Alert Service (GEAS). http://www.unep.org/pdf/GEAS_Feb2012.pdf (accessed 20 January 2014.)

Valadez–Rocha, V. and Ortis–Lozano, L. (2013). Spatial and temporal effects of port facilities expansion on the surface area of shallow coral reefs. *Environmental Management* **51**, 250–260.

Wang, Z., Huang, N., Luo, L., Ren, C., Song, K. and Chen, J. (2011). Shrinkage and fragmentation of marshes in the West Songnen Plain, China, from 1954 to 2008 and its possible causes. *International Journal of Applied Earth Observation and Geoinformation* **13**, 477–486.

Watmough, M.D. and Schmoll, M.J. (2007). Environment Canada's Prairie & Northern Region Habitat Monitoring Program Phase II: Recent Habitat Trends in the Prairie Habitat Joint Venture. Technical Report Series No. 493. (Environment Canada, Canadian Wildlife Service: Edmonton, Canada.)

Waycott, M., Duarte, C.M., Carruthers, T.J.B., Orth, R.J., Dennison, W.C. *et al.* (2009). Accelerating loss of seagrasses across the globe threatens coastal ecosystems. *Proceedings of the National Academy of Sciences of the United States of America (PNAS)* **106**, 12377–12381.

Whillans, T.H. (1982). Changes in marsh area along the Canadian shore of Lake Ontario. *Journal of Great Lakes Research* **8**, 570–577.

Williams, R.J. and Thiebaud, I. (2007). An Analysis of Changes to Aquatic Habitats and Adjacent Land–use in the Downstream Portion of the Hawkesbury Nepean River over the Past Sixty Years. NSW Department of Primary Industries – Fisheries Final Report Series No. 91.

Wilson, A.M. and Moser, M.E. (1994). Conservation of Black Sea Wetlands: a review and preliminary action plan. Publication No. 33. (International Waterfowl and Wetlands Research Bureau: Slimbridge, UK.)

WWF. (2010). Assessment of the restoration potential along the Danube and main tributaries. (WWF: Bucharest, Romania)

Yaw, A.T. and C.M. Edmund. (2007). Using Remote Sensing and GIS in the Analysis of Ecosystem Decline along the River Niger Basin: The Case of Mali and Niger. *International Journal of Environmental Research and Public Health,* **4(2),** 173–184.