
Rapid Loss of Cambodia’s Grasslands

Tropical grasslands are important for both biodiversity and ecosystem services. However, owing mainly to the ease with which they can be converted to intensive agriculture (and in some anthropogenic landscapes lost to scrub encroachment following abandonment of agricultural activity), they are among the most threatened biomes globally (Bond & Parr 2010). With no substantial area of grassland remaining in Thailand or Vietnam, the floodplain of Cambodia’s Tonle Sap Lake contains the largest remaining seasonally inundated grassland in Southeast Asia (BirdLife International 2003). This floodplain, which consists of inner wet grassland (flooding is longer and deeper) and outer dry grassland (flooding is shorter and shallower), is of major importance for biodiversity and livelihoods. When the grassland is exposed, it is used by 11 globally threatened bird species, including two-thirds of the world’s critically endangered Bengal Floricans (Houbaropsis bengalensis) (Gray et al. 2009), and it supports pastoralism, traditional low-intensity rice cultivation, and fisheries in seasonal pools. When flooded, it is vital to fisheries and contains a high diversity of watersnakes (including threatened endemic Enhydris longicauda) and many waterbirds.

![Figure 1. Land cover for the Tonle Sap floodplain (11,187 km²) in (a) 1995 and 1996 (JICA 2000) and (b) 2005. Land cover for the southeastern section (2407 km²) in (c) 1995 and 1996, (d) 2005, and (e) 2009. (Protected areas are outlined in black in [e]; southeastern section is outlined in black in [a] and [b].)]
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Some 1.1 million people in its immediate surroundings depend on it for subsistence (Varis & Keskinen 2003). Even so, it is disappearing at a speed that so far has defied quantification.

We assessed habitat conversion rates across the Tonle Sap floodplain by comparing land cover manually delineated from aerial photographs (1:25,000) taken in January and February 2005 (Pasco-Finnmap 2005) with land cover derived from satellite imagery (Landsat and Spot), aerial photographs (1:25,000 and 1:40,000), and topographic maps (1:50,000; JICA 2000) for 1995 and 1996. To quantify grassland conversion after 2005 in the largest remaining area, we updated land cover with supervised classification of February 2009 Landsat imagery (ground-truthed data consisting of 740 training points and 189 validation points taken from across the area, 2407 km²). For all 3 mapping periods, land cover was consistently classified as wet or dry grassland, scrub, permanent wetland, wet-season rice, dry-season rice, or other. Traditional wet-season rice provides fallows and stubbles used by grassland biota during the dry season. Intensive, commercial dry-season rice fields are of little conservation value and require construction of industrial-scale dams and canals.

In 1995 and 1996, grassland covered 3349 km² (30%) of the floodplain (Fig. 1a). By 2005 this was reduced to 1817 km², a net loss of 1532 km² (46%) of grassland in 10 years. The greatest losses occurred in the north and west and in inner floodplain areas (Fig. 1b). Wet grassland declined by 64% and dry grassland by 23%, whereas scrub cover increased by 23% to 5413 km², which accounted for 65% of grassland loss. The least affected area was in the southeast, where 81% of 1995 grassland remained in 2005 (Figs. 1c & d). However, in this area grassland subsequently declined by 19% in 4 years (from 923 km² in 2005 to 751 km² in 2009). Of this loss, 95% was attributable either to dry-season rice cultivation (84%) or associated newly constructed reservoirs (11%). In 2005 dry-season rice covered 50 km² of former grassland (Fig. 1d). By 2009 the area of dry-season rice production had increased by 666% to 383 km² (Fig. 1e).

Following historic extirpation of naturally occurring large herbivores, traditional practices probably checked scrub encroachment in the inner floodplain, where pastoralists grazed cattle during the dry season and local communities cultivated deep-water rice. Both these land uses are associated with scrub clearance and dry-season burning. However, with economic and political changes, local communities have become increasingly sedentary in peripheral villages, leaving the remote inner floodplain susceptible to scrub encroachment. Meanwhile, the rapid and extensive loss of grassland through abandonment has been compounded by industrial-scale dam construction and cultivation of dry-season rice. The marginalized status of rural communities leaves them vulnerable to the privatization of common resources, whether through formal concessions or ad hoc arrangements between companies and local authorities, both of which usurp customary land-use rights of grazing and traditional rice cultivation. Moreover, the massive reduction in grassland extent has severe implications for biodiversity. Only 173 km² (23%) of the 2009 grassland area is under some form of protection. By 2011, 28% of even these protected areas had been lost to intensive cultivation, which is ongoing (Mahood et al. 2012).

Grassland capable of supporting threatened bird species can regenerate in 1–2 years following abandonment of wet-season rice fields, but recovery from intensive cultivation of dry-season rice may be slower. Protecting or restoring remaining areas of grassland and traditional wet-season rice to conserve biodiversity may be compatible with safeguarding the livelihoods of local communities. However, achieving these goals without constraining future economic and development opportunities may require innovative approaches, such as payment for environmental services, land acquisition, or conservation leases (Wright et al. 2012). Unfortunately, the Cambodian government’s welcome condemnation of illegal dams in 2010, along with the demolition of some of these (prompted by fears of their effects on fish stocks), has not been maintained. Only a strong political commitment to protection and restoration can prevent the impending loss of the last major flooded grassland in Southeast Asia.

Charlotte E. Packman,* Thomas N. E. Gray,* Nigel J. Collar,†‡ Tom D. Evans,§ Robert N. Van Zalinge,§ Son Virak.§ Andrew A. Lovett,* and Paul M. Dolman†

*School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, United Kingdom, email lotty.packman@gmail.com
†BirdLife International, Wellbrook Court, Girton Road, Cambridge CB3 0NA, United Kingdom
‡School of Biological Sciences, University of East Anglia, Norwich NR4 7TJ, United Kingdom
§Wildlife Conservation Society Cambodia Program, #21, St.21, Tonle Bassac, Phnom Penh, Cambodia

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