

AN INTRODUCTION TO THE BIOPHYSICAL ENVIRONMENT AND MANAGEMENT OF WETLANDS OF TRAM CHIM NATIONAL PARK, DONG THAP PROVINCE, VIET NAM

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ABSTRACT: *Tram Chim National Park is a 7,600-ha wetland in which the characteristic hydroperiod of the Plain of Reeds in southwestern Vietnam has been reproduced in part. Since the late 1980s, wetlands in Tram Chim were restored by means of a system of dykes and water gates to preserve a mosaic of native vegetation communities that has attracted the Eastern Sarus Crane for seasonal visits for the first time in decades. Problems associated with canal construction and drainage in the Mekong Delta, such as the development of acid sulphate soils, make the success of this site especially remarkable. Like other large wetlands dominated by both herbaceous plants and occasional stands of trees, fire should play a prominent role in its ecological functions. The park is now surrounded by villages, however, and maintaining its integrity against natural threats such as invasion of the alien weed *Mimosa pigra* and anthropogenic threats such as illegal resource harvesting becomes an increasingly difficult task.*

1. INTRODUCTION

Most large wetland landscapes have been lost from the world, and in many cases little remains of their original characteristics and their once-vital connections with ecosystems both near and distant [17]. The Plain of Reeds in Viet Nam is such a wetland, until recently a vast floodplain of some 800,000 ha northeast of the Mekong River and a mosaic of freshwater marshes and swamp forests dominated by a native *Melaleuca* tree (*Melaleuca cajuputi* subsp. *cumingiana*). Decades of war and agricultural development led to extensive drainage that transformed the landscape [24]. Altered hydroperiods lead to excessive dryness, which in turn lead to catastrophic fires and high concentrations of toxins released from acidic soils. As a result, many species were extirpated, including the Eastern Sarus Crane (*Grus antigone sharpii*), an endangered bird for which the Plain of Reeds was a major dry season habitat [15].

This paper presents wetland ecology and management information for Tram Chim National Park, Dong Thap Province, Viet Nam. The wetlands at Tram Chim comprise a 7,600-ha portion of the Plain of Reeds that was hydrologically restored in the late 1980s by means of a system of dykes and water gates in an attempt to recapture the important characteristics of this unique landscape. Reestablishment of native plants soon after the natural hydroperiod was partly restored was followed shortly by the return of the Eastern Sarus Crane and other waterbird species for the first time in decades. The return of the crane brought attention from local institutions and from international conservation organizations [1], [2], [7], [8], [9]. Recognition that the initial impoundment was insufficient for effective long-term restoration of the natural hydrologic regime led to construction of a new system of dikes and sluice gates for active control of water levels inside the park. At the same time, ecological studies were initiated to document biotic and abiotic characteristics of the newly restored ecosystems, as well as the socio-economic context in which the Park exists.

General description

The Mekong Delta has a tropical monsoon climate, characterized by the alternation of a rainy and a dry season each year. Mean annual rainfall varies across the delta from 2400 mm in the west to 1300 mm in the center and 1600 mm in the east. The rainy season is from April to November in the

west, and from May to November in the rest of the Delta. The rainy season is also the high flow season of the Mekong River. The combined effects of river flood and local rainfall inundate a large part of the Mekong Delta. Inundation lasts for 4-5 months in depressed areas and 1.5-2 months in areas of higher elevation. The maximum depth of inundation, ranging from 1.47 m to 5.50 m, varies in relation to the topography and the magnitude of flood [11].

Tram Chim National Park (10°40'–10°47'N; 105°26'–105°36'E) covers 7,600 ha of wetlands within one of the deepest areas in the Plain of Reeds of the northeast Mekong Delta (Figure 1). The Plain is a vast depression with an average elevation of 1.0-1.2 m above mean sea level, bounded by the natural levees of the Mekong and the Vaico River, and by old alluvium terraces along the Cambodian border. Even though the entire plain is a depressed area, its micro-topography varies greatly. Sand ridges and alluvium terraces have created relatively higher ground with different soil conditions [5]. The sand ridges can be as high as 2.3 m, while the lower areas have an average elevation of 1.0 -1.2 m [23]. These variations in micro-topography account for marked differences in the vegetation composition and structure amongst the wetlands of Tram Chim (Figure 2), and have important hydrological management implications [3].

Tram Chim was designated a national park by the Government of Viet Nam in December 1998, and is administered by the People's Committee of Dong Thap Province. Management activities at Tram Chim National Park are directed by the Board of Management led by the park director. The Board of Management cooperates closely with the province and district authorities in dealing with issues related to buffer zone management. It is important, however, to note that Tram Chim National Park does not have a buffer zone in its traditional meaning. Instead, the land area surrounding the park is often regarded as the buffer zone even though park management does not have any authority over the use of that "buffer zone". Tram Chim is surrounded by 5 villages and one town with a total human population of more than 40,000 people, making it one of the most populated areas of the rural Mekong Delta.

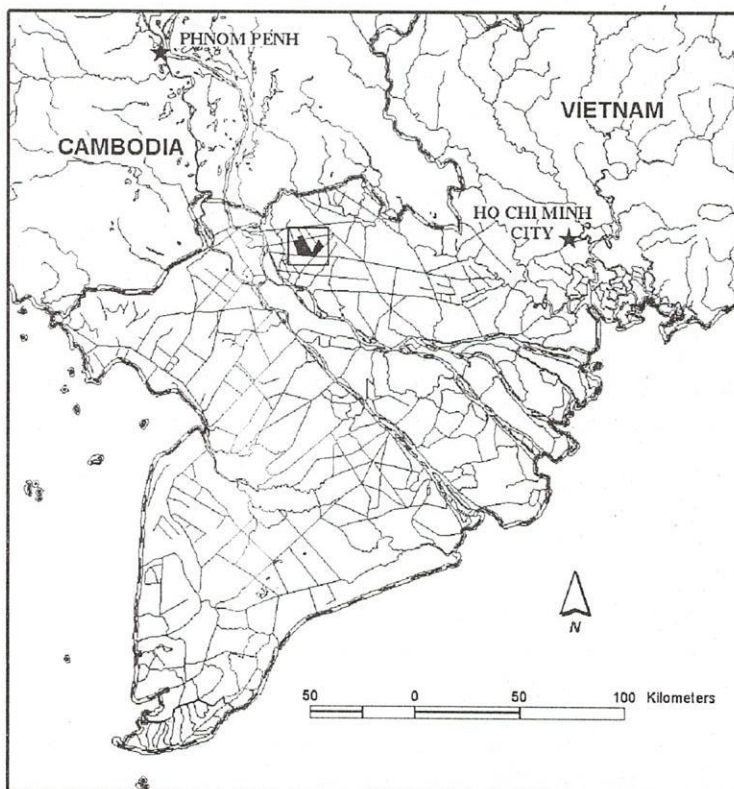


Figure 1: Location of Tram Chim National Park in the Mekong Delta.

2. CANALIZATION

At the begin of the 20th century, several large canals were constructed in the Plain of Reeds by the French colonial government. More canals were dug by the South Vietnamese government between 1954–1965, mostly for military purposes and rice production. It was only after 1975, however, that the canal system in the Plain of Reeds, as well as in the whole Mekong Delta, expanded greatly to meet the requirements of agricultural development and human settlement [21], [24]. Among the canals that encircle Tram Chim, the Dong Tien canal was dug in 1959, Phu Hiep in 1965, and Ca Dam in 1966. The Phu Thanh (1979), Phu Duc and An Binh (1980-1983), and Lung Bong (1990s) canals were all dug after the war. The dense network of canals drastically altered the natural hydrologic regime of the Plain of Reeds, and of Tram Chim in particular, especially by shortening the water retention time during the dry season, lowering the water table, and increasing the sediment loads in the channels [3].

With channelization, floodwaters are now distributed to, and drained from, the lower areas much more rapidly, resulting in a shorter retention time of standing water [3]. Wetland drainage also lowered the water table during the dry season [3], [6], [16], [18]. The shorter period of floodwater retention and lower water table accelerated the desiccation of wetlands, triggering more frequent wild fires on grasslands [3]. Evidence of increasing fire frequency is also indicated by the common practice throughout the Delta nowadays of protecting stands of *Melaleuca cajuputi* by constructing dikes around the forest stands to maintain waterlogged conditions during the dry season. Prior to channelization, flood water in the Delta entered low areas primarily as sheet flow with the sediments being filtered out by the vegetation. Because of direct links to the Mekong River, channeled water carries higher sediment loads at the beginning of the rainy season and can significantly increase the turbidity of standing water during this time [3], [10]. Turbid water may limit the occurrence of many submerged plant species in the river and wetlands [13].

Canal construction accelerated soil acidification in two ways, by directly exposing excavated soils to air, and by lowering the water table, extending aerobic conditions deeper into the sub-surface soil layers. When canals were dug on acid sulphate soils, the sub-surface layers containing pyrites were excavated and piled up along the canal banks. Some segments of canal banks were so strongly acidic that, five years after the canals were dug, no plant life could colonize them [10]. Lowering the water table, however, had a far more widespread effect on soil acidification and is considered the main cause of extensive acidification of acid sulphate soils in the Delta [18].

Re-establishing the natural hydrologic regime became the basis of wetland management at Tram Chim. The water level inside the Park is now controlled by a system of dikes and sluice gates intended to re-establish the natural wet-dry cycle for the wetlands of this area [3], [23]. Water management at Tram Chim cannot be independent of broader water management decisions in the surrounding landscape, nor isolated from the constraining factors of fire and weed invasion.

3. WETLAND HABITATS AND VEGETATION COMMUNITIES

There are three types of natural wetland habitats at Tram Chim: *Melaleuca* woodland, seasonally inundated grassland, and permanently inundated swamp. The pre-disturbance vegetation of the Plain of Reeds is poorly known. Records from French naturalists indicate that considerable areas of the Plain of Reeds were covered by forests dominated by *Melaleuca cajuputi* during the first half of the 19th century [12]. *Melaleuca* swamp forest is the only type of forest known to exist in the region since reliable scientific records were established. There is, however, evidence of more ancient forests dominated by other species of trees in the Plain of Reeds. Large tree stumps (1.8–2 m in diameter) with shallow-spreading root systems were discovered in the buffer zone of Tram Chim National Park [12] and were subsequently identified as a species of the genus *Syzygium* (Myrtaceae) (L. C. Kiet, pers. comm.). The reason why these types of forest disappeared or failed to re-establish remains

unknown. At present, all forest stands at Tram Chim are replanted with the native *Melaleuca cajuputi*. The ages of the *Melaleuca* stands range from 4-20 years [23].

The seasonally inundated grasslands at Tram Chim are the last extensive remnant of the once immense freshwater marshes of the Plain of Reeds. "Grassland" used here refers to the marshy herbaceous vegetation dominated by grasses (Poaceae) and sedges (Cyperaceae). Air photos taken by the US Army over Tram Chim in 1958 (Figure 2) show that grassland and open woodland were the predominant landscape at Tram Chim prior to the 1954-75 war and subsequent agriculture development; closed woodlands occupied less than 10% of the total area. Grasslands of Tram Chim exhibit large variation in plant species composition. The plant communities are not clearly delineated, but intermingle to form a continuum, closely following the gradient of water depth: (1) *Panicum repens* – *Eragrostis atrovirens* community located on sand ridges and old-alluvium uplands, (2) *Oryza rufipogon* – *Eleocharis dulcis* community located on the most depressed areas, and (3) *Ischaemum rugosum* community in areas of medium elevation between the deepest basins and uplands. Panic grass (*Panicum repens*) is able to withstand long periods of flooding, and it dominates larger areas surrounding sand ridges and old-alluvium uplands [24].

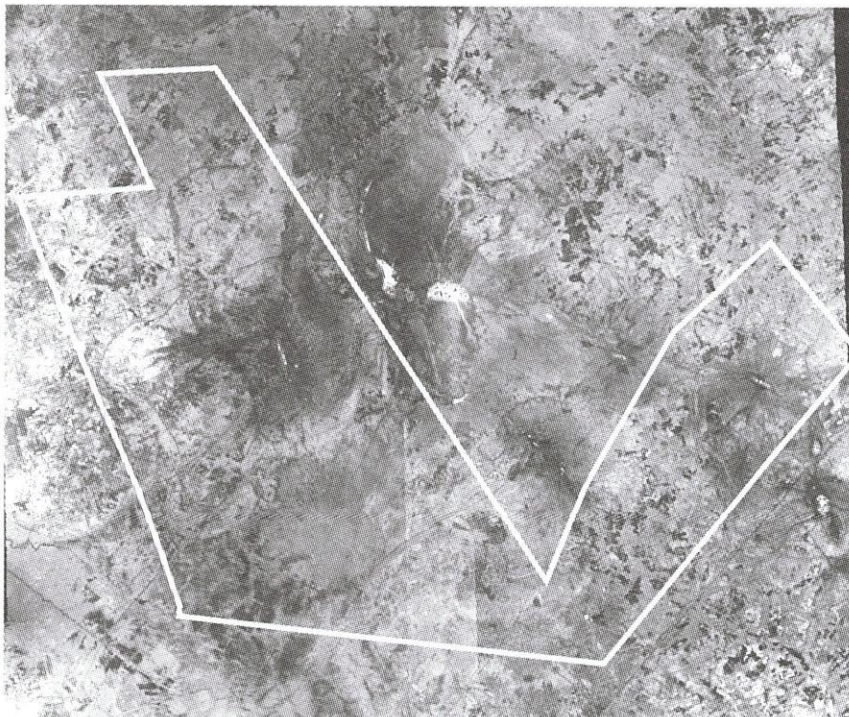


Figure 2: An airphoto of Tram Chim area taken in 1958 by the U.S. Army. The photo showed that Tram Chim wetlands, prior to major human disturbances, were a mosaic of open grasslands, old streambeds and forests in which forest was not a dominant landscape.

Permanently inundated swamps dominated by lotus (*Nelumbo nucifera*, Nelumbonaceae) are one of the characteristic wetland habitats of Tram Chim. These swamps are located on permanently inundated oxbow ponds, old riverbeds, and shallow streams. Besides *Nelumbo nucifera*, many other aquatic plants are also found, such as *Nymphaea nouchali*, *N. tetragona* (Nymphaeaceae), *Polygonum tomentosum* (Polygonaceae), *Ludwigia adscendens* (Onagraceae), *Nymphoides indica* (Menyanthaceae), and *Hymenachne acutigluma* (Poaceae).

Some alien invasive plants are present at Tram Chim, most notably *Mimosa pigra*, *Eichhornia crassipes*, and *Pistia stratiotes*. The floating aquatic plants, *Eichhornia crassipes* (Pontederiaceae) and *Pistia stratiotes* (Araceae), both from tropical South America, are found in still or slow flowing water, such as in ditches and sluggish streams. Efforts to remove these plants mechanically have been reasonably effective, and the expansion of these species seems to be under control at Tram Chim. The invasion of *Mimosa pigra* (Fabaceae), which is regarded as the worst weed in many tropical wetland

systems [14], poses a more serious threat to the native species of Tram Chim. The first *Mimosa pigra* plants were seen at Tram Chim around 1985-1986, and by May 2002, the infested area was estimated at 1,900 ha [27]. *Mimosa pigra* can spread rapidly, especially into areas exposed during the dry season draw-down. The seasonally inundated grasslands are most susceptible to *Mimosa pigra* invasion.

Seasonally inundated grasslands are distributed predominantly within the freshwater zone of the Delta [13], [19]. Recent ecological surveys ([21], [25]) have found that these grasslands, which include permanent water bodies and *Melaleuca* woodlands, support the highest levels of species diversity of plants (and also birds) in the Delta. Over the last two decades the extent of grasslands of the Mekong Delta has been greatly reduced, mostly due to the expansion of agriculture [24].

4. WETLAND FAUNA

The diversity of the avifauna at Tram Chim, especially in the dry season, is one of the characteristics that makes this wetland reserve unique in the Mekong Delta. Of the 175 bird species identified at Tram Chim, 84 live in the area year round. Another 69 species visit Tram Chim during the dry season, and 22 species visit the area occasionally, without any predictable pattern. Dry season visitors typically do not nest but utilize the park to acquire nutrient reserves for migration and to wait until conditions on breeding areas improve. Some of these migrants are from palearctic areas (e.g., Common Teal *Anas crecca*) while other species migrate short distances between breeding and nonbreeding areas (e.g., Eastern Sarus Crane *Grus antigone sharpii*). The avifauna of Tram Chim also includes 13 species that are endangered or threatened: Comb Duck *Sarkidiornis melanotos*, Grass Owl *Tyto capensis*, Bengal Florican *Houbaropsis bengalensis*, Eastern Sarus Crane *Grus antigone sharpii*, Greater Spotted Eagle *Aquila clanga*, Oriental Darter *Anhinga melanogaster*, Black-headed Ibis *Threskiornis melanocephalus*, Black-faced Spoonbill *Platalea minor*, Painted Stork *Mycteria leucocephala*, Asian Openbill *Anastomus oscitans*, Lesser Adjutant *Leptoptilos javanicus*, Greater Adjutant *Leptoptilos dubius*, and Black-necked Stork *Ephippiorhynchus asiaticus* [4].

The 55 species of fish that have been recorded at Tram Chim include those that live in standing water and those that live in flowing water [29]. Standing-water fish are year-round residents at Tram Chim and can withstand high acid water; flowing-water fish often migrate to Tram Chim wetlands for feeding or spawning during the flood season [29]. By providing critical breeding habitats for fish, Tram Chim wetlands play an important role in maintaining fish stocks for extended areas surrounding the park. For people living in the buffer zone, fish from Tram Chim are probably the most desirable resource. Illegal fishing for commercial purposes, particularly by destructive means such as electric shocking, is a serious problem and has been one of the major sources of conflict between park management and local communities [22]. Local people also harvest turtles, snakes, and birds for food.

Other vertebrate species (amphibians, reptiles and mammals) at Tram Chim have been poorly studied. Wetland drainage and large-scale fires likely extirpated most species of mammals. Unlike mobile bird species, few mammals have been able to return to the park following the initiation of restoration activities, because habitat corridors that connect source populations to available habitat have been cut.

5. MAJOR MANAGEMENT ISSUES

Management of the hydrologic regime is critical to maintaining the biophysical values of the park. This has been recognized in a recently developed management plan that also lists other important issues, including the conservation of wild plants and animals, sustainable use of fish resources, wetland inventory and monitoring, and buffer zone management [23].

Mimosa pigra is the major weed in the park, and it has considerable potential to spread further. Control measures have not been implemented, but steps are underway to obtain external advice and

develop management strategies and actions in line with local conditions and resources. These are most likely to be manual unless concerns about using herbicides in a protected wetland and the cost of importing such chemicals are overcome. It is recognized that this weed is a serious problem and could rapidly spread and further degrade the natural biophysical values of the park.

Fire management has been a critical issue in the park, especially since an uncontrollable fire swept through a large stand of *Melaleuca* forest (approximately 100 ha) in 1995. Fighting and preventing fire are among the major concerns of Tram Chim's managers. Fire management has largely been based on maintaining high water levels during the dry season, a strategy that confounds efforts to encourage bird species such as Eastern Sarus crane and Bengal Florican to use the park (Figure 3). High water condition in Zone A1, maintained for much of the last decade, resulted in the reduction of wild rice and *Eleocharis* grassland areas. It is also observed that in a predominantly wet condition, *Eleocharis* produces less tubers which are an important food item for the Sarus crane. Prolonged inundation also lead to poor growth of *Melaleuca* which is the subject of fire control. On the other hand, "too-dry" condition in Zone A4, i.e. water was lost too quickly at the end of the flood season resulting in a prolonged dry season, has lead to the expansion of *Panicum* grassland and the invasion of *Mimosa pigra* into areas previously occupied by *Eleocharis*. During the period 2000 – 2003, more canals and ponds were dug inside Tram Chim core zone to serve fire control purposes. These structures further fragmented Tram Chim wetlands and made hydrological management even more complicated.

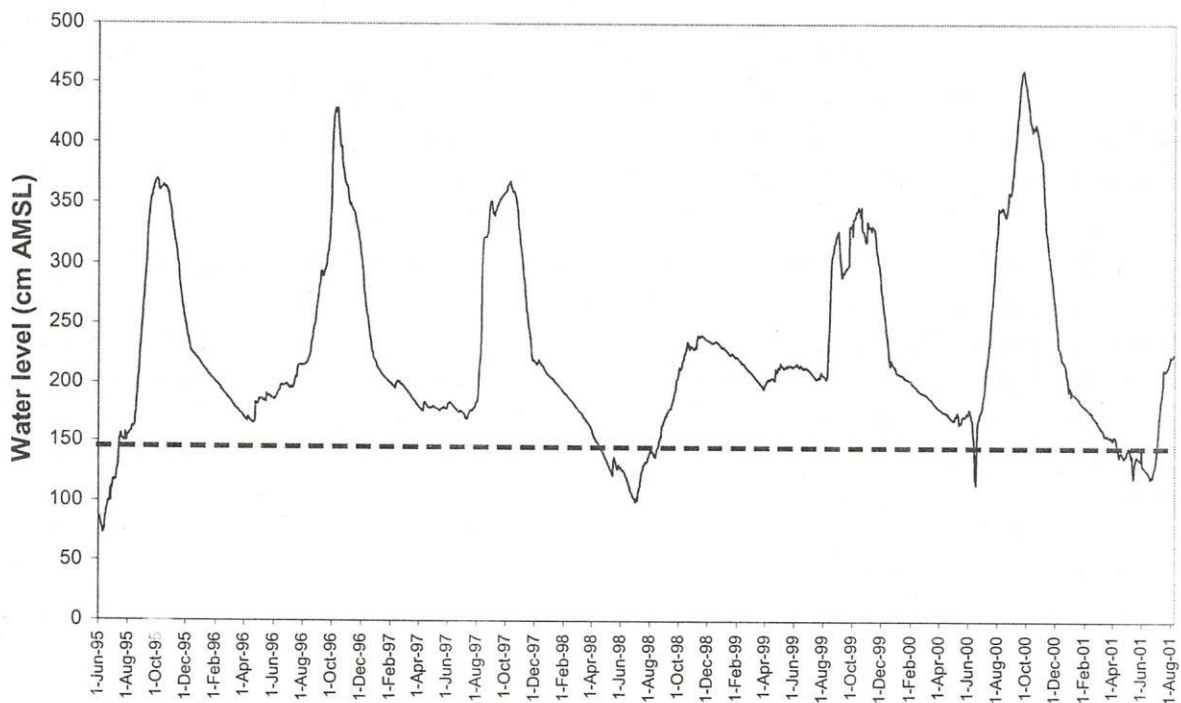


Figure 3: Water level record in Zone A1, Tram Chim National Park from June 01, 1995 to August 01 2001. the dotted line shows the average elevation of Tram Chim wetlands. During the observation period, most of the wetlands were inundated all year round because too much water was kept inside the Park.

Management of Tram Chim National Park is not independent of the socio-economic issues that greatly influence the livelihood of the human population that surrounds the Park. Management of the buffer zone is complicated, because the current buffer zone does not have the traditional meaning of a protected area buffer zone. The Tram Chim buffer zone comprises the territory of five villages and a town situated around the park, and park management has no control over resource management

practices there. Human density in this zone is high (410 people/km²) and is even higher on the dikes encircling Tram Chim (600 people/km²) [23]. Large numbers of seasonal migrants from nearby districts and provinces come to Tram Chim during flood season to fish [23], [28]. Buffer zone management has been identified as the key element for the success of wetland conservation at Tram Chim and is integrally linked with the prevailing socio-economic conditions in the villages and town around the park boundary [20], [22], [23].

6. CONCLUDING REMARKS

The management of Tram Chim wetlands has been strongly influenced by the policy over forest fire control. The fear of fire and the desire to completely eliminate fire resulted in the application of inappropriate methods such as maintaining high water level and the construction of canals and ponds in the core zone. To prevent further destruction to Tram Chim wetlands, an ecologically-sound fire and water management plan should be developed, based on thorough studies on the hydrology and the responses of key flora and fauna to various water-fire management scenarios. To facilitate the endorsement and implementation of such a plan, the communication between scientists, provincial officials and Tram Chim managers should be improved so that issues related to the ecology and management of Tram Chim wetlands can be better discussed and understood.

The success of Tram Chim management also depends upon resolving the conflict over resource use by local people. Even though current policy prohibits the exploitation of natural resources in the core zone of a national park, the fact is that Tram Chim managers are unable to control illegal harvesting of wetland resources, especially fish. It is important to distinguish subsistent and commercial harvesting, destructive and non-destructive harvesting methods. Policy should evolve to finally allow appropriate access to wetland resources for the people who indeed depend upon those resources for their subsistence.

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MÔI TRƯỜNG VẬT LÝ – SINH HỌC VÀ VIỆC QUẢN LÝ ĐẤT NGẬP NƯỚC CỦA VƯỜN QUỐC GIA TRÀM CHIM, TỈNH ĐỒNG THÁP, VIỆT NAM

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TÓM TẮT: Vườn quốc gia Tràm Chim là một vùng đất ngập nước có diện tích 7.600 ha trong đó các đặc điểm thủy chế tự nhiên của vùng Đồng Tháp Mười được phục hồi một phần. Từ những năm cuối 1980, vùng đất ngập nước này đã thu hút sự trở lại của đàn Sếu đầu đỏ sau nhiều thập kỷ vắng bóng. Những vấn đề liên quan đến đào kênh và tiêu thoát nước trên toàn vùng Đồng bằng sông Cửu Long làm cho sự thành công trong việc khôi phục đất ngập nước ở Tràm Chim mang một ý nghĩa to lớn. Tương tự như những vùng đất ngập nước rộng lớn khác có cùng một đặc điểm thảm phủ thực vật bao gồm đồng cỏ và rừng cây gỗ, yếu tố lửa rừng luôn đóng một vai trò quan trọng trong các chức năng sinh thái của Tràm Chim. Vườn quốc gia Tràm Chim hiện đang bị bao bọc bởi nhiều khu dân cư và việc duy trì đặc điểm môi trường trước

những tác nhân tự nhiên, như sự xâm lấn của cây Mai dương (*Mimosa pigra*), hoặc tác động nhân tạo như khai thác tài nguyên trái phép đang đặt ra nhiều thách thức to lớn.

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