



A Review of Thailand's Proposed Mae Wong Dam



March 2015

Prepared for the IUCN National Committee for Thailand by the IUCN Asia Regional Office

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List of Abbreviations/Acronyms

1st AMC	First Asia Ministerial Conference on Tiger Conservation
CEPF	Critical Ecosystem Partnership Fund
DNP	Department of National Parks
DP-KY	Dong Phayayen - Khao Yai Forest Complex
EHIA	Environmental Health Impact Assessment
EIA	Environmental Impact Assessment
GEF	Global Environment Facility
GTI	Global Tiger Initiative
GTRP	Global Tiger Recovery Program
HKK	Huai Kha Kaeng Wildlife Sanctuary
IUCN	International Union for Conservation of Nature
IWMP	Integrated Water Management Plan
MIST	Management Information System
MONRE	Ministry of Natural Resources and Environment
MWNP	Mae Wong National Park
NGO	Non-governmental Organization
NSC	National Specialist Committee on EHIA
ONEP	Office of Natural Resources and Environmental Policy and Planning
OUV	Outstanding Universal Value
PA	Protected Area
REDD	Reducing Emissions from Deforestation and Forest Degradation
RID	Royal Irrigation Department
SEA	Strategic Environmental Assessment
SMART	Spatial Monitoring and Reporting Tool
SWAT	Soil and Water Assessment Tool
UNESCO	United Nations Educational, Scientific and Cultural Organization
WCO	Wildlife Conservation Office
WCS	Wildlife Conservation Society
WEFCOM	Western Forest Complex
WFMC	Water and Flood Management Commission
WWF	World Wide Fund for Nature

1. Introduction

In October 2013, following a request by Mrs. Rataya Chantian, the President of the Seub Nakhasathien Foundation (a member of IUCN), the IUCN National Committee for Thailand asked the IUCN Secretariat to use its status as a respected, credible, science-based international organization to conduct a study into the proposed dam on the Mae Wong River, Nakhon Sawan Province, Thailand. This report is intended to give a brief overview of the history of this issue in Thailand, and address some of the concerns surrounding it - including the ecological value of the proposed dam site, the ongoing discussion over the dam's intended use as an irrigation or flood-prevention tool, and potential alternative mechanisms for water management in Thailand. Following a short discussion of these topics, it gives recommendations on how these issues might be resolved, and how water resources might most effectively and efficiently be managed in Thailand.

2. Methodology and Approach

This study was conducted primarily through a series of semi-structured interviews with recognized experts on this topic (see Table 1). Additional information was gathered through online research, published newspaper articles, and other publications.

Table 1 - List of key interviewees

Name	Organization	Position
Anak Pattanavibool	Wildlife Conservation Society	Country Director
Apichote Urantinon	Department of Water Resources, Faculty of Engineering, Kasetsart University	Researcher
Petch Manopawitr	World Wild Fund for Nature	Conservation Programme Manager
Rataya Chantian	Seub Nakhasathien Foundation	Chair
Robert Steinmetz	World Wild Fund for Nature	Conservation Biologist
Sasin Chalermklarp	Seub Nakhasathien Foundation	Secretary-General
Somruthai Tasaduak	Department of Water Resources, Faculty of Engineering, Kasetsart University	Lecturer

3. The Proposed Mae Wong Dam

Thailand's terrestrial agricultural production depends heavily on irrigation by the Chao Phraya river system, which includes the Sakae Krang River (of which the Mae Wong River is a tributary). As such, issues of water management are central to agriculture and economic development in Thailand. In recent decades, Thailand's agriculture and infrastructure have increasingly come under pressure from drought during the dry season (November to May), and flooding during the wet season (May to November). These pressures are compounded by the rapid intensification of agricultural production nationally (rice farmers now regularly harvest three or four crops each year, compared with one or two crops per year, historically). As a result, issues of water management have become increasingly politicized, with successive governments struggling to find sustainable solutions to this issue.

History

A dam on the Mae Wong River (Figure 1) has been proposed multiple times over the past 20 years. However, the precise location of such a dam has varied, and each proposal has been met with criticism from a variety of sources. Early proposals for a Mae Wong Dam focused on its role as an irrigation tool to provide water to cultivated land during the dry season. The proposed land to be irrigated included large parts of Mae Wong and Lat Yao Districts, Nakhon Sawan Province.

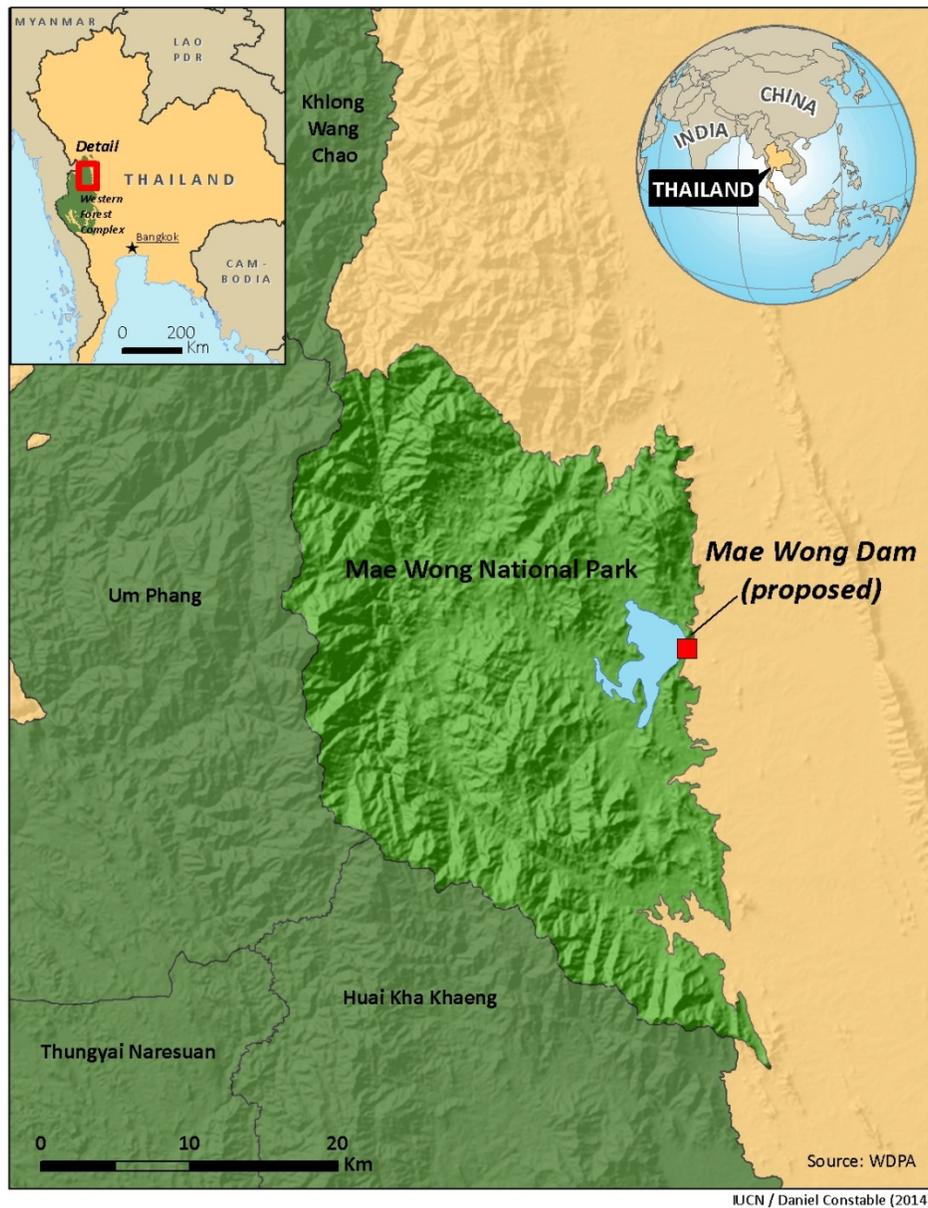


Figure 1 - Location of the proposed Mae Wong Dam.

A proposal for a dam on the Mae Wong by the Royal Irrigation Department (RID) in 2003 led to the establishment of a 'National Specialist Committee on EHIA' (NSC), under the Ministry of Natural Resources and Environment's (MONRE's) Office of Natural Resources and Environmental Policy and Planning (ONEP). The NSC, with the Sakae Krang River Basin Committee, demanded the undertaking of a Strategic Environmental Assessment (SEA), and the development of an Integrated Water Management Plan (IWMP) before any dam construction commenced. The SEA has since been completed by Kasetsart University, but has not been officially ratified, and so the results cannot be made public. This document assessed two potential sites for a Mae Wong Dam, in order to reduce potential negative impacts on the environment.

Heavy flooding in Lat Yao district in 2006 prompted the then Minister of Natural Resources and Environment to propose a Mae Wong Dam again, this time described as a flood-control mechanism. Following strong criticism in the national media, primarily from Thai civil society, a government order suspended this dam proposal.

In 2010, the RID proposed to ONEP to re-start the Environmental Impact Assessment process (this time with an Environmental Health Impact Assessment - in accordance with the 2007 Thai constitution. This EHIA was subject to a stakeholder consultation process, including consultation with local communities, but the full process of consultation and approval was not completed.

In 2011, lowland areas of Thailand suffered widespread flooding during the rainy season, putting the government again under pressure to identify mechanisms for the more effective management of Thailand's water resources. A new proposal for a Mae Wong Dam (THB 13.28 billion/USD 403 million) was approved by the Thai Government as part of the THB 350 billion (about USD 10.7 billion) IWMP, without the full approval of the EHIA. The IWMP included several water management projects from across the country, but was criticized by some as suffering from a lack of transparency. This Mae Wong Dam proposal described the dam as a flood-control mechanism, to assist with flood prevention on the central plain of Thailand.

In April 2012, the Cabinet approved the Mae Wong Dam as a flagship project for flood prevention, despite the fact that the EHIA was not completed until later in 2012. The dam was to be constructed within MWNP, creating a reservoir measuring 291,000 rai (46,560 ha) in the rainy season, and 10,000 rai (1,600 ha) in the dry season, holding 200 million m³ of water - 30-40% of the input to the Sakae Krang River basin.

Civil society responded with the publication of a book analyzing the results of this EHIA, with input from academia, and presenting counter-arguments against the construction of the dam. The NSC (a specialist committee including key members of the National Parks Board, managed by the National Environmental Board, which is in turn managed by ONEP) disagreed with the results of the EHIA, citing a lack of clear mitigation mechanisms for dealing with negative environmental impacts, a lack of clarity about the proposed dam's location, and a lack of clarity about the intended positive impacts of the dam.

In early 2013, the NSC was re-shuffled, with some observers complaining that the members most concerned about environmental impacts were removed from the committee. In August, an amended EHIA was re-submitted to the government for approval. In September, the Seub Nakhasathien Foundation submitted a letter of protest to the Secretary of ONEP, and organized public demonstrations. In November, the NSC visited the proposed dam site. Many of their findings were not in line with those of the EHIA.

Active campaigning against the construction of the Mae Wong Dam has been primarily led by the Seub Nakhasathien Foundation. Through their efforts, they have been very successful in raising the public profile of this issue within Thailand. In 2011, the Seub Nakhasathien Foundation started working with the Nakhon Sawan environmental network, including organizing demonstrations, and working with academics to raise awareness of the scientific basis to their arguments. Since 2012, they have continued to commission studies, organize seminars and press conferences, and produce books, posters, video clips and other materials aimed at raising awareness and engaging the public in this issue. Since the Mae Wong Dam project was integrated into the national IWMP, the public discourse now concerns water management at the national level, not just the Mae Wong Dam.

In September 2013, Sasin Chalermklarp, Secretary-General of the Seub Nakhasathien Foundation and a high-profile environmental activist in Thailand, led a ten-day march from MWNP to Bangkok (a total distance of nearly 400km). Organized primarily over social media, this event saw Sasin and his team joined by student environmental groups, and many others who felt strongly about the issue. Eventually, tens of thousands of people were present for the latter stages of the march, generating heavy national media coverage. The public awareness generated by this event saw a petition calling for the scrapping of the dam signed by over 200,000 people.

Following this campaign, the government conceded that the dam should be redesigned if it is to be used for flood mitigation purposes rather than irrigation of agricultural land.

Recent Developments

In May 2014, the government of Yingluck Shinawatra was replaced by a military government, led by Prime Minister Prayut Chan-o-cha, former Commander-in-Chief of the Royal Thai Army. Although this government has withdrawn the IWMP, the Mae Wong Dam may still be constructed as a stand-alone project.

On the 20th November 2014, the NSC (chaired by Kasemsant Jinnowaso, Secretary-General of ONEP) recommended to the National Environment Board that plans for the dam be dropped. This recommendation was supported by the DNP.

According to Deputy Prime Minister Plodprasop Suraswadi (Chairman of the Water and Flood Management Commission (WFMC)), the government intends to conduct a new study into the proposed dam's utility as a flood prevention mechanism.

3. Concerns about the Proposed Dam

Following each periodic revival of political interest in the construction of a Mae Wong dam, each new proposal has been met with criticism from Thai civil society and international organizations.

Environmental Impact

Dam proponents emphasize that construction of the Mae Wong Dam would only inundate 18km² of MWNP (1-2% of its area). However, it should be noted that development of this type within a national park is currently illegal under Thai law. If dam construction were to go ahead, this would appear to set a worrying precedent for infrastructure development within protected areas (PAs) in Thailand.

While the direct impact of flooding (habitat destruction) would be limited to a small area, indirect impacts would likely affect a much larger area of MWNP. Improved access to the site (due to road construction), and increased human population during construction, would likely lead to a significant increase in illegal hunting of wildlife and illegal logging (particularly of high-value hardwood tree species). Effective management of the protected area would become more difficult and resource-intensive, and eventually the ecological value of MWNP and other parts of WEFCON could become severely degraded.

In addition, as explained in Section 5, the area to be inundated by the Mae Wong Dam is of particular ecological value, both nationally and globally. The habitat type is rare elsewhere in the region, has recovered significantly since the establishment of MWNP, is currently under-represented in Thailand's protected area system, is the most productive area in MWNP for the recovery of sambar populations, and is home to a tiger population of global importance. A 2012 biodiversity occupancy survey in MWNP by the Wildlife Conservation Office of DNP found tiger tracks well inside the area that would be flooded by the proposed dam, and on one of the hills that would be used for dam construction. This survey also found evidence of the important tiger prey species sambar, wild pig, and munjac.

Gibson *et. al.* (2013) surveyed small mammals in forest islands in Chiew Larn Reservoir, southern Thailand, and found "near-complete extinction of native small mammal fauna" 25 years after the forest was fragmented as a result of flooding 165km² of forest in southern Thailand in 1986-1987. Although this is a much larger inundated area than would be created by the Mae Wong Dam, this demonstrates how habitat fragmentation can be just as significant a driver of biodiversity loss as habitat destruction.

Irrigation

Regarding the dam's function as an irrigation tool, some have asserted that the likely reservoir size would be too small to adequately irrigate the intended areas of Nakhon Sawan Province. Indeed, there are related problems with land-use planning elsewhere in the Chao Phraya basin - a number of reservoirs further downstream do not regularly contain

enough water to operate as intended. The Natural Resources and Environment Conservation Network believes that rather than irrigating almost 291,000 rai of farmland (as is claimed by the dam proponents), the dam would only benefit about 116,000 rai of farmland.

Flood Control

Regarding the dam's function as a flood control mechanism, critics have asserted that similarly, the likely reservoir size would be too small to function effectively in this manner. While it has been claimed that the Mae Wong Dam would help prevent flooding across the central plain of Thailand, and even as far downstream as Bangkok, research by the Seub Nakhasathien Foundation suggests that it would only reduce flood water levels in this region by less than 1%.

Environmental Health Impact Assessment

Critics of the most recent EHA claim the following:

- a lack of clarity about environmental impact mitigation measures;
- a lack of detail on the precise location and architecture of the dam;
- a lack of analysis on the expected positive impacts of the dam;
- a lack of analysis about land-use changes in the affected area;
- a lack of information about how water will be directed to communities;
- a lack of mechanisms to ensure sufficient water will be available to down-stream communities.

Critics also claim that the hydrological modeling used is not appropriately rigorous for informed decision-making. Some experts believe that in place of the Soil and Water Assessment Tool (SWAT) currently used, a distributed model (including an analysis of hydrology at multiple points along the river) would be more appropriate.

Critics believe that the dam's potential benefits for national flood control and local irrigation have been significantly overstated by the dam's proponents. Some believe that the 2012 dam approval was motivated more by political and financial considerations, than a rigorous scientific assessment of its utility for flood control or irrigation.

4. The Western Forest Complex

Thailand's Western Forest Complex (WEFCOM), the largest protected area complex in Thailand (about 18,000km²), is made up of 17 contiguous PAs (six wildlife sanctuaries and 11 national parks (see Table 2)). With forest cover nearing 80%, and habitat continuous with intact forests in Myanmar, this area is one of the most important remaining tracts of relatively intact forest in Southeast Asia; as such, it is of global importance for biodiversity. Elsewhere in Thailand, most forested areas (with the notable exception of the Eastern Forest Complex, and a handful of smaller PAs) have been converted to agricultural land.

Mae Wong National Park (MWNP) was established in September 1987, as Thailand's 55th national park. Situated in the Thanon Thong Chai mountain range, one of the highest ranges in western Thailand (the highest peak within MWNP, Khao Mokoju, reaches 1,964m above sea level), MWNP is covered primarily by mixed deciduous and evergreen forest, and contains the source of the Mae Wong River, a tributary of the Sakae Krang River, itself part of the Chao Phraya River's drainage basin.

MWNP is one of only three PAs in WEFCOM that has no communities living within its boundaries. Communities living in the surrounding area are of diverse ethnicities including Mon, Yao, Karen, Lahu, and Thai.

Table 2 - Thailand's Western Forest Complex

	Name	Established	Area (ha)	Province(s)
1	Salakpra Wildlife Sanctuary	1965		
2	Huai Kha Kaeng Wildlife Sanctuary	1972	278,014	Kanchanaburi, Tak, Uthai Thani
3,4	Thung Yai Naresuan (West and East) Wildlife Sanctuary	1974	369,000	Kanchanaburi, Tak
5	Khao Sanampriang Wildlife Sanctuary		10,100	Tak
6	Um Phang Wildlife Sanctuary			Tak
7	Erawan National Park	1975	55,000	Kanchanaburi
8	Chaloem Rattanakosin National Park	1980	5,900	Kanchanaburi
9	Sai Yok National Park	1980	50,000	Kanchanaburi
10	Si Nakharin National Park	1981	153,200	Kanchanaburi
11	Khlong Lan National Park	1982	42,000	Kamphaeng Phet
12	Mae Wong National Park	1987	89,400	Nakhon Sawan, Kamphaeng Phet
13	Phu Toei National Park	1987	31,900	Suphanburi
14	Khlong Wang Chao National Park	1990	74,700	Kamphaeng Phet, Tak
15	Khao Laem National Park	1987	149,700	Kanchanaburi
16	Thong Pha Pum National Park		112,000	Kanchanaburi
17	Lam Khlong Ngu National Park		60,000	Kanchanaburi

Source: Department of National Parks, Wildlife and Plant Conservation.

UNESCO World Heritage

In 1991, three large PAs comprising the core area of WEFOM (Huai Kha Kaeng, Thung Yai West and Thung Yai East) achieved designation as the Thungyai-Huai Kha Khaeng Wildlife Sanctuaries World Heritage Site, Thailand's first Natural World Heritage Site. World Heritage inscription was based on Criteria (vii), (ix) and (x) (Table 3).

Table 3 - Natural Criteria for inclusion on the World Heritage List

Criterion	Description	Relevance to Thung Yai-Huai Kha Khaeng
(vii)	to contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance	<ul style="list-style-type: none"> - "biological features of outstanding natural beauty and of great scientific value" - "two major watersheds with their associated riverine forests" - "ridges that run parallel from north to south, rising to heights well over 1,500 meters" - "the tallest peak reaches 1,830 meters above sea level, while the numerous valley bottoms slope from 400 to 250 meters above sea level, creating stunning landscapes and encompassing superlative forest habitats"
(ix)	to be outstanding examples representing significant on-going ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals	<ul style="list-style-type: none"> - "represents an outstanding and unique biome in mainland Southeast Asia with flora and fauna characteristic of the Sino-Himalayan, Sundaic, Indo-Burmese, and Indo-Chinese biogeographical zones" - "encompasses significant ecological and biological processes, including ... limestone habitats, mineral-licks, wetlands, and sink-holes" - "the savanna forest of Thung Yai is the most complete and secure example of Southeast Asia's dry tropical forest"
(x)	to contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation	<ul style="list-style-type: none"> - "exceptional species and habitat diversity. ... supports many wild plant and animal relatives of domestic species" - species lists include "120 mammals, 400 birds, 96 reptiles, 43 amphibians, and 113 freshwater fish" - many regional endemic species, and 28 internationally threatened species - "at least one-third of all mainland Southeast Asia's known mammals are represented ... providing the major stronghold for the long-term survival of many species"

The 'Outstanding Universal Value' of Thungyai-Huai Kha Khaeng Wildlife Sanctuaries was recognized as it is the "largest conservation area in Mainland Southeast Asia" (UNESCO 1991). "The flora and fauna of the sanctuaries include associations found nowhere else, with many species ... rare, endangered, or endemic. The sanctuary's importance as a conservation area lies in the heterogeneity and integrity of its habitats, the diversity of its flora and fauna, and the complexity of its ecosystem. The property contains exceptional natural beauty and aesthetic importance with steep sided valleys and impressive mountain peaks interspersed with small lowland plains. The scenic beauty of the property is exceptional, enhanced by the sight of a host of tributary streams and waterfalls, the unique mosaic of forest types and the sweeping spectacles of variations of colour, form, and foliage." With regards to the integrity of the World Heritage Site, it is noted that "...development pressures, dam and mining projects, which facilitate access to the property and illegal poaching, continue to impact the property." (Source: <http://whc.unesco.org/en/list/591>).

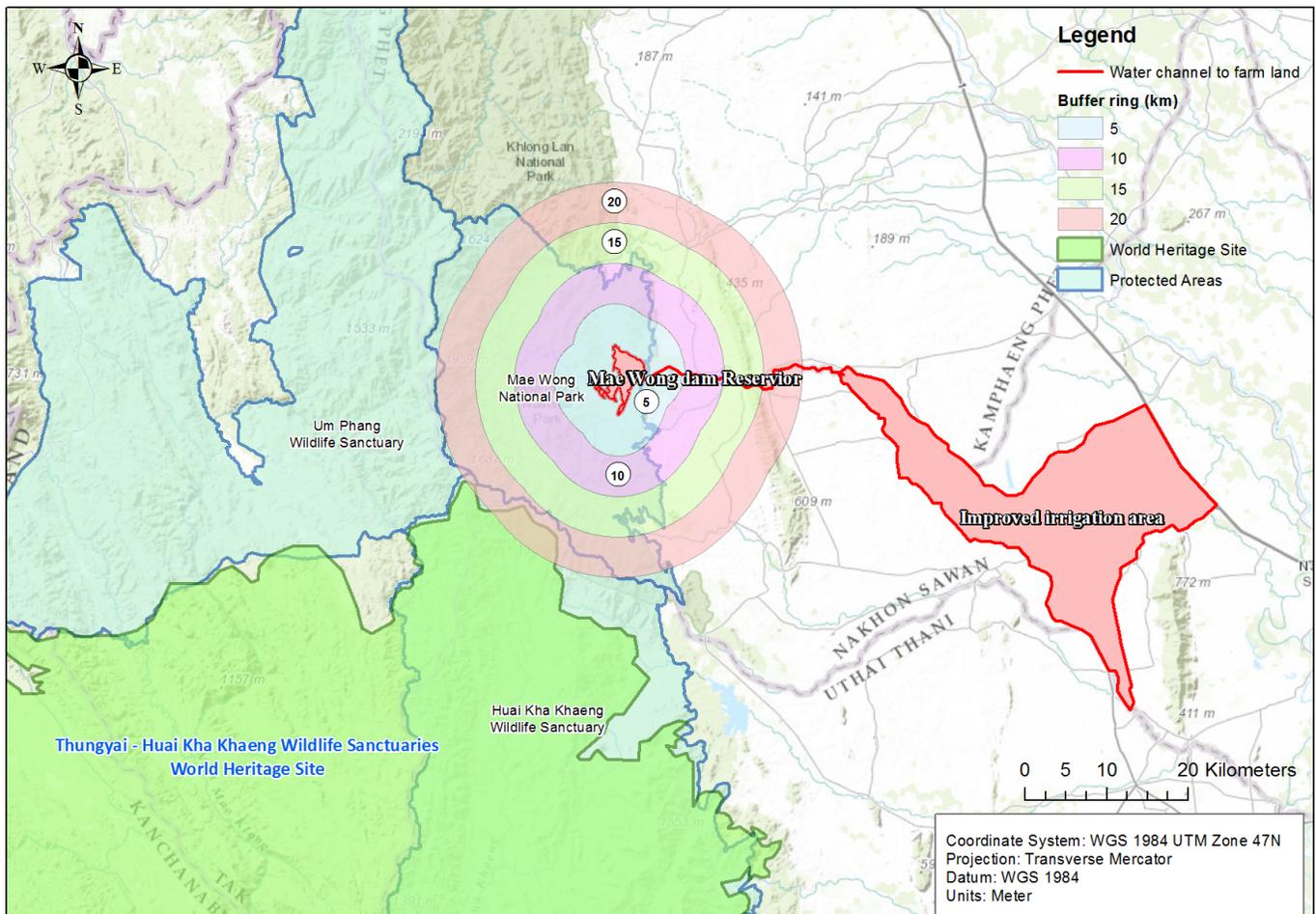


Figure 2 - Proximity of the proposed Mae Wong Dam to the World Heritage Site.

5. Biodiversity

"a wildlife oasis in a country otherwise transformed by economic development." (WCS 2010)

At the establishment of Mae Wong National Park in 1987, surveys noted large areas of degraded forest (including land that had been used for agriculture prior to the establishment of the park), and little evidence of large mammals. Since then, however, much of the forest has shown a marked recovery. Large specimens of hardwood tree species including teak may be found, and populations of mammals such as sambar are now becoming well established. While this recovery (in stark contrast to the trend elsewhere in the region) is very encouraging, it will only be sustained if the integrity of the PA is maintained, and threats to its biodiversity are successfully mitigated.

Mae Wong National Park now includes large areas of flat, low-lying deciduous forest and riparian grassland, habitat types that are now very rare in Southeast Asia, and heavily under-represented in Thailand's PA system (which currently focuses primarily on mountainous areas). Mae Wong National Park and Huai Kha Khaeng Wildlife Sanctuary include the last two remaining areas of riverine forest in Thailand that have not been flooded following dam construction.



Figure 3 - Grassland and forest habitats of MWNP © Wildlife Research Group/DNP

The forests of WEFKOM are home to many species that are no longer commonly found elsewhere in Southeast Asia. Notable mammals found here include the tiger (listed as Endangered on the IUCN Red List) (100-120 individuals are thought to be found within WEFKOM), sambar (listed as Vulnerable) (an important tiger prey species), banteng (Endangered), gaur (Vulnerable), wild water buffalo (Endangered), Malayan tapir (Endangered), Asian elephant (Endangered), three species of otter, some primate species, and some wild cats. Over 490 bird species are found in WEFKOM, including green peafowl (Endangered), Gurney's pitta (Endangered), six species of hornbill (including rufous-necked hornbill (Vulnerable) and plain-pouched hornbill (Vulnerable), and 20 species of woodpecker.

However, there remain significant threats to the biodiversity of WEFKOM. These include habitat loss and degradation (due to illegal logging, clearance for agriculture, and infrastructure development), and the poaching of wildlife (at least three tigers were killed in 2010 alone). Several local and international NGOs are working to support the Thai Government and local communities in securing the protection of this site.

For the last ten years, the Seub Nakhasathien Foundation (one of Thailand's most respected environmental NGOs) has been working alongside communities in WEFKOM in order to encourage them not to expand their cultivated land

into intact forest, and to assist them with the development of sustainable community forestry programs. International groups including the Wildlife Conservation Society (WCS) and the World Wide Fund for Nature (WWF) have focused on assisting the Thai Government to improve law enforcement (including through training rangers, and implementing SMART patrolling (since 2006 in Huai Kha Kaeng) and MIST (since 2008)), and conduct biodiversity monitoring. As a result, PAs such as Huai Kha Kaeng have seen a decline in illegal land clearance, a stabilization of hunting levels, and some decreases in rates of logging (although these decreases have not always been sustained).

On 7th November 2014, the Seub Nakhasathien Foundation held a seminar at Kasetsart University on the biodiversity of Mae Wong National Park ("Mae Wong Dam Seminar: new information and findings"). At this event, the Department of National Parks presented the results of research conducted by the DNP wildlife research group at the site of the proposed Mae Wong Dam reservoir, between October 2012 and August 2013. This research identified 442 species within the national park (32 amphibians, 42 reptiles, 279 birds, and 87 mammals), including 272 species at the dam reservoir site itself (24 amphibians, 22 reptiles, 171 birds, and 55 mammals). These figures are significantly higher than those found within the Mae Wong Dam EHA (which identifies only 239 species), and those of previous studies.

Notable records from this research include a newly-discovered species of horseshoe bat (*Rhinolophus sp.*) (yet to be named), Walston's tube-nosed Bat (*Murina walstoni*) (a recently-discovered species previously only known from Cambodia and Vietnam), the Kakhyen Hills spiny lizard (*Salea Kakhienensis*) (a new record for Thailand - normally found in western Yunnan, Myanmar, and eastern India), the Doi Suthep Caecilian (*Ichthyophis youngorum*) (first found at Doi Suthep in northern Thailand - this is the second record in Thailand in 53 years), and a new species of bowfingered gecko (*Cyrtodactylus sp.*). Based on these findings, it is clear that the low-lying riverine forest is of great importance for biodiversity. It seems likely that further research will highlight more species, previously unknown to science.



Figure 4 - A newly-discovered species of horseshoe bat from MWNP © Wildlife Research Group/DNP

Tigers

Global tiger populations are currently thought to be lower than 3,200 individuals, and found in less than seven per cent of the species' historical range. With the exception of the Russian Far East, populations are restricted to small pockets, mostly within PAs. Global population declines have been caused by both the overhunting of tiger and their prey, and the loss and fragmentation of their habitat.

The Global Tiger Initiative has identified 42 tiger source sites in eight tiger range states (only 18 of these 42 are outside of India and Russia), two of which are within Thailand: Thungyai - Huai Kha Khaeng and Kaeng Krachan - Kuiburi. Source sites are "areas that have concentrations of tigers that have the potential to repopulate larger landscapes." They "have the potential to maintain >25 breeding females, being embedded in a larger landscape with the potential to contain >50 breeding females, having an existing conservation infrastructure, and having a legal mandate for protection" (Walston *et. al.* 2010). These source sites currently contain about 2,200 tigers - nearly 70% of the global population (WCS/GTI, 2010).

The only other recognized tiger source site in SE Asia is Nam Et - Phou Louey National Protected Area in Lao PDR, which may now contain as few as two individuals (WCS, 2013). There is no evidence of breeding populations in Vietnam or Cambodia. Huai Kha Kaeng Wildlife Sanctuary, and by extension the rest of Thailand's WEFKOM, can therefore be considered the most important site for tigers in SE Asia. As Huai Kha Kaeng itself is now likely at carrying capacity for this species, sites elsewhere in WEFKOM, such as MWNP now become a priority for tiger conservation nationally.

Since 2010, WWF has been working at Mae Wong and Khlong Lan National Parks through their Global Tiger Recovery Program. This work consists of tiger and prey monitoring (camera trapping, scat analysis, and prey studies), efforts to strengthen law enforcement at the sites (by training rangers, and implementing SMART patrolling), and community education and outreach work (building a network of schools in communities surrounding the sites).



Figure 5- Tigers in MWNP ©Wildlife Research Group/DNP

As a result of this work and surveys implemented by the Thai Government (2011-2012 WEFCON mammal survey), there is now clear evidence of breeding tigers dispersing from Huai Kha Kaeng to Mae Wong, including photographs of individual tigers in Huai Kha Kaeng, and then again in Mae Wong some months later. MWNP may now be home to as many as 20 tigers. In 2014, WWF obtained photo and video evidence of three breeding females in MWNP. The tiger populations in HKK and MWNP are now the only confirmed breeding tiger populations in SE Asia, and one of only four populations globally that have successfully recovered from very low population densities (the other examples are in the far east of Russia, India's Western Ghats, and in Nepal).

An increase in MWNP's tiger population must be due both to dispersal from Huai Kha Kaeng and an increase in prey densities (particularly sambar and wild boar) in MWNP. One of Mae Wong's breeding females in 2014 is currently raising three cubs - requiring her to hunt about 5,000kg of meat/year. This is the same litter size as is found in parts of India, where tiger prey densities are typically 10-100 times what is found in Thailand. While tiger prey species such as sambar are still not common in Mae Wong as a whole, there must be pockets (in low-lying deciduous forest, such as the recently recovered forest surrounding the Mae Re Wa River), with high population densities. Indeed, a 2012 biodiversity occupancy survey conducted by the Wildlife Conservation Office of the Department of National Parks found tiger tracks near the Mae Re Wa river and in the surrounding hills, accompanied by evidence of tiger prey species sambar, wild pig and muntjac.



Figure 6 - Tiger cubs in MWNP ©Wildlife Research Group/DNP

In January 2010, at the First Asia Ministerial Conference on Tiger Conservation (1st AMC), the Thai Government endorsed the Hua Hin Declaration on Tiger Conservation. This document recognized the "crisis of extinction" that is facing global tiger populations, and reaffirmed commitments to implement national tiger conservation efforts - focusing on landscapes, law enforcement and illegal trade, management, communities, sustainable financing, and accelerated implementation of national and regional tiger conservation programs.

Table 4 - Thailand Tiger Action Plan 2010-2022: Vision, Goals and Objectives

Vision	By 2022, tigers have recovered and thrive in the priority landscapes managed under high standard interventions and monitoring systems, and Thailand has become a strong support for international collaborations on tiger and wildlife conservation and protected area management in Southeast Asia.
2-year Goals	1. High-standard monitoring interventions and monitoring systems established and functioning in Tenasserim-WEFCOM and DP-KY landscapes.
	2. Tiger occurrence status established at all additional potential tiger landscapes.
	3. The system to monitor captive tigers strengthened and standardized with clear penalties in place for violations
5-year Goals	4. Effective management systems in place in the Tenasserim-WEFCOM and DP-KY landscapes.
	5. Key tiger threats in the priority landscape show a clear decline
	6. Important tiger ecology (e.g., home-range variation) in the priority landscapes very well understood and used to guide management
	7. Tiger populations stabilized or increased in Tenasserim-WEFCOM and DP-KY landscapes and possibility for re-establishing in other areas explored.
12-year Goal	8. To increase tiger populations of Thailand by increasing the populations in the Tenasserim – WEFCOM and DP-KY landscapes by 50%, and reestablish populations in other potential tiger landscapes such as Phu Khew – Nam Nao Forest Complex and Klong Saeng – Khao Sok Forest Complex.
	Priority Action 1: Strengthening direct conservation action and enforcement
Objectives	1. Promote conservation efforts at the scale of entire populations (e.g., forest complex and associated corridors)
	2. Provide long-term support for tiger habitat restoration activities
	3. Ensure that the government policy of protecting tiger habitat from development threats, as committed to in the Hua Hin declaration, is followed
	4. Encourage community participation and cooperation in protected area conservation activities
	5. Support local communities in developing sustainable economies that reduce dependence on forest resources
	6. Facilitate international cooperation in tiger conservation efforts
	7. Strengthen national laws, policies, and enforcement of tiger related crimes
	8. Support national and international efforts to manage captive tigers responsibly
	Priority Action 2: Building capacity based on successful models
Objectives	9. Establish a Regional Tiger Conservation and Research Center at Huai Kha Khaeng Wildlife Sanctuary
	10. Ensure national training capacity can deliver high quality tiger conservation training at all levels
	Priority Action 3: Strengthening monitoring, research, and information management
Objectives	11. Monitor tiger and prey populations in priority landscapes
	12. Maintain long-term tiger and prey ecology research in priority landscapes
	13. Ensure that relevant information for tiger conservation is well managed and available to inform strategy and planning
	Priority Action 4: Promoting education, awareness, and public participation
Objectives	14. Convey tiger conservation-related messages to a diverse Thai public, policy-makers, and politicians
	15. Ensure that basic concepts of the tiger's ecological and cultural significance become part of Thailand's standard curriculum at several educational levels
	16. Ensure that co-benefits of tiger landscape conservation are understood and appreciated
	Priority Action 5: Strategic financing for tiger conservation
Objectives	17. Identify the costs of effective tiger conservation, current expenditures, and efficiency of these expenditures
	18. Make use of large scale funding opportunities such as Global Environment Facility for Biodiversity (GEF) 5, REDD, and other programs to fund tiger conservation efforts
	19. Develop sustainable funding mechanisms

Following this declaration, the Thai Government produced a national Tiger Action Plan for 2010-2022. This plan highlighted the importance of WEFCOM for global tiger conservation, emphasized Thailand's role as a world leader in tiger conservation best practices, science and policy, and committed to a framework of eight goals, 19 objectives and 51 activities (see Table 4). Efforts to monitor and secure the growing tiger population in MWNP would appear to align well with all stated goals, and particularly objectives 1, 3, 7, and 11.

4. Mechanisms for Water Management

At various times, the Mae Wong Dam has been proposed as both a tool for irrigation of dry-season agriculture, and as a tool for preventing rainy-season flooding. However, there does not yet appear to be a consensus on how effectively the proposed dam would function at either of these roles.

In 2013, Lat Yao town, Nakhon Sawan province was again subject to serious flooding. Local media reports at the time were vocal in calling for the construction of a dam to prevent this from happening again. However, research conducted by Kasetsart University concluded that the flooding was caused not by the lack of a dam on the Mae Wong river, but by the ineffective management of water resources, basin-wide. In particular, two key flood gates upstream from the town (designed to direct water away from the town in times of high flood risk) did not appear to have been properly utilized.

Researchers studied the cases of flooding in the region, in order to provide recommendations to the dam proponents. In many cases, the primary cause of flooding appears to be inappropriate construction (particularly of roads and houses) in the river's natural flood-way. Reclamation of land for construction severely reduces the drainage capacity of the flood-way, leading to flash-flooding and the destruction of property. In some cases, urbanization has replaced wide klongs (canals), with smaller underground channels, more easily overloaded by rainy-season water flow.

While it is clear that work needs to be done to solve the problems of water management in Nakhon Sawan Province (and nation-wide), experts recommend that the various available options be fully assessed for effectiveness and efficiency, before any decision to build a Mae Wong Dam is made. Here, we present a brief summary of some of the alternative options for consideration:

Existing Infrastructure

Between the proposed Mae Wong Dam site and the town of Lat Yao, four small check-dams are already in place, designed to manage water flow at times of high flood risk. Unfortunately, it does not appear that these are currently under regular management by local authorities. Graffiti found on these structures indicates some level of unofficial community-based management, and disagreement between local communities over their most effective use.

In addition, Lat Yao town has an extensive drainage system including check-dams, canals, levees, and drainage ditches, all designed to aid the flow of water downstream. Unfortunately, in recent years, many of these have fallen into disrepair - control structures have not been well maintained, drainage ditches have been blocked by debris from construction and plastic waste, and poorly-planned road and building construction has rendered some of them no longer fit for purpose. As a priority, an assessment should be undertaken into which control structures are currently in use, which are in need of repair, and what the likely cost of repair would be. A rapid assessment indicates that several of these structures are relatively new, and could be brought back into full use at relatively little cost.

The more effective use of existing infrastructure may well be an efficient strategy for addressing issues of water management in Nakhon Sawan province, and certainly should be undertaken in order to compliment any other investments made. Unfortunately, to date there appears to have been little political will to do this, with instead a focus on the revenue-generating opportunities of large new infrastructure projects.

Additional Small Weirs

As mentioned above, between MWNP and the town of Lat Yao, four small check-dams have previously been constructed. One option, first proposed by an EHIA consultant and worth investigating in more detail, is the expansion of this system into a chain of 12 small weirs - designed to minimize impact on fish passage. Researchers at Kasetsart University have looked into the option of complementing this system with a chain of small storage ponds (connected to the small weirs, and sometimes referred to as 'monkey cheeks') and believe that this may be a cost-effective mechanism for providing dry-season irrigation water and rainy-season flood prevention. Although groundwater may currently be found in some places only 30-40cm below the surface, it is thought that the option of complementing this system with the pumping of groundwater is not likely to be a sustainable approach.

Community-Based Solutions

In recent years, as the public debate about the Mae Wong Dam has evolved into a nation-wide discussion on water resources management, much of the dialogue and decision-making has remained at the level of the national government. However, the most effective and efficient solutions may be found to lie at the community level. There is one pilot project already operating in Mae Wong division, with technical input from Mahidol University. A small community-based reforestation and irrigation project is now storing water for use by 220 households during the dry season. Similar initiatives could conceivably be scaled-up to provide water security for much of Nakhon Sawan province, at a much lower cost (economic and environmental) than large dam-building projects.

The value of local knowledge about hydrology and water resources management must not be understated when planning local and national-level water resources projects. The residents of Nakhon Sawan province are very keen to provide input to the planning of new projects, but so far many feel that their recommendations have not been adequately incorporated into the EHIA. Kasetsart University is currently working with a number of affected communities, to help address this issue.

Some experts have recommended a 'jigsaw' model of water management, with each piece representing an area of locally-managed agricultural land. In this model, each jigsaw piece would include a small storage pond, connected to its neighbors, and to the main river channel. Such a locally-managed system would provide flood relief during the rainy season, and if coupled with investment in modern irrigation techniques, would allow for the efficient use of stored water during the dry season.

5. Conclusions/Recommendations

IUCN recognizes the need for Thailand to take steps to resolve national issues of water resources management, in order to secure the nation's irrigation system, and reduce the impacts of floods and droughts. In this particular case, however, it would appear that the environmental costs of dam construction would outweigh the positive impacts on national water resources management. MWNP is part of a protected landscape of global importance, forms a buffer zone for a World Heritage Site, includes a habitat type of great ecological value that has been mostly eradicated elsewhere in SE Asia, and is home to a globally-significant and recovering population of tigers in addition to a number of other globally threatened species.

The information reviewed during the preparation of this report suggests that the construction of a dam within MWNP *does* have the potential to negatively impact both the integrity and 'Outstanding Universal Value' of the Thungyai-Huai Kha Khaeng Wildlife Sanctuaries World Heritage Site. Habitat destruction and increased poaching in MWNP related to dam construction would be likely eventually to 'spill over' into the World Heritage property, impacting its Outstanding Universal Value as recognized under criteria (ix) and (x). These concerns were raised in November 2012 by the Director of the World Heritage Centre, in a letter to the Government of Thailand. Furthermore, the evidence generated by the 2011-2012 WEFOM mammal survey that individual tigers utilize habitats both in MWNP and in Huai Kha Khaeng Wildlife Sanctuary suggests that the construction of a Mae Wong Dam in its proposed location could impact directly on the tiger population in the World Heritage Site through loss of dispersal habitat and a reduced prey base.

On the 7th November 2014, at a seminar at Kasetsart University organized by the Seub Nakhasathien Foundation, the Department of National Parks confirmed their intention to propose the expansion of the Thungyai-Huai Kha Khaeng Wildlife Sanctuaries World Heritage site to include Mae Wong National Park, and adjacent Klong Lan National Park.

Aside from environmental considerations, significant knowledge gaps still remain about how successful the Mae Wong Dam would be as a tool for irrigation and flood prevention. While it is likely that its construction would have some utility under both of these functions (locally, if not nation-wide), it seems unlikely that this will be sufficient to justify the scale of the investment or the environmental cost. As a priority, assessments should be undertaken of the proposed dam and the alternative water management options available. Alternative options may be shown to be as (or more) effective, significantly cheaper, and less destructive.

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