

GIBBON STUDIES IN KHAO YAI NATIONAL PARK: SOME PERSONAL REMINISCENCES

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ABSTRACT

This is a highly selective, informal account of my experiences in pursuing my main interest—gibbons—in Khao Yai National Park, which has recently passed its 50th anniversary. Khao Yai, one of the largest and most popular national parks in Thailand, has developed into one of the most important wildlife research sites in the world, particularly for birds and large mammals. This personal account is designed to teach readers about the importance of Khao Yai National Park as a gibbon research site and present a brief overview of some of the major findings that have been made about gibbons, touching on such aspects as taxonomy, speciation, vocalizations, social behavior, group structure and feeding ecology. The difficulties and challenges of carrying our field research in Khao Yai, and the unforeseen obstacles, are also woven into the story. To me, the long period of research from about 1975 has been an exciting rollercoaster ride, with many breath-taking dives and turns, and some calm areas. I hope readers feel some of the thrills that I did.

Keywords: gibbon, hiking, *Hylobates*, *Hylobates lar*, *Hylobates pileatus*, Khao Yai, Mo Singto, poaching, protected area, sound recording, taxonomy

BEGINNINGS

Gibbon research in Khao Yai National Park began just about the time of America's final defeat in Saigon which ended the Vietnam War, and not long after the 1973 political upheaval in Bangkok, which helped turn the kingdom on its rocky path toward democracy. Not too many active researchers remember that exciting time. I had completed graduate school in the 1960s—in the Bob Dylan generation (I am proud to admit that I am the same age as Bob Dylan)—and by some incredible and unforeseen twists of fate, ended up on the streets of Bangkok, with easy access to the rain forests of Thailand, and an abundant population of the strange and incredibly athletic singing apes.

This essay commemorates the 50th anniversary of the national park, which is Thailand's first, founded in 1962. It is one of the largest protected conservation areas in Thailand (2,168 km²). With about half of its area being up on a high plateau 500–800 meters above sea level, and with no road access initially, its lush forests escaped significant deforestation by lowland Thai farmers, and it had not been colonized by tribal swidden farmers who migrated into Thailand from the north and west. At the time of gazettment, however, it was being penetrated by lowlanders, many of them said to be fugitives from the law, who were starting

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to clear forests on the top of the plateau for their settlements. Their clearings are still visible (Figs. 4D, 5A) some now regenerating into young forest, and other areas, especially along the road through the park, maintained as fields by fire or by mowing to provide grazing for ungulates and allow visibility of the wildlife. Had the Thai Forest Department not created a national park over the mountain plateau, I am certain that there would hardly be a single native tree left standing on the mountain by now. During the 1970s and 1980s I hiked through many of the dwindling forest patches north, east and southeast of Khao Yai, and witnessed the total destruction of remaining forest not converted to conservation forest (national parks and wildlife sanctuaries). All forest was being cleared and planted first in maize, then other cash crops such as cassava, cotton, rubber and fruit trees, and later wood pulp plantations. This process was initiated by the rampant and unsustainable logging promoted by the Forest Department, which was occurring throughout most of Thailand, which degraded the forests and opened them up to fire (which does not normally invade mature evergreen forest) and landless farmers. The forest on Khao Yai Mountain, however, had escaped this concession logging because of its inaccessibility. We can be thankful, therefore, for the vision of the Thai government in creating our protected area system, and for the survival of a large patch of still-pristine forest so close to Bangkok. This park has proven to be a leading recreation site and attraction for tourists, as well as a great benefit to agriculture under the influence of the abundant water and cool climate on the mountain.

Khao Yai Park has also proven to be a great boon to science, as a leading site for research on the ecology and behavior of birds and large mammals. In the somewhat rambling commentary that follows, I will review some of my experiences in studying gibbons in the forests of Khao Yai and also the roles some of my colleagues played. I will emphasize the early years which are absent from most people's memories, and before they start to slip from mine. I write this to inform young researchers of the breadth and depth of research that has already been carried out, and the larger community of interested observers—particularly park officials—of the importance of this research to the park, and to the scientific world.

Khao Yai is one of several important research sites on gibbons in South and Southeast Asia (including Indochina). Other important sites have been established in China, peninsular Malaysia, Sumatra, and Kalimantan where long-term studies have been conducted by multiple researchers, but Khao Yai arguably has become the longest-running and most productive site for the study of wild gibbons. I believe that more new findings have been made in Khao Yai than anywhere else, and these have greatly changed our understanding of the biology of gibbons.

EARLY RESEARCH

We may start by spotting the oldest paper in the list: that by J. T. MARSHALL *ET AL.*, (1972), on the species of gibbons found in Thailand. I had known and befriended Joe (Fig. 1C) while we were both at the SEATO Medical Research Lab (SMRL), he a civilian employee of the Department of Army and I a reserve officer in the Medical Service Corps fulfilling my two-year active duty obligation, during 1968–69. [After the South-East Asia Treaty Organization (SEATO) became militarily obsolete and was disbanded, the SMRL was simply renamed the Armed Forces Research Institute of Medical Sciences, or AFRIMS, and continued under a bilateral agreement between the U.S. and Thailand. It hasn't moved from its original location on Rajavithi Road.] It was a lucky assignment for me, as it allowed me to become familiar



Figure. 1. A, The author tracking gibbon group on Mo Singto Plot at dawn in 2010 (photo: Kulpat Saralamba); B, lar female Andromeda with her last infant (Adam) at Mo Singto (photo: Kulpat Saralamba); C, Joe Marshall (foreground left) and Edward Dickinson in Khao Yai Park, 1968; D, author instructing in plot survey (photo: Anuttara Nathalang); E, lar male feeding on figs (photo: W. Y. Brockelman).

with captive gibbons in the lab, gibbons released on Ko Klet Kaeo, an island in the Gulf of Thailand, and gibbons in the wild. The attempt by the SMRL to establish a breeding colony of gibbons on an island for medical research is described by BERKSON *ET AL.*, (1971). It was Marshall, and also my army assistant Bruce Ross, who in 1969 introduced me to wild gibbons in Khao Yai Park. Joe T. Marshall, Jr. was employed as a zoological expert at SMRL (as was the ornithologist H. Elliott McClure), being both a good ornithologist and mammalogist. Joe



Figure 2. A, A dark-phase lar female with light infant (photo: Kulpat Saralamba); B, lar gibbon diving through canopy (photo: Kulpat Saralamba); C, pileated gibbon female with infant (photo: Kulpat Saralamba); D, adult male pileated gibbon (photo: Kulpat Saralamba).

was particularly interested in vocalizations as a taxonomic tool; he taught me to recognize the calls of all the owls (about eight species) and other night birds in Khao Yai.

Back then it was a lot easier to start a research project in a national park than it is now. When I first went to Khao Yai, Khun (Mr.) Phairote Suwanakorn was the chief of the park. Khun Phairote was highly respected for his integrity and devotion to conservation, and he also wielded considerable power. He later became director-general of the Royal Forest Department, which at that time included management of parks and wildlife. If Khun Phairote said you could do research, you just did it. No written applications to the National Research Council or the Forest Department were required. Research was under the control of the park chief during many subsequent tenures of park chiefs. In recent years, starting a research project has required considerable paperwork and meetings; it could take six months to a year to gain the necessary administrative approvals; however, the National Research Council more recently has tried to impose a greater degree of order and predictability on the process of obtaining the needed permissions for foreigners, and has shortened the period to three to six months, barring any unforeseen snags. The Department of Parks, Wildlife and Plant Conservation (DNP), however, has not had a stable policy regarding researchers. Their policy on accommodations for researchers in protected areas has at times been particularly capricious, with some officials wanting to charge researchers tourist rates for rooms (without providing tourist-quality service) and others being more sympathetic to the needs and limited budgets of researchers.

A couple of years ago, for example, the director-general of the DNP decided that parks were for tourists, not researchers, and he ordered all senior researchers to be thrown out of their previously rented rooms in Khao Yai, and summarily rejected their applications for permission to continue research. After he retired last year, this policy was reversed under a new chief. The department has tried to make up for this damaging policy by holding several meetings with officials and researchers, extolling the importance of scientific research. The senior researchers who were suddenly excluded from Khao Yai Park greatly appreciated these actions; we felt that some park officials did not appreciate the importance of wildlife research. We would remind them that without the accumulated findings of researchers (summarized in LYNAM *ET AL.*, 2006), the Dong Phrayayen – Khao Yai Forest Complex would likely not have been proposed as a World Heritage Site and gained the renown that it now has. In addition, most Thai conservationists and wildlife researchers were trained by more senior academic researchers in parks, and researchers have provided many of the educational benefits of managing protected areas, and created most of the publicity in the media that they and their spectacular wildlife have received. Researchers (including myself, in the case of Khao Yai Park) have participated in developing management plans which guide park officials, which are modeled after I.U.C.N. guidelines. When senior researchers based in universities were suddenly stopped from doing research, I must admit that we felt an acute sense of injustice.

The subsequent meetings held between researchers and park department officials earlier this year (2013) did much to restore good relations, but they also revealed a basic problem that needs to be solved: the lack of regular formal communication and exchange of knowledge between park officials and researchers. The great majority of national park and wildlife conservation officials do in fact respect and support researchers, but they are also beholden to regulations and to the whims of their superiors. A persisting problem, however, is that park officials often do not know how to incorporate the findings of researchers into management policy, and much research is, admittedly, arcane to non-scientists and not aimed at improving management to begin with. Both sides need to work hard to correct this situation.

Let us return to our adventures in the forest. Marshall had discovered that the pileated gibbon occurred in Khao Yai Park in contact with the white-handed, or lar, gibbon (Figs. 1E, 2A, B). The pileated gibbon (Figs. 2C, D) was known to occur in Southeast Thailand and through Cambodia to the banks of the Mekong River, but how far it extended to the northwest (into Khao Yai Park) was not yet clear. Marshall could easily distinguish the species by their song patterns alone while they sang their duets, which were both species- and sex-specific. He then set out to record the songs of all species of gibbons in Southeast Asia, and demonstrated that each species could be distinguished more easily by voice than by pelage (MARSHALL & MARSHALL, 1975).

At that time only one species of gibbon had been studied in the wild, *Hylobates lar*, by the legendary pioneer Clarence Ray Carpenter in northern Thailand (CARPENTER, 1940), and decades later by John Ellefson (Ph.D. from U. C. Berkeley), in peninsular Malaysia (ELLEFSON, 1968). David Chivers, out of Cambridge University, was just finishing his pioneering research on the siamang in Kuala Lompat, Malaysia (CHIVERS, 1974). I was fortunate to meet both Carpenter and Ellefson at the second meeting of the International Primate Society in Atlanta, Georgia, in the summer of 1968, just before I was sent by the Walter Reed Army Institute for Research (WRAIR), Washington, D.C., to Thailand. So in 1972 we did not have a clear understanding of the patterns of the songs of all the gibbon species (then believed to number anywhere from five to nine). Marshall set out to correct that. Being able to reliably identify gibbons by their songs implies that these songs must be rather rigid and stereotyped and under considerable genetic control, like species-specific bird songs, for example.

STRANGE-SOUNDING GIBBONS

Joe Marshall was an excellent naturalist and wonderful field companion; his delightful and always-enthusiastic wife Elsie usually accompanied him on field trips. We had many memorable trips to Khao Yai together in the mid 70s, after my wife and I returned to Thailand (in 1973) to live and start a family. We focused our attention in the area of forest just east of the Tourist Organization of Thailand bungalows (since taken over by the Parks Department and now known as the Research and Training Center). A dense rattan thicket blocks any researcher who tries to enter or leave this forest. Joe had heard both lar and pileated gibbons here, and some strange anomalies: a group with a *lar* male and *pileatus* female, and some individuals with not-quite-typical calls of the species. One female gave a great-call with too many hoots given too rapidly to be a typical *lar*. Another had a great-call that started off like *pileatus* but did not speed up fast enough to become a real bubble sound typical of *pileatus*. One male gave *lar*-like hoots but they sounded a bit like the “hoo-haah” phrases of the male agile gibbon (*H. agilis*) of Malaysia and Sumatra. We were confused; were these animals just varying their voices according to their mood, or could they be hybrids? We argued about it. I believed that they must be hybrids because each individual stuck to its own pattern which did not vary.

These songs Joe recorded on his big heavy Nagra IV tape recorder which he lugged through the forest. Soon I decided to buy (with help from the New York Zoological Society) one of those miniature Swiss Nagra SN recorders made for spies; they were light and very convenient for wildlife recording as well as spying. I had it hooked up to a long (and expensive) Sennheiser “shotgun” microphone, courtesy of the Frankfurt Zoological Society and sound recording equipment experts in the electronics shop of the Rockefeller University in New

York. Having lighter recording gear allowed me to more quickly sneak up to the gibbons and get under the group while they were occupied with singing their duet. Since none of the animals we were trying to record were habituated, if they saw you or heard you step on a dry leaf they would usually give a few alarm calls and flee through the canopy, making any further recording that day impossible. Learning the art of recording unhabituated wild gibbons and having state-of-the-art equipment, I was able to obtain some of the best recordings of wild gibbons ever made. All these recordings, and the detailed notes accompanying them, have now been digitally archived by the Macaulay Library of Natural Sounds at the Laboratory of Ornithology, Cornell University. The lab has recently put its huge collection of sounds online, where anyone can listen to them at the website <MacaulayLibrary.org> or by accessing it through the Ornithology Lab's website <www.birds.cornell.edu>. The website has a search menu for species in the upper right corner where you can type gibbons × recordist (type “brock” in the drop-down menu).

We tracked down these unusual-sounding animals, hacking trails through the rattan thicket with our machetes or following deer trails. It took us a week or so to get good looks at them in the area. Sure enough; they looked as strange as they sounded. Joe made some nice watercolors of the various hybrids that we saw; the paintings were photographed and reproduced in MARSHALL & BROCKELMAN (1986) but the color reproduction was not very good. Better reproductions appear in Joe's *tour de force* paper MARSHALL & SUGARDJITO (1986) which summarizes all Marshall's findings and opinions on the systematics and zoogeography of gibbons. I wrote my own account of the frequency of morphs in the contact zone between the species in the “Lesser Apes book”, in BROCKELMAN & GITTINS (1984), along with a brief account of Paul Gittin's findings in the *lar-agilis* contact zone in the headwaters of the Muda River in northern Malaysia near the Thai border. In both contact zones, the parental species phenotypes predominate, which requires strong premating isolation and reduction of gene flow between the species. The lack of free interbreeding between the species where they come into contact in the wild, as they do in a relatively small area of Khao Yai, justifies their status as biological species.

THE BIG DEBATE

You would think that all primate experts would then agree that at least *Hylobates lar*, *H. agilis*, and *H. pileatus* were all good biological species, right? Unfortunately that didn't happen. There has long been debate among the experts about the number of true species of gibbons. In July of 1980, the great majority of researchers on gibbons in the world came together in a refurbished castle in southern Germany, Schloss Reisensburg, to discuss all aspects of gibbon biology. The meeting resulted in the publication of the “Lesser Apes book” (PREUSCHOFT *ET AL.*, 1984). Among the many topics debated at this wonderful and friendly meeting was how many species of gibbons should be recognized. The number you gave was important, and it revealed your basic philosophy of evolutionary systematics. The answer depended on what characters one wished to use as providing evidence for reproductive isolation and separate pathways of evolution that should result from such isolation. On this point the participants of the meeting (and indeed, the editors of the Lesser Apes book) were deeply divided. On one side were the functional anatomists, led by the distinguished and respected Prof. Holger Preuschoft of Bochum University and Prof. Norman Creel of the State

University of New York at Stonybrook, who argued that if species have attained reproductive isolation, it must be reflected in basic morphological structure, especially cranial anatomy, as revealed by sophisticated multivariate techniques. By this criterion, none of the five forms of the “lar group” (*Hylobates agilis*, *lar*, *moloch*, *muelleri* and *pileatus*) qualified as distinct species, and therefore all were relegated to subspecies of *Hylobates lar* in their treatment (CREEL & PREUSCHOTT, 1984). Thus, they recognized a total of five species of gibbons (also including *Hylobates concolor*, *hoolock*, *klossii*, and *syndactylus*). At that time all members of the family Hylobatidae, which includes all of the gibbons and the siamang, were included within the single genus *Hylobates*.

On the other side of this debate were arrayed the majority of participants who believed that all five members of the “lar group” (a group of species that share some basic characteristics and are believed to have a common ancestor) should be recognized as full species, making a total of nine gibbon species. This included all the field workers: people who based their judgment on evidence from behavioral studies in the forest, especially pelage coloration and vocal patterns. All nine species were recognized in the opening chapter of the Lesser Apes book dealing with conservation issues (BROCKELMAN & CHIVERS, 1984). Colin Groves of Canberra, Australia, our foremost primate taxonomist, weighed in with a thorough discussion of the gibbon species question and ended up recognizing eight species; *muelleri* (a Bornean form) was not deemed sufficiently different from *agilis* in pelage characteristics, on which Groves tends to rely heavily, to merit species rank (GROVES, 1984). Groves would later change his mind, after examining more evidence. To bring the story up to date, the number of species recognized on the island of Borneo has now reached four, as *H. muelleri* has been divided into three species populations and a population first named *H. agilis albibarbis* in the southwest has now earned the species name *Hylobates albibarbis* (MITTERMEIER ET AL., 2013). The total number of species in the family Hylobatidae has now reached an astronomical 18, and the species “splitters” have triumphed!

Vocal characters have now come to carry much more weight in defining species of gibbons, just as they had long before in studies of songbirds. Evidence that vocal patterns are rather stereotyped and inherited came from careful study of mixed-species groups and hybrids in the overlap zone in Khao Yai: in mixed-species pairs the intermediate vocal patterns of the great-call (never given by the adult male) of female offspring cannot have been learned from the mother (BROCKELMAN & SCHILLING, 1984). GEISSMANN (1984) came to a similar conclusion studying captive hybrids. Marshall’s work, of course, was particularly influential in supporting the importance of vocalizations, which must play such a great role in defining the limits on who constitutes a suitable mate, and incidentally affects reproductive isolation from gibbons of other species. Research in Khao Yai has played a vital role in the development of our understanding of what gibbon species are.

STUDYING THE TWO SPECIES

Even though this is the most-studied contact zone between any gibbon species, there still is a great deal to study there. I am sitting on manuscripts and lots of data that have not yet been published. There is just too much to do. My interests have been growing wider, but my capacity to do research is not increasing. I am now relying more on students and collaborators.

For example, one vitally important topic is how the two species of gibbons in Khao Yai Park get along with one another ecologically and behaviorally where they come into contact. This greatly depends on the question of how different they are—in particular, on how different *they* consider themselves to be. We have found from the first field study of pileated gibbons by Sompoad Srikosamatara in Khao Soi Dao Wildlife Sanctuary in Southeast Thailand (SRIKOSAMATARA, 1984), that this species is quite similar to the lar gibbon in basic ecology and social structure. It lives in small territorial groups, sings duets, and eats the same kinds of fruits as the lar gibbon. Although the species of fruits differ between study sites, all the gibbon species in fact eat the same general types of succulent drupes, berries and figs as are available.

The existence of lar and pileated gibbons in the same place allows us to compare the species in the same habitat. In particular, it allows us to determine if they compete for the same limited supply of food. In nearly all gibbon species, small groups dominated by monogamous pairs of adults have been observed to defend territories against other groups. If the species are closely similar in diet and habitat requirements, shouldn't they defend their territories against groups of the other species as well as their own species where they occur in the same place? This would lead to a checkerboard pattern of the groups of the two species, rather than extensive overlap between their ranges. My Ph.D. student Udomlux Suwanvecho set out to answer this question in Khao Yai, in the same area in which Joe Marshall and I observed them years before. She found that *lar* and *pileatus* groups defended their territories against the other species as well as their own; in ecological jargon they were “interspecifically territorial” (SUWANVECHO & BROCKELMAN, 2012). Even though they did not regard the other species as potential mates (the great majority of adults mate only with their own kind), they did regard the other species as competitors for resources. No other example of defense of territories between species has been found in primates to our knowledge, although there are numerous examples from birds, most of which are also monogamous and highly territorial like gibbons. Competition for space is a more potent and efficient form of competition for resources than is the mutual exploitation of resources without direct aggressive behavior. It has potential importance in explaining the geographic distribution of the species, a topic which now interests us but which I will not elaborate on here.

Recently I and several colleagues (Udomlux and also Norber Asensio, Chalita Kongrit and Anuttara Nathalang) have renewed our study of interrelations between lar and pileated gibbons to include habitat preference, diet and genetic relations. This will be a very long term, team effort. One vital question is what prevents one species from becoming more successful and driving the other out of its range? There is no physical barrier to prevent this from happening. Or are both species just equally competitive? We have initiated genetic studies, led by Chalita, to determine just how genetically isolated the species are. This will be a challenging study because we do not have the time to habituate all the groups that we intend to study.

HIKES TO DISTANT PLACES

I have made many trips to observe and make tape recordings of gibbons within and on both sides of the contact zone between the species in the park. Observing gibbons outside the zone, far from the developed area about the headquarters and the Research and Training Center, is very difficult because the density of gibbons falls in more remote sections due to increased poaching, and the gibbons seem shyer and more difficult to observe. It requires

making back-packing expeditions farther to the east and to the west. During the 1970s and 80s I made numerous trips to find gibbons in these outlying areas. In 1980 I asked the park chief if I could make an expedition to the Muak Lek section of the park in Saraburi Province in the far northwest. The chief at that time, Mr. Wijit Yarnpirat, said that he would not send his rangers over there to guide us because the villagers were not friendly to park personnel. If we wanted, we could ask villagers in the area to guide us up the mountain (Fig. 3A). My hiking friends (Fig. 3B) Bob Dobias, Suchinda ("Sue") Nilchan and I made several attempts to contact villagers in the area, who at the time were mostly poor corn farmers. First they said that it was too dangerous for us up there—either there were "bad people" reported in the area, or the villagers might be shot at by park rangers. Finally, in 1981, the headman in the village of Ban Sap Tai, Mr. Prateuang (Fig. 3C), said that he was willing to find us guides to hike across the park. We offered to pay his men good wages.

We finally got time to make the expedition in October of 1982, and I set out from Ban Sap Tai with Bob Dobias, Phil Round, Sue and two other visitors from the U.K. who wanted to hike with us, Cindy Renwick and Ray Karam (Fig. 3B). Mr. Prateuang gave us three guides/porters, and two others joined the expedition along the route. That part of the park is very scenic, with bluffs rising to 1000 meters in elevation over the village (Fig. 4A, B). To our knowledge we were the first hikers ever to trek into the area apart from poachers. The first night we camped on the top of the escarpment above the valley near a small brook; the next morning was sunny and clear and the view to the north was beautiful, over the patchwork of corn fields and forest on the foothills. We continued hiking south and eastward deep into the park, following fresh elephant and gaur trails (Fig. 3D). Soon the villagers could no longer lead us—they had never been that far into the park. Never mind, I pulled out my map and compass and guided the rest of the way as I usually do. Over the years I had become proficient at reading the topographic maps, which were the same ones that I had been trained to use while an army cadet and officer. I already knew how I wanted to go, and I could tell from the terrain where good elephant trails were likely to be on the map. We arrived at park headquarters after four days of walking, right on schedule. We heard some gibbons, but they were sparse compared to the headquarters area. I did not have enough time to linger and get many recordings.

Mr. Boonruang Saisorn, the new park chief, was enthusiastic about our efforts to hire local villagers for hiking. He had begun to enforce park regulations in the Muak Lek area in the northwest; in the 1970s and 80s, nearly all parts of the park periphery were lawless and being encroached by farmers (in spite of the fact that the park was created in 1962) (Figs. 3E, 5B). In Ban Sap Tai we established good relations with villagers and helped promote several conservation projects. Villagers made good wages from some Siam Society hikes Bob Dobias and I organized. We make several treks into the park from the village (Fig. 4C, D, E). Our visits to the Ban Sap Tai area led to several new projects which contributed to the conservation and development of the area. The first one was a World Wildlife Fund project to conserve elephants in Khao Yai, involving surveys and treks with local villagers, developed by Bob Dobias and me in collaboration with the Office of the National Environment Board, under the guidance of Dr. Kasem Snitwong. Several other NGOs (non-government organizations) saw opportunities in this isolated village near the park's remote border and new projects followed, carried out by Wildlife Fund Thailand, and then the Population and Community Development Association under Dr. Meechai Viravaidya, which established a base in the village and initiated a family planning and development project. The village is no longer a haven for encroachers, poachers



Figure 3. A, approaching Ban Sap Tai village with mountains of Khao Yai in background; B, trekkers at headman's house at Ban Sap Tai, 1982; C, (from left) Bob Dobias, village headman, Jim Thorsell of IUCN Parks Commission at Ban Sap Tai, 1984; D, hiking on gaur trail inside the park; E, cleared slopes near Ban Sap Tai, June 1983.



Figure 4. A, cliff face on mountain facing Ban Sa Tai, 1982; B, view from Khao Fa Pha mountain above Ban Sap Tai, June 1983; C, Ban Sap Tai villagers entertaining Siam Society hikers, 1983; D, Siam Society hikers crossing field in western Khao Yai Park; E, Siam Society hikers resting at corn planter's hut, June 1984.



Figure 5. A, view east toward Khao Laem across big field; B, poachers hut, western Khao Yai, 1984; C, large *Aquilaria crassna* tree felled in Mo Singto plot, 2006; D, *A. crassna* tree shaved at base and fallen near plot; E, *A. crassna* tree chopped at base.

and outlaws; it has yielded mostly to resort developers, wealthy investors and vineyard owners. The dirt-poor villagers we knew have apparently found new jobs or moved away. No more corn fields cover and obscure the boundary between national park and village.

For my part, I did not succeed in obtaining many gibbon observations and recordings by hiking from the village because the density of gibbons was low due to past poaching, and I lacked the time to spend many days hiking and camping in remote areas. Our new project will have to try again because we need data on lar gibbons in the remote western area to compare with that obtained in and near the contact zone to test for genetic introgression through interbreeding with the pileated gibbons.

I have also run into villagers in the forest in less congenial circumstances. I will relate an incident that occurred while I was observing and recording pileated gibbons in a little-explored area on the east side of the gibbon contact zone (Fig. 5A). In November of 1986, I was recording a pileated gibbon group on a hillside east of the Sai Yai River, about a day's leisurely hike from the station at Hiew Suwat Falls. I had made camp on the bank of the Sai Yai, and the park rangers accompanying me had returned to headquarters, leaving me alone for a few days. As I was following the gibbons, two young men, probably teenagers, suddenly appeared in front of me, dressed in military field clothing and carrying AK-47 rifles. They were as surprised and afraid as I was and pointed their weapons at my stomach. I glanced down at their feet and thought to myself, "Oh shit!" Park rangers, who should be patrolling this forest, wear similar camouflaged military dress but do not wear rubber sandals as these men were; they are supplied with boots. Rangers also don't carry AK-47s, the choice assault weapon of Communist insurgents in Thailand and elsewhere. I was suddenly aware that I was in a serious predicament, but decided to act friendly and follow any instructions. The young men seized my recording gear and asked me to remove my loose shirt, and gestured for me to head downhill toward the river, and walk slowly. When we reached the elephant trail that runs along the riverbank, three more similarly dressed and armed men were waiting.

The oldest one of the five was in charge; he asked me to sit down and started questioning me and going through my gear. Our conversation was in Thai, of course, and I had a little trouble understanding the dialect of the leader. "What is this?", he said as he pointed to the large gray polyvinyl tube that held my microphone in its foam sheaf which acts as a wind-screen. The tube, which I carry over my back on a strap, could be mistaken at first glance for some sort of personal rocket-launcher. This resemblance has always worried me a little. I gingerly removed the cover of the tube and drew out the Sennheiser microphone, which I tried to explain was not a weapon. Satisfied that it did not have a gun barrel, he then turned to the tape recorder in my waist bag. I explained that it was for recording sounds of gibbons and other wildlife. "Let's hear them," he directed. I explained that the tiny Nagra recorder did not have a built-in speaker (it was an old and inferior model), and that he had to listen through headphones. He put on my headphones and I switched on the tape. "Ah, yes!" he exclaimed as he listened to a loud pileated gibbon duet recorded that morning in high fidelity. After I explained that I was a professor at Mahidol University and did research, the leader directed me to go back to my camp, which he had already found a little way up the river and carefully inspected, and wait. He held on to my wallet and all my equipment. I did so, and decided to follow his advice, and not try to flee through the night back to headquarters, as the leader had been polite and seemed to trust me.

One thing that greatly impressed me was the military-like discipline of this group. One man was the leader, and the other men took orders and remained silent. These men had not

come to enjoy the forest or to poach animals, but I didn't understand what their mission was. After all, the insurgency movement in Thailand had already given up several years before, after accepting the government's offer of amnesty.

I bathed in the river as I normally do and at dusk began preparing my evening meal. Out of the darkness on all sides came the men holding their rifles, and they slowly approached and sat down in a semicircle around my campfire. They crossed their legs and rested their rifles on their laps. The leader then proceeded to question me for about two hours, asking me about where the headquarters and guard stations were, and which direction the roads went, etc. I tried to answer their questions; they seemed to know less than I did about this part of the park, where I had hiked many times.

As the conversation went on, the leader mentioned that they did not like the park rangers, who sometimes shot at the villagers. I mentioned as politely as I could that the rangers did not fancy villagers who hunted in the park and sometimes shot back at them. My mind envisaged a funeral for two park rangers held in a local temple in the town of Pak Chong a few years before. I had been invited to attend by Dr. Boonsong Lekagul, the famous Thai conservationist, and rode with him in his car to the funeral. Dr. Boonsong had helped to establish Khao Yai as the first national park, and he wished to show his support for the rangers who put their lives at risk protecting wildlife. After a tragic encounter between poachers and park rangers in the forest, a group of 40 villagers attacked a ranger station at the edge of the park one night, resulting in the murder of the two rangers. And these weren't the only rangers who had lost their lives. One park chief told me that about 24 guards and rangers have been lost in skirmishes with poachers, although I cannot verify this number.

At the end of my interrogation the leader, apparently satisfied, handed me all my equipment back, including my wallet, car keys and even the loose change I had in my pocket. At the last minute, however, one of them asked to "borrow" my Leitz binoculars, and said they would return them tomorrow. I was not about to refuse the request, although I suspected that I had seen the last of my new binocs. I was happy enough not to lose my recording equipment which was much more valuable, not to mention my own life. They politely apologized for all the inconvenience to me, bid goodbye and disappeared into the darkness. I never saw them again.

I was left stunned, but did not feel that I was in danger anymore. I decided to stay a couple of more days to continue recording as I told the men I intended to do (partly to avoid giving the impression that I would immediately report them to park officials, as I knew that I was at their total mercy, and that they might be watching me). The next day when I returned to camp Mark Infield was sitting there waiting; two park rangers had brought him there, at the suggestion of Philip Round that I was still in the forest. Mark Infield was a birding enthusiast travelling in Thailand who had worked on conservation projects for IUCN. The rangers had returned to headquarters and Mark camped with me for a couple of more nights. I had been very calm and composed during the whole incident, but as I tried to explain to an astonished Mark what had just passed I began to lose composure for the first time. I was glad that no one else was with me during the incident because I felt I could handle it better alone. I was certainly relieved that the rangers hadn't showed up while my heavily armed guests in rubber sandals were visiting. They might not have made it back to headquarters.

Upon reaching headquarters I met Mr. Boonruang when he invited me to a dinner with some VIPs representing World Wildlife Fund – U.S., including Russell Train, Bruce Bunting, and Pisit na Pattalang. I enjoyed the dinner, but did not mention anything about my recent experiences until several days later. I decided that the park rangers were no match for the

heavily armed patrol, and moreover, their job was to catch poachers, not insurgent groups. Boonruang was a little annoyed; I probably should have informed him sooner, as it is up to the park chief to decide whose job it is to catch people in the forest. It is likely that he would have informed the Thai Army. On the other hand, had the chief immediately sent a lot of armed patrols in the forest to catch the men, my life could be in danger the next time I met armed villagers in the forest. I think I made the right choice, but it was not an easy one.

A few days after the incident, it became clearer what the military-like men of the forest were up to. An article in the Bangkok Post reported that heavily-armed insurgent-like men had held up 30 vehicles on the Prachinburi road through the park and stolen millions of baht worth of watches and personal jewelry, and disappeared with it into the forest.

I recalled the park chief Mr. Wijit back in the late 1970s warning us not to go into the eastern part of the park around Khao Laem (mountain) (Fig. 5A), and Sai Yai River because of the presence of insurgents. I am certain he had been warned about this by Thai Army officials, and so patrolling was reduced. Our initial visits in the 1970s had revealed a dense population of gibbons and other wildlife such as gaur. After it was considered safe again during the mid 1980s, and after the Thai government made a truce with Communist insurgents throughout the country, we found that the density of gibbons had markedly declined and I could no longer find some of the important mixed groups and hybrids that I once had recorded. The insurgency had made it safe for villagers to return to the forest and hunt animals. My appetite for work in the east also declined a bit after my unfortunate but lucky encounter in 1986. The density of pileated gibbons as revealed by the surveys of PHOONJAMPA & BROCKELMAN (2008) appear to reflect this decline. The density of gibbon groups in remote areas of the east averages one to two per square kilometer, rather than the four or five groups found around headquarters.

VALUABLE WOOD

A question which I ought to say something about is whether researchers and tree poachers can coexist in the forest. Not without some friction. It so happens that Udomlux's study area had a relatively high density of the tree *Aquilaria crassna*, which botanically-minded readers will recognize as the species (called *gritsana*) which is harvested in central and eastern Thailand for agarwood or aloewood, known in Thai as *mai hom* (aromatic wood). When the tree is cut or injured by burrowing beetles or by a knife (Fig. 5C, D, E), the tree secretes a black resin (rich in organic chemicals) which stains the wood dark brown or blackish. This resin may be a defensive reaction to prevent infection by microbes, although I know of no research designed to test the idea. The wood of the *gritsana* tree is extremely light and soft—you can shave off strips with a sharp knife. That is exactly what illegal wood harvesters do; most larger trees have their trunks shaved every few months to stimulate the production of more resin which stains the exposed wood. Increasingly, however, the inexperienced or impatient poachers just chop down the trees (Fig. 5E). Usually they find no blackened wood.

A Chinese student of mine, Zhang Lixin, carried out a demographic study of the tree, and found that although the size distribution had fewer large trees than normal, it was still sustaining itself (ZHANG ET AL., 2008). *Aquilaria* trees are still fairly common in the park, and the species shows good regeneration. I used to see trees in the 1970s up to a meter in diameter, but now it is hard to find a tree over 50 cm in diameter. Anyway, *mai hom* is the most important non-timber forest product in Southeast Asia, and *mai hom* collectors constitute the

great majority of poachers in the park. The resin distilled from *mai hom* is worth more than its weight in gold, and a ready international market in the Middle East and other places as a cosmetic and pharmaceutical drives the illegal poaching and trade.

Mai hom poachers roam everywhere in the forest, and my student Udomlux was a little unnerved and apprehensive when she would smell their cigarette smoke, while they retreated and hid from her in the forest. We did not consider the poachers dangerous, but they did carry knives, axes and sometimes guns. A few times when we detected their presence we reported it to park authorities. The park guards would search the forest the next day, but this never resulted in any encounters with the poachers. The poachers had fled. In seeming retaliation for calling in the park guards, poachers would rip down our trail markers and even carve obscenities in the tree bark along our trails.

One time when I was out in the forest trying to obtain sound recordings of pileated gibbon songs east of the Hiew Suwat Waterfall, in May of 1984, I heard a party of *mai hom* poachers coming up the trail toward me banging on trees with an axe. Normally I greet poachers in the forest with a “*sawadee krap*”, but this time I was annoyed and decided to hide from them by the trail. After they passed, I hurried several kilometers back to where I parked my car and drove to headquarters, where I reported the incident to the park chief. At that time it was still Mr. Boonruang Saisorn, with whom I had established a good relation. He immediately organized a patrol of 14 rangers, and we set back into the forest late in the afternoon. We arrived at a campsite just about dusk, near the small waterfall at the junction of the branches of the Sai Yai River, near the south edge of the “big field”. The rangers looked about and could see no poachers’ camp. I decided to have a look about myself, and within ten minutes found it; I saw their campfire through the trees up the east branch. The rangers would deal with the poachers first thing in the morning. They turned out to be a group of five poor villagers, aged about 10 to 60 years. They were living off the forest; they had set out nearly 100 noose traps for ground birds and had caught five species that were dangling by their legs, already dead. But my resentment at their intrusion was mixed with sympathy.

Stopping agarwood poaching seems a hopeless task. No Khao Yai Park chief has succeeded in doing it, though some have made considerable effort. Because it is driven by a commercial market, I believe that trying to increase patrolling alone will not solve the problem; the Thai government must at the same time go after the factories that distill the resin and the traders. There are lots of shops, mostly in the Sukhumvit–Soi Nana-north area of Bangkok, that sell the darkened wood, its distilled resin, and factory-packaged cosmetics made from it. They may even take you into the back room and show you special “high quality” wood from Khao Yai Park if you pose as a real tourist. Trade in the wood and resin (which is now also produced in tree plantations) must be closely regulated to have any chance of controlling poaching. Mr. Boonruang once related to me his experience in going after traders. His men seized a truck full of *mai hom* near Khao Yai Park, and he started legal proceedings against the owner. But the Forest Department’s “lawyer” intentionally botched the paperwork and the case, and the truck and its valuable load of agarwood had to be released to its owner.

Now we don’t report the presence of *mai hom* poachers in the forest any more; we have decided that it is wiser just to try to coexist with them. We are not responsible for catching poachers, and it seems that we will have to share the forest with them for the foreseeable future.

STRANGE FINDINGS IN GIBBON BEHAVIOR

Many other topics of research have been studied at Mo Singto in Khao Yai near the park headquarters, an area where lar gibbons occur nearly exclusively. This area, containing about ten groups within an area of about two square kilometers, has become an international focus of research on gibbon behavior, especially vocalizations, social structure and mating behavior. What makes this study area so valuable is that virtually every individual gibbon there is so well known: its name, age, and group in which it was born. The first attempt to study the Mo Singto groups dates to 1979, when Sompoad Srikosamatara, a biology student at Mahidol University, undertook a survey of groups as a senior thesis project. He was soon followed by Jeremy and Patricia Raemaekers who studied vocal behavior using playbacks of tape recordings. Jeremy, one of David Chivers' students at Cambridge, cut his teeth studying the diet of lar gibbons and siamang in Kuala Lompat, Malaysia, and then spent two years at Mahidol University, during which he studied lar gibbons at Mo Singto. The Raemaekers found that playback of gibbon songs within a territory elicited vigorous aggressive responses from the resident male.

Because of the difficulties researchers had in finding places to stay in the park when needed, the Raemaekers decided to move into the forest and live in a lean-to in the middle of their study area, after I discovered a permanent spring in a ravine, and showed them how to build a forest shelter. I had seen villagers construct such shelters in Khao Soi Dao Wildlife Sanctuary where my student Sompoad studied pileated gibbons. He also had to live in the forest because his study area was rather remote. The Raemaekers wrote an entertaining book, "The Singing Ape", on their experiences living in the forest which was published by the Siam Society. It was the Raemaekers who initially established the whole Mo Singto area as a serious lar gibbon study site, and began naming all the individuals in each group. Each group was given a letter name, and all individuals originally seen in that group are given a name beginning with that letter.

The Mo Singto gibbons have been studied by many researchers; those who have carried out their doctoral research in behavior there include Ulrich Reichard, Anouchka Nettelbeck, Thad Bartlett, Tommaso Savini, Claudia Barelli and Esther Clarke. Several other student researchers, including Jedediah Brodie, Wirong Chanthorn, and Chanpen Wongsriphuek, and post-doc researcher Kim McConkey, have studied the role of gibbons and other frugivores in seed dispersal.

Research findings at Mo Singto have shaped our knowledge of gibbon behavior. I cannot review all this research in detail here, and I do not wish to bore the general reader with all the scientific citations; BROCKELMAN *ET AL.*, (1998), REICHARD (2009) and REICHARD & BARELLI (2008) have summarized many of these findings. Here are some major findings that have helped to reshape our understanding of gibbons; the relevant references are included at the end of this article.

1. The life cycle of gibbons in the wild is longer than originally believed, and the birth rate lower. Gibbons mature at approximately eight years and the interval between births averages about 3.5 years.
2. Males have been found to often delay dispersal from their natal groups for two or more years, presumably because the dense population at Mo Singto has little space for new territories.

3. Take-over of an existing territory and displacement of the adult of the same sex (sometimes violently) is a common method of acquisition of a mate and territory. The first observation of a male “take-over” was made by my M.Sc. student Uthai Treesucon in 1983.
4. Gibbon groups frequently contain stepchildren and stepadults, half siblings, and extra male adults (generally relatives of some sort). They are often not nuclear families as previously assumed.
5. “Social polyandry” seems to occur in some groups, with extra male adults. There is some dispute over whether the term “polyandry”, which properly refers to the breeding or reproductive system (and not merely the social arrangements), really applies here. The extra males are most often subadults of the group or relatives of the main breeding pair, but in some cases this has not been verified. An important recent genetic study (BARELLI *ET AL.*, 2013) has verified that the extra males that occur in some groups are very rarely fathers of young born in the group, so that the breeding system is not truly polyandrous. To prove the existence of true polyandry one would have to show that both adult males in the group actually father offspring, or that extra-pair copulations with neighboring males frequently result in extra-pair paternity (as has already been shown in some bird species).
6. Extra-pair copulations have been frequently seen, usually between adults in neighboring groups. Such copulations probably rarely result in extra-pair paternity, but it is not known how often this occurs.
7. Strong circumstantial evidence exists for infanticide when a male take-over occurs while the resident female is carrying an infant. Overall, however, its incidence appears to be low, which is presumably why it has not been reported from other studies.
8. In general, gibbons are more flexible in their group structure and mating relationships than we have understood from any other study area. In fact, in this respect they strongly resemble humans.

This is quite a litany of differences from results found in mostly short-term studies in other parts of Asia. New findings continue to emerge from Mo Singto. The gibbons there have revealed so many unusual features not reported from other sites that some researchers have expressed doubt that they are representative of normal gibbons. The only thing that is unusual about our gibbons is that they have been studied longer than those at any other site in Asia, and by more researchers. Also, the population is quite dense and at maximum level (about four to five groups per square kilometer), creating more opportunities for social interactions and competition for space not present at sites with more sparse populations reduced by hunting.

THE MO SINGTO PLOT

During the 1990s my students and I increasingly turned our attention to the study of gibbon diet and ranging behavior, and also the role of gibbons in seed dispersal. Gibbons swallow nearly all the seeds they ingest, which they pass unharmed, and are regarded as high quality seed dispersers. The first studies of diet at Mo Singto were carried out by Claudia Whittington, an M.Sc. student at Mahidol University, and Thad Bartlett, a Ph.D. student from Washington

University (St. Louis). These studies have revealed most of the major plant foods consumed by gibbons, but they were each completed in a single year of field work. Many food plants are difficult to identify, especially lianas, and satisfactory voucher specimens were not being properly collected. Moreover, I was to find that most plant species used by gibbons do not fruit every year, and the diet of gibbons changes from year to year. Also, names of species change as plant taxonomists continually revise species and genera. Unfortunately there is no published flora of Khao Yai Park, and the few books available (mostly just picture books) are highly incomplete. When I would take a specimen to a botanist, I would get a tentative name, but then a second opinion from another botanist would often yield a different name. In fact, most published lists of species in the diets of primates are completely unverifiable and highly incomplete and, lacking vouchers in official herbaria, we can expect that many species will have incorrect names.

This situation was completely unsatisfactory for our long term study. I wished to study ranging behavior and seed dispersal as well as diet. Therefore I took the bull by the horns and decided to create a permanent plot at Mo Singto, which would require identification of every tree, and collection of vouchers for every species of woody plant. The methodology for establishment of large permanent biodiversity plots had been established not long ago by the Center for Tropical Forest Science (CTFS) of the Smithsonian Tropical Research Institute (STRI), Washington D.C., based on the initial 50-hectare plot established by Stephen P. Hubbell on the Island of Barro Colorado in the Panama Canal (MANOKARAN, 1990; CONDIT, 1998). Botanist Peter Ashton, famous for his pioneering work on Asian forest ecology, advocated establishing a world-wide network of forest dynamic plots based on Hubbell's methodology. The task was soon given to CTFS and Stuart Davies was hired as its director. Having a uniform methodology and standard database format, the network of forest plots makes possible the testing of ideas and hypotheses about forest dynamics using comparative data from forests all over the world.

The first large forest dynamics plot in Thailand was established in Huai Kha Khaeng Wildlife Sanctuary under the leadership of Sarayudh Bunyavejchewin, an ecologist in the Forest Department. The CTFS considered the establishment of another large plot in Khao Yai, but opted for a wetter site, Khao Chong in Trang Province, instead, to better complement the somewhat drier and more seasonal plot in Huai Kha Khaeng. Therefore, if I wanted a plot at Mo Singto, I would have to do it myself. Around 1993, I started surveying the area occupied by gibbon group A into 20-meter squares, and after about a year had finished a 30-ha rectangular plot 500 by 600 meters in size. To help me begin, Ulrich Reichard brought a Leica theodolite from Germany. I was able to obtain support from the Biodiversity Research and Training (BRT) program to purchase another digital theodolite and hire field assistants to finish the job. Tree censuses have been completed in 1998, 2001, 2006 and 2011. My field assistant and database manager Anuttara Nathalang has taken responsibility for management of the plot, something which requires constant attention, as well as about a million baht per year. There are about 131,000 trees of about 260 species over 1 cm in diameter on the plot.

The CTFS nevertheless provided much advice and guidance in the establishment of the Mo Singto Plot, and it is now part of the global network. In December of 1999, a CTFS team visited Khao Yai, including Stuart Davies, Steve Hubbell, Liz Losos, Jim LaFrankie and Ira Rubinoff (then head of STRI). This gave us considerable encouragement.

Voucher specimens have been collected for all species on the plot, and stored in our herbarium in BIOTEC, Science Park, National Science and Technology Development Agency,

and several other accredited herbaria, including those at the Royal Forest Department, and Harvard University. Although many botanists have helped in this effort, we are particularly indebted to J. F. Maxwell for insuring that everything is properly identified and for teaching our field assistants how to collect specimens for herbaria up to professional standard. We are proud of our collections, because the collection and identification of vouchers is the most serious and difficult problem in establishing a large plot in very diverse tropical forest. It is almost always underestimated.

The Mo Singto forest dynamics plot has been described in detail in a previous article in the *Natural Bulletin of the Siam Society* (BROCKELMAN *ET AL.*, 2011), so I will not dwell further on it. The major advantage of this plot over most others in the world is its relatively intact community of wildlife species, which has allowed us to study the interactions between animals and plants. In addition to white-handed gibbons and pigtail macaques, the plot is inhabited or regularly visited by wild elephants, sambar and barking deer, about five species of civets (Viverridae), black bears, sun bears, four species of hornbills, and recently tracks of a large gaur (*Bos gaurus*, the forest ox) were found in the upper reaches of the plot for the first time. The gaur, the largest member of the cattle family, is doing well in the park but is extremely shy and generally avoids contact with humans.

Our main approach to studying seed dispersal has been to select a single tree or liana species and evaluate the roles of all animals that consume the fruits and potentially disperse the seeds. Study of frugivory and seed dispersal has benefited greatly from the collaboration of Kim McConkey who has become an expert in the subject of dispersal by mammals. Collaboration with her continues on the plot, as well as with David Greenberg who is helping us analyze spatial aspects of solar irradiation. Another collaborator, Norberto (“Norber”) Asensio, has carried out studies of gibbon navigation, ranging behavior and range use, employing his talent for GIS analysis. Studies of the role of wildlife and seed dispersal have been briefly reviewed in this volume by BRODIE *ET AL.*, (2013).

CODA

I believe it was Joe Marshall who first referred to the male’s series of hoots that follows the female’s great-call, and concludes the sequence, as a “coda”. Joe liked to compare the gibbons’ elaborate songs to music, as they are highly structured and tonal. I will finish with a “coda” here in recognition of his insights.

People sometimes ask me when my research In Khao Yai will be finished. I have done quite a lot, and brought in many excellent colleagues and students, but I still feel that the work is still just beginning. There is so much more to do, as new questions and opportunities continue to emerge. The answer is I will finish when I can no longer walk into the forest. The most important feature of gibbon research in Khao National Park is that it has gone on for so long, and involved so many people. When people collaborate in research projects and share findings, and share responsibility for the training of students, all researchers benefit, and science benefits. It is long-term cooperation in research and management that has made Khao Yai Park arguably the most important gibbon research site in Asia. Officials sometimes say that older researchers should quit and make way for younger researchers. It doesn’t work that way—older more experienced researchers promote and facilitate research by the younger generation. They have more ideas for new projects to carry out, and help in getting funding.

Research of course should be carried out in other protected areas. However, there are only a limited number of researchers, and it is scientifically most productive if they work together. By making it easier to develop research projects in other parks and sanctuaries, more researchers would be attracted and spread out over other areas.

I must say that the sentiment I have expressed runs counter to an ethic that is common in academia—especially in more scientifically developed capitalist countries—that researchers are in competition with one another to publish first, and produce publications more rapidly. This has led to a pattern of selfishness and territorialism at some field sites that is destructive to both science and management. The idea of “capitalist scientists” being more competitive is conjectural, but I like the idea and throw it out for debate. Being a permanent resident here, I have seen the benefit of lasting cooperation and continuity over the long term in Khao Yai.

There has also been research on many other kinds of organisms, including birds, bears, large cats, ungulates, lichens and insects, and some of this research has involved collaboration with gibbon researchers. The earliest naturalists to work in the park were mostly ornithologists, including such pioneers as Dr. Boonsong Lekagul, Edward Dickinson (Fig. 1C), Ben King and H. Elliott McClure. McClure was a mentor of Pilai Poonswad, well known for her classic studies of hornbills in Khao Yai and throughout the country. All these people were generous in sharing their experiences and knowledge, and gave rise to the spirit of cooperation.

Many other scientists have more briefly visited Khao Yai Park and shared some of my experiences, and provided encouragement and insight; I thank them for their company. To start, Colin Groves visited the forest where Joe Marshall and I were beginning to find mixed groups and hybrids. Primatologists Paul Gittins, Ronald Nadler, Duane Quiatt, Russ Mittermeier and Volker Sommer all visited to see our gibbons; Russ and the new American student studying at Cambridge Elliott Haimoff had a memorable run-in with a big tiger that, Russ likes to recount, scared the daylights out of them with its stare. Volker returned to set up his student Ulrich Reichard in his research. In the 1970s, Jeff McNeely, Jack Seidensticker and Weerachai Nanakorn hiked with me to the Khao Laem area where I first heard many pileated gibbons calling. Wildlife researchers Johnsingh and Ajith Kumar visited to see gibbons and other wildlife; Ha Din Duc from Hanoi visited to train in survey techniques, and later Jayanta Das, Jihosuo Biswas and Nabajit Das visited to learn and participate in gibbon survey in our new Khlong Sai study area. Ecologists Ted Case, Rob Colwell and Robin Chazdon all visited to see the forest and its gibbons, as well as Greg Asner and Eric Dinerstein who showed special interest in the Mo Singto Plot, and more recently, Richard Primack. From China, I was grateful to receive visitors Fan Peng-Fei (Dali University), Yan Lu (F.F.I. China) and Zhao Chao (a renowned photographer). These are only some of the visitors to our research areas; others have come at times when I was not there.

If I have any parting thought, it is that better collaboration is needed among researchers, and between researchers and management personnel in the Department of Parks, Wildlife and Plant Conservation. This will insure that Khao Yai Park continues to be one of the world's most important wildlife research sites and a conservation area of international renown.

One final issue raised in my article, but not directly addressed, is the lack of cooperation, or even friendly relations, between the national park and the surrounding villages. This is the central conservation management problem facing the establishing of protected areas throughout the world, and field researchers frequently suffer from the consequences and have

to get involved. If protected conservation areas are worthwhile to have, then it is imperative that we continue to look for solutions to this problem.

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The list below includes all published scientific studies of gibbons in Khao Yai Park that I am aware of, and includes studies of plants and seed dispersal that involve gibbons and a few conservation works that impinge on gibbons, as well as a few other references cited in the body of my article. I have excluded most of the "gray" literature: abstracts, meeting presentations, unpublished reports, magazine articles, and masters and doctoral theses (with a few important exceptions). If I have inadvertently omitted anyone's publication I am deeply sorry.

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