6.0 WCS SCARLET MACAW CONSERVATION PROGRAM AND MONITORING SITES

Major Contributors: Rony Garcia, Victor Hugo Ramos, Roan Balas McNab, Gabriela Ponce, Donald Brightsmith, Nancy Clum
Editors: Janice Boyd, Roan Balas McNab
Spanish Translator: Rony Garcia

6.1 The Maya Biosphere Reserve

The Wildlife Conservation Society's Guatemala Program is focused on the conservation of the eastern Maya Biosphere Reserve (MBR), in the northern half of the Guatemalan Department of Petén. The MBR was established by the Guatemalan government in 1990 and is part of the largest tract of intact tropical forests remaining in Central America (Fig. 6-1), the tri-national *Selva Maya* of Belize, Mexico, and Guatemala. The reserve contains both core protected areas and multiple use areas dedicated to sustainable extraction of forest resources and is managed by CONAP, Guatemala's National Council of Protected Areas. Key protected areas include Laguna del Tigre National Park, Mirador-Rio Azul National Park, Sierra del Lacandón National Park, Tikal National Park, El Zotz Biotope, Dos Lagunas Biotope, and Yaxha-Nakum-Naranjo National Park (Fig. 6-2). Unfortunately, the reserve faces many threats; in particular, illegal human invasion and colonization, illegal conversion of land to ranching and agricultural activities (often fueled by money from the illegal drug trade), uncontrolled fire-setting, unsustainable natural resource extraction, looting of archaeological sites, and weak governance.
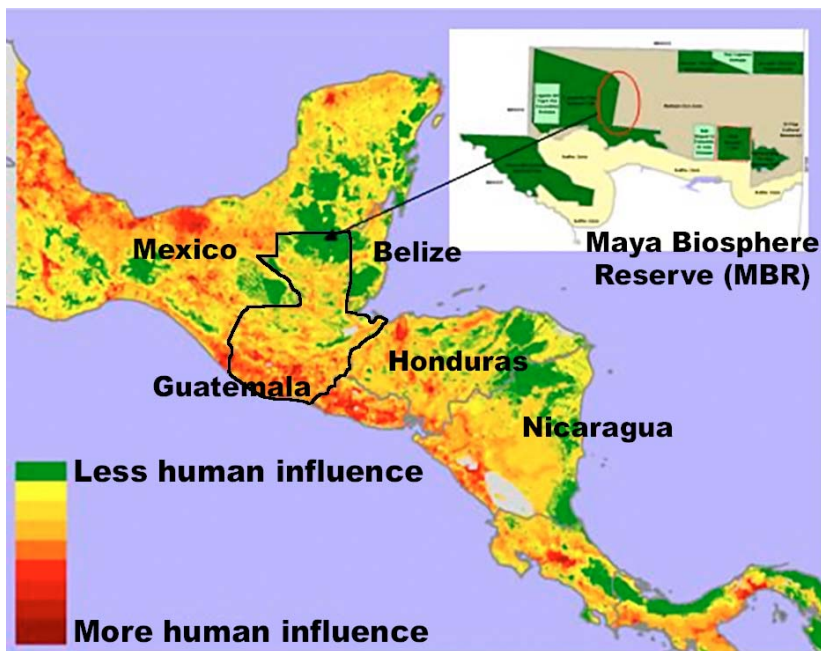

Figure 6-1. Much of Central America is heavily impacted by human influences (red to yellow). The Maya Biosphere Reserve is the largest tract of intact tropical forests remaining in Central America. (From Ramos and McNab, in prep., "The Maya Biosphere Reserve in Relation to the Human Footprint in Mesoamerica")
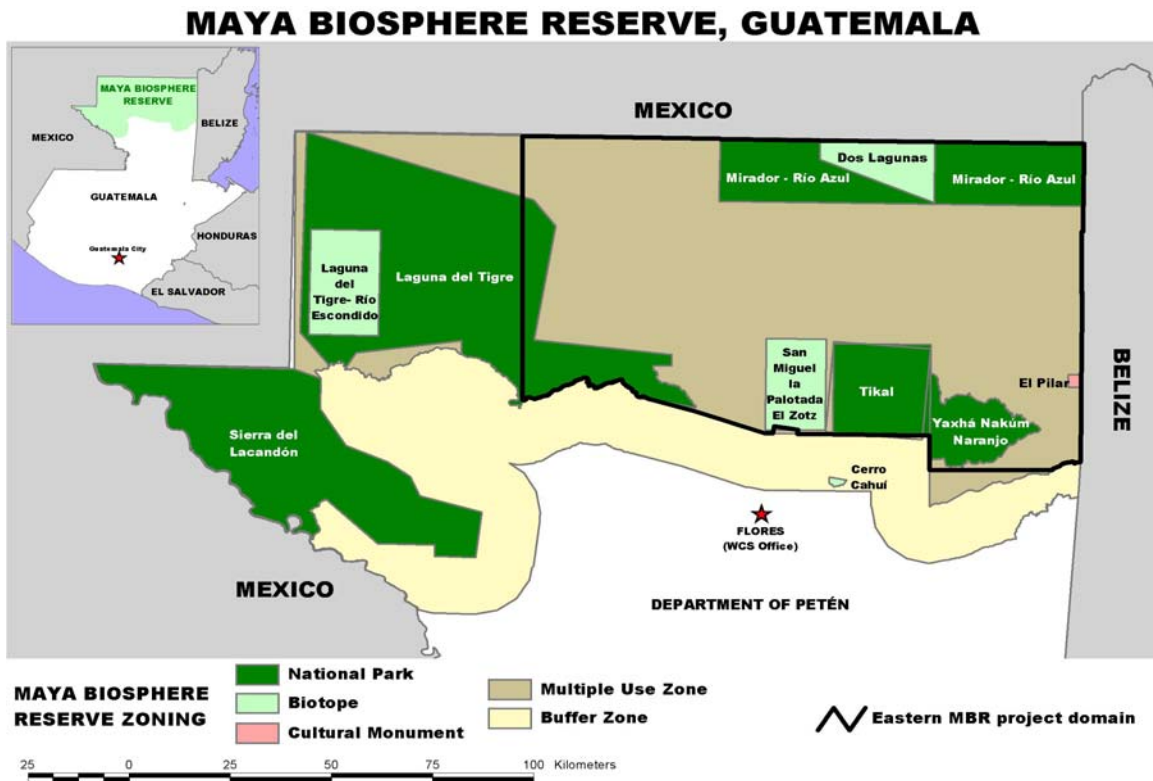
MAYA BIOSPHERE RESERVE, GUATEMALA

Figure 6-2. Maya Biosphere Reserve and the core protected areas and multiuse and buffer zones. (CEMEC/WCS-Guatemala)

6.2 WCS Scarlet Macaw Conservation Program

In his presentation on the WCS program on scarlet macaw conservation on Monday evening (10 March), Lic. Rony Garcia of WCS Guatemala described the four main threats to scarlet macaws in the MBR: habitat destruction, poaching, natural predation, and competition for nest cavities. Of the four, habitat destruction and natural predation are currently of the most significant concern. Prior to WCS work in the region, poaching was also of serious concern.

6.2.1 Main Threats to the Scarlet Macaw

Habitat destruction: Habitat destruction is largely the result of illegal invasions into the MBR, and subsequent deforestation and purposely set fires. The problem is particularly severe in the western sections of the reserve, particularly in Laguna del Tigre and Sierra del Lacandón, both areas formerly being strongholds of scarlet macaws. In many sections of these national parks, areas are so dangerous that WCS cannot operate on the ground. WCS conducts over-flights (via the volunteer LightHawk program) to detect illegal colonization, deforestation and fires, and cooperates with the government of Guatemala to strengthen protected areas. WCS also works with national partners to strengthen fire prevention and suppression initiatives in and around key macaw nesting sites. Almost all fires are purposely set by people for hunting, forest destruction for agricultural and ranching purposes, and on rare occasions to induce removal of the land from

conservation protection. Where WCS is able to work, the area burned by fires has dropped by an order of magnitude, as mentioned in Chapter 3, and the deforestation rate has been drastically reduced compared to other parts of the MBR. The severity of fires and habitat conversion is apparent from Fig. 6-3, where large sections of Laguna del Tigre and parts of Sierra del Lacandón have been seriously degraded.
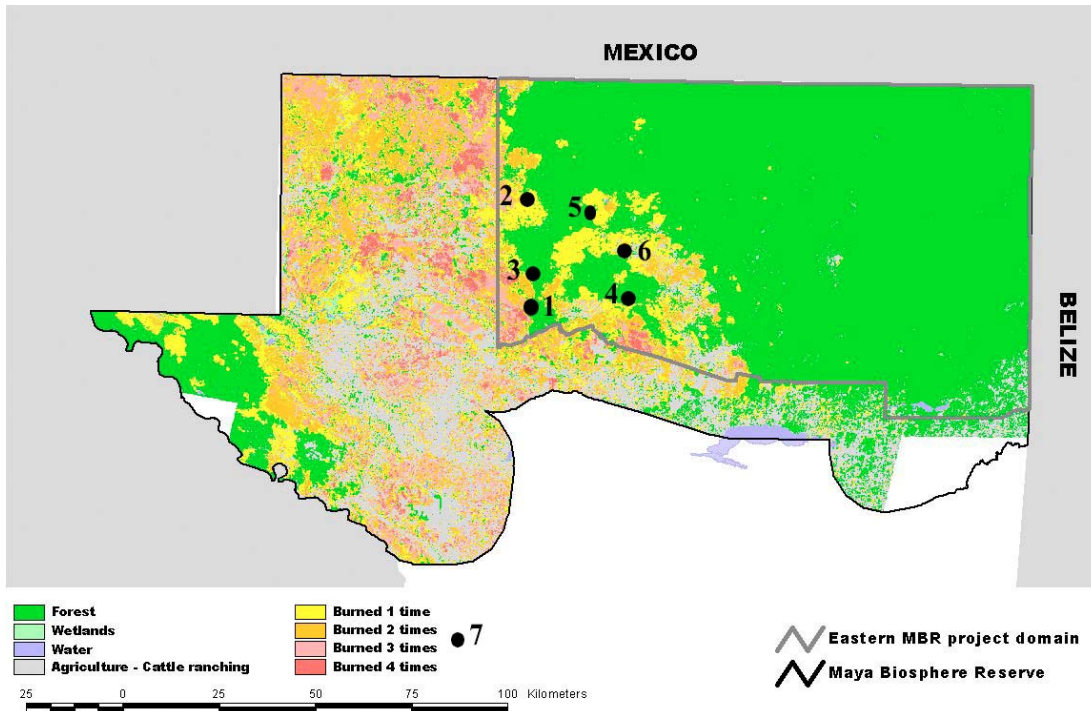

Figure 6-3. Vegetation types and burn status of the Maya Biosphere Reserve as of 2007. Natural fires are rare; virtually all fires are human set illegally to clear land or for hunting. Numbered sites are the locations of scarlet macaw nesting sites monitored by WCS: 1 – El Perú; 2 – La Corona; 3 – El Burral; 4 - Peñon de Buena Vista; 5 – AFISAP; 6 - La Colorada; 7 – Pipiles (outside the MBR)

Poaching: Poaching occurs where there is human presence coupled with lack of law enforcement and/or protection. Poaching in areas where WCS has been working has dropped greatly since 2003. (See Figs. 6-3 and 6-4 for these areas.). In areas where such protection is lacking, however, it is likely that the vast majority of macaw nests are poached, with few if any young are being recruited into the population from these unprotected areas. The exceptions to this rule are likely to come from macaws nesting in standing dead trees considered to risky to climb, or nests in trees with Africanized bees in an adjacent cavity.

Natural Predation: Adult macaws are only rarely taken by non-human predators for most of their life span, since macaw predators such as harpy eagles are in very low numbers in the MBR, and predation by other large eagles such as hawk eagles is uncommon. Most natural predation

occurs on chicks. Nest monitoring by WCS field personnel during the 2008 breeding season in El Perú using in-nest cameras have indicated predation commonly takes place in the nest on chicks by collared forest falcons (*Micrastur semitorquatus)*; three predation events by *Micrastur* were recorded in 2008 (García et al. 2008). However, in most monitored nests that lost chicks, nestlings have simply disappeared and no specific predator could be identified. WCS personnel feel it is unlikely that these were human poaching events, since no tree scars indicating use of climbing spikes were observed. This remote monitoring based on placing infra-red cameras in nest cavities was initiated in 2008 as an attempt to better understand natural sources of nest failure, and will be continued during the 2009 nesting season in El Perú to identify these unknown sources of chick mortality.

Falcons are sight predators, so double-chambered artificial nests that obscure view of the chicks from the outside have been constructed out of sections of large fallen trees in an attempt to reduce predation. By the end of last season (2007), ten double-chambered nests had been installed. So far only two artificial nests have been used, but macaws did successfully fledge offspring from one in 2006. The type of substrate inside artificial nests might be one of the factors why the nests have not been used by macaws, since very little/no natural material had been placed in the nests previously. Thus, the nest substrate did not fully replicate natural cavity conditions, nor permit macaws to bury their eggs (a behavior recorded with the in-nest cameras). This season we will line nests with natural wood detritus, place fist-sized wooden chunks in the cavity to allow nesting macaws to chew on the material, and evaluate if the frequency of use is improved.

Competition for cavities: the most serious competitor for cavities seems to be Africanized bees that prevent cavity use by their presence or drive away adults, and kill chicks or cause them to starve by taking over occupied cavities. Preliminary experiments in 2007 consisting of spraying the inside of nest cavities with permethrin (5%) suggest that persistent application of insecticides with low avian toxicity is highly effective. Of 15 nest treated, 14 were not invaded by Africanized bees during this breeding season. Additional research on this topic continues.

6.2.2 Habitat Modeling

Victor Hugo Ramos presented his work on scarlet macaw habitat modeling in the Maya Biosphere Reserve, part of the WCS Maya Forest Living Landscape Program financially supported by USAID/Global Conservation Program, on Tuesday evening (11 March).

Biological Landscape: The scarlet macaw landscape conservation model uses historical records of nesting sites over the last 25 years to preliminarily define the general distribution of the species, and helps us to exclude areas without recent distribution records. The density of active nests in three general areas with known active nesting populations (and precise nest locations) was used to estimate the potential number of macaws across the landscape, although we do have reservations regarding the current state of nesting numbers in Belize and Mexico (see Literature consulted, 2008, in References). Similarly, the biological model to estimate habitat suitability was based on habitat type and surface water availability, although these two values combined accounted for only 15% of the weight of the biological model. The biological model estimates a potential for approximately 120 active nests across the Guatemalan, Belizean, and Mexican areas

modeled, and assigns an average number of 3 birds to each active nest, that is to say, one breeding pair and one juvenile. The model also assumes the presence of another 117 available nesting cavities capable of being used by a nesting pair, although they are not occupied by macaws. In total then, we estimate the carrying capacity (K) for the landscape based on 234 nesting cavities distributed across the landscape, with an average of 3 individuals per each cavity (i.e. a total of 702 individuals). These calculations are only partially based on recent field observations (just from a large percentage of the current Guatemalan distribution), and for this reason they should be considered as a first, rough guess, and be subject to revision as more precise data are obtained. Table 6-1 details the carrying capacity (K) without considering the threats resulting from human activities, and/or human activities designed to mitigate threats, such as effective park management and protection.

Human Landscape: The "human landscape" detailing threats and protection efficacy is largely defined by two key parameters, ease of access and history of fire. The greatest weight was assigned to ease of access, since it functions as a proxy for the poaching of macaw chicks in the nest – that is, the anthropogenic threat most likely to reduce the population over time. The recurrence of fire was registered as a threat due to the ability of fire to destroy viable nesting cavities, although its ability to reduce the carrying capacity (K) was considered lower than that of human access (i.e., poaching). Finally, as previously mentioned, within the human landscape model we also assigned values to specific areas that partially reduced the severity of the threats. These values were based on protected area status, and known/estimated efficacy of the protection on the ground (especially in Guatemala).

Conservation Landscape: We spatially identified the priority conservation areas by superimposing the human (i.e. threats) landscape on top of the biological (i.e. carrying capacity) landscape, and identifying areas where threats are causing the greatest reduction in population numbers, or may do so in the future. The resulting map coincides with much of the ongoing work of WCS in the Guatemalan section of the landscape. However, it also identifies the western part of Laguna del Tigre National Park as an area with capacity to support significant numbers of scarlet macaws – and as an area that is currently lacking conservation interventions. Table 6-1 depicts estimates for the carrying capacity (K), the reduction of estimated abundance per each threat, and the estimated current abundance. Figures 6-6, 6-7, 6-8, and 6-9 depict, respectively, the biological landscape, the human landscape, the current carrying capacity (K), and the conservation landscape for scarlet macaws in the tri-national area.

Table 6-1. Scarlet macaw carrying capacity, reduction of populations based on threats, and current abundance per country and protected area status

AREA	Carrying Capacity (K) (individuals)	Reduction in Population (individuals)	Current Abundance (individuals)
BELIZE (Unprotected)	21	11	11
BELIZE (Protected)	131	39	92
GUATEMALA (Unprotected)	16	10	6
GUATEMALA (Protected)	281	128	153
MEXICO (Unprotected)	131	71	60
MEXICO (Protected)	121	44	77
TOTALS	**702**	**303**	**399**

The model predicts that two main blocks of good habitat remain, including a modest tract of intact habitat in the Chiquibul and Maya Mountains areas of Belize, and a large area of potentially high and very high quality habitat in the western part of the MBR and extending into Mexico. Unfortunately, comparing Figs 6-6 and 6-7 reveals that the regions of highest human encroachment (Laguna del Tigre and Sierra del Lacandón), are where the best macaw habitat is predicted to be. Rony García said that based on data from one nesting site (El Perú), the impression is that the population of adult birds nesting there is decreasing—perhaps as much as 40% since 2003, but this impression may not be accurate since nesting adults may be moving to nest at other sites.

6.2.3 Nest Monitoring

WCS-Guatemala field staff led by Rony García search for and monitor scarlet macaw nests at five main sites/areas in the MBR to:
    a) increase field presence, and thereby discourage poaching
    b) evaluate levels of poaching, natural predation, and levels of competition for nest sites
    c) estimate scarlet macaw nesting success
    d) estimate population trends

Additional information is also collected annually for two other nesting sites that are monitored less intensely, La Colorada and Pipiles.

These focal field sites/areas are (see Figs. 6-3, 6-4, and 6-5):
    1. El Perú
    2. La Corona
    3. El Burral
    4. Peñon de Buena Vista
    5. AFISAP
    6. La Colorada
    7. Pipiles

In 2007, 31 active scarlet macaw nests were monitored within these seven sites. The highest concentration of nests was at El Perú, but that is also where the level of monitoring effort has been greatest. In 2007, 51 chicks hatched across this sites, but only 15 (29.4%) fledged successfully. For reasons not fully understood, the percentage of chicks that fledged successfully was particularly low in the sites of El Perú, El Burral, and Peñon de Buena Vista (Fig. 6-4 and Table 6-2). Nevertheless, research during 2008 has helped us begin to unravel the mystery. As previously noted we were able to register three predation events at El Perú by one of the chicks' predators, the collared forest falcon (*Micrastur semitorquatus*) reinforcing the hypothesis that natural predation is one of the main forces determining chick survival and fledging.
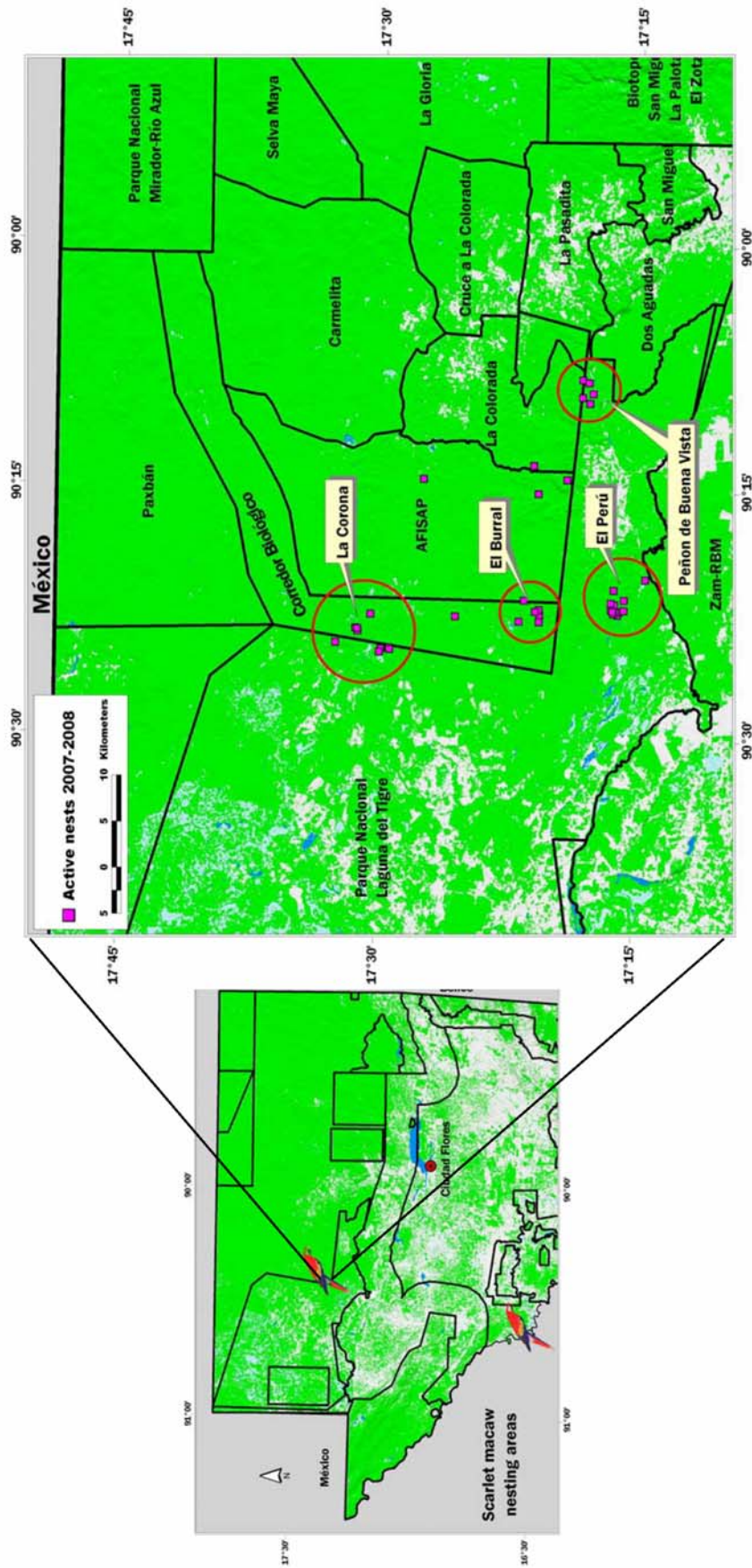
Figure 6-4. Active scarlet macaw nest distribution in the eastern Maya Biosphere Reserve, 2007-2008. (Note: green areas represent intact forest, grey-white areas represent deforested habitat. The smaller map to the left depicts the entire Maya Biosphere Reserve, with national parks and Biotopes located on the peripheral edges of the reserve (i.e. "Core Zones" in theory dedicated to protection), and a large Multiple-Use Zone at the center of the reserve. The larger map to the right zooms in on the concentrations of nests in eastern Laguna del Tigre National Park, the Laguna del Tigre-Mirador Biological Corridor, and Multiple Use Zone community forest concessions such as AFISAP, and La Colorada).
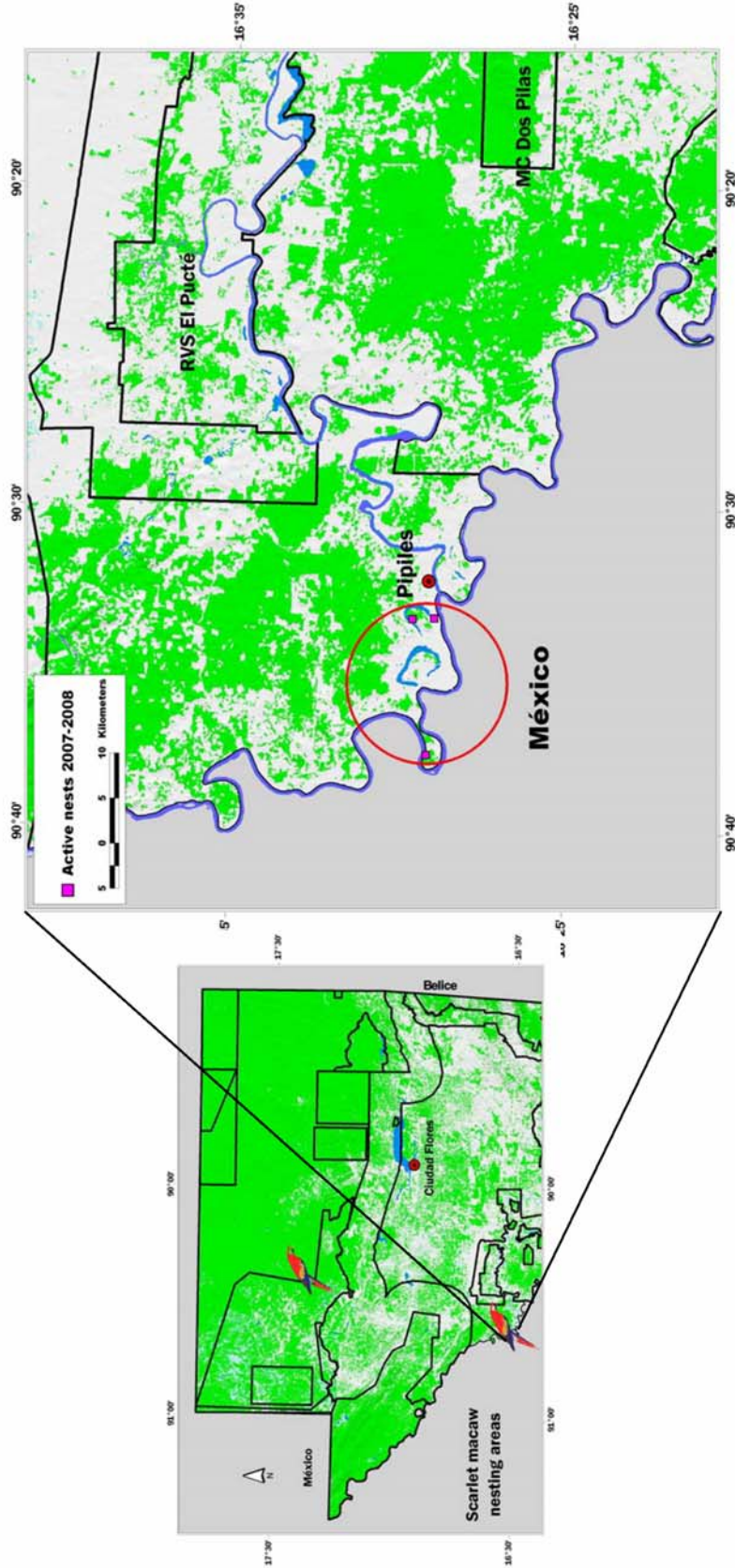
Figure 6-5. Active scarlet macaw nest distribution in Pipiles in the South of Petén, 2007-2008. (Note: green areas represent intact forest, grey-white areas represent deforested habitat. The smaller map to the left depicts the entire Maya Biosphere Reserve, with national parks and Biotopes located on the peripheral edges of the reserve. The Pipiles nesting sites lie just beyond the southern edge of the Maya Biosphere Reserve Buffer Zone, and slightly to the west of the Dos Pilas Archaeological Reserve. The larger map to the right zooms in on the concentrations of nests in Pipiles. Note the abundance of riparian habitat, as the border with México is also divided by a waterway, the Usumacinta River, Mesoamerica's largest river.)
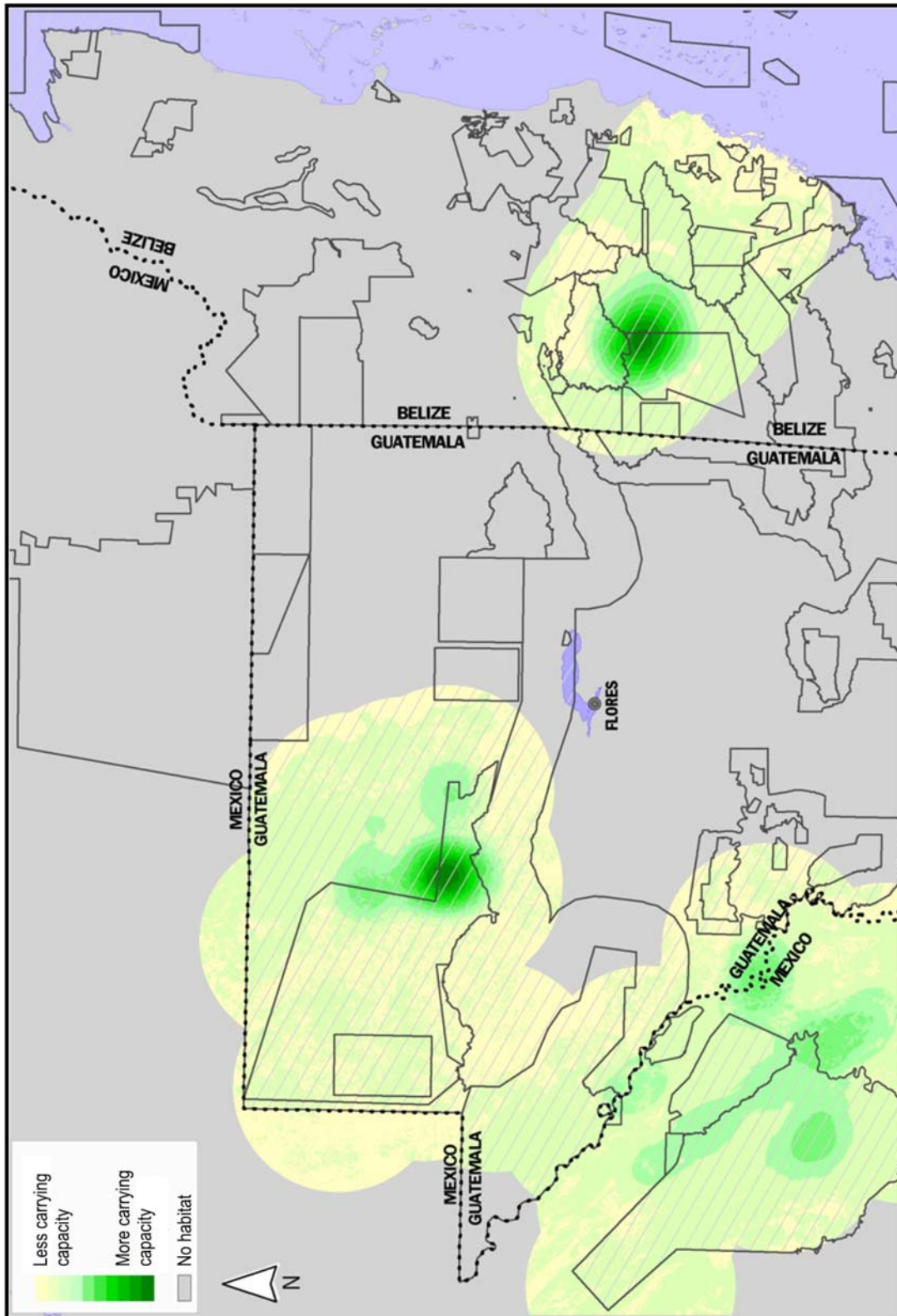
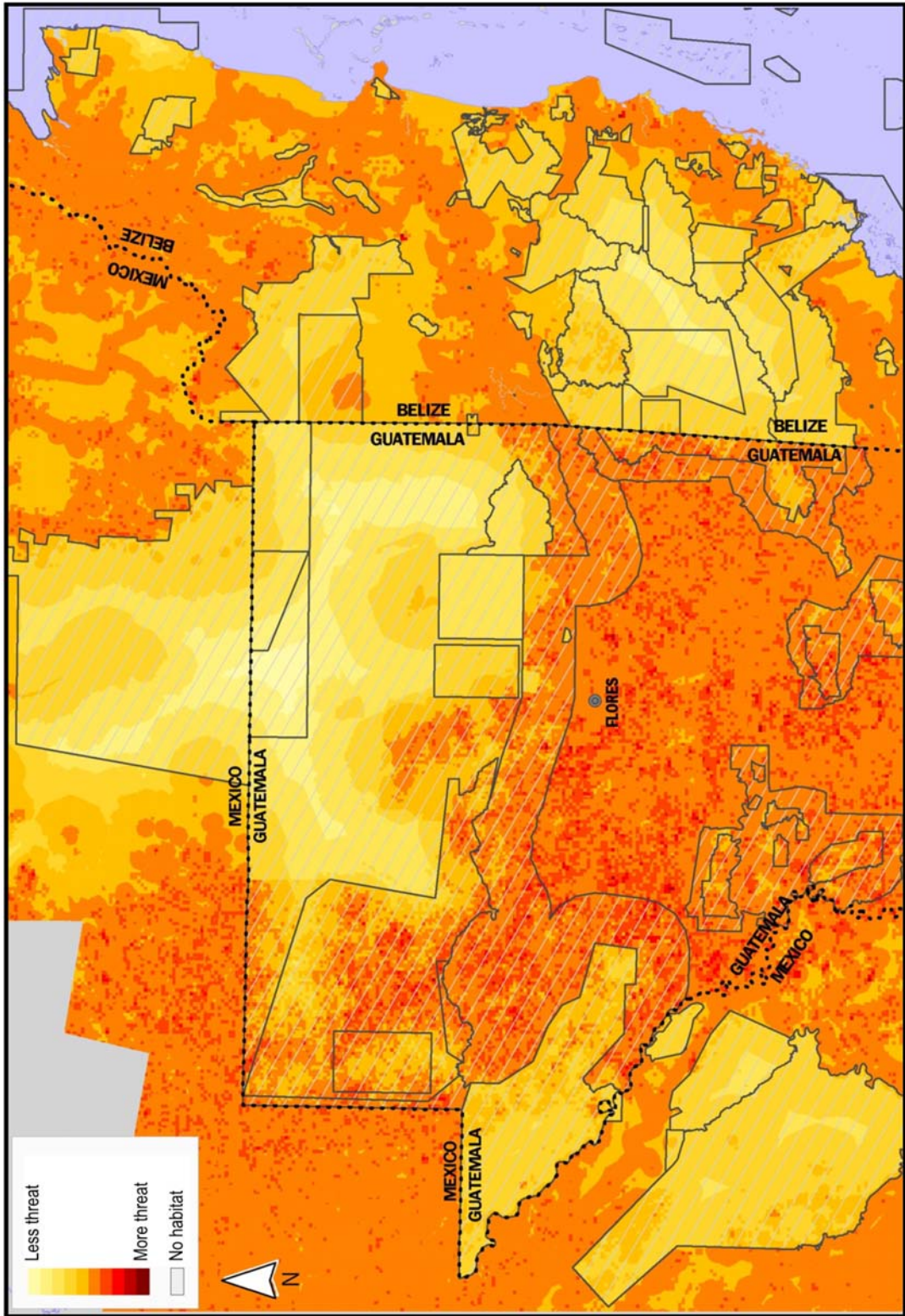**Figure 6-6.** Carrying Capacity of the Scarlet Macaw (Biological Landscape).

Figure 6-7. Synthesis of Threats to Scarlet Macaws (Human Landscape).
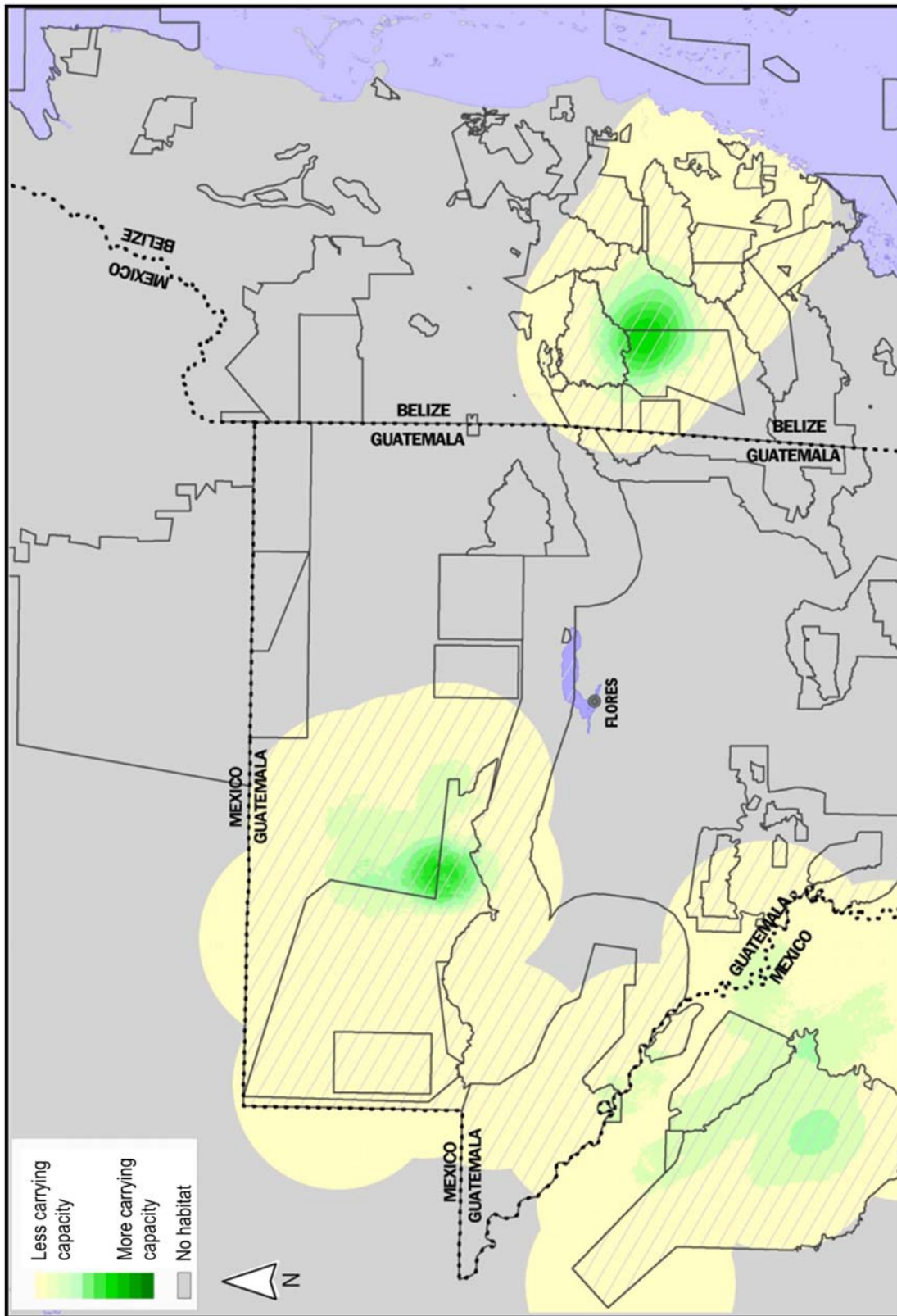
Figure 6-8. Carrying Capacity of Scarlet Macaws as Impacted by Threats (Biological Landscape – Human Landscape).
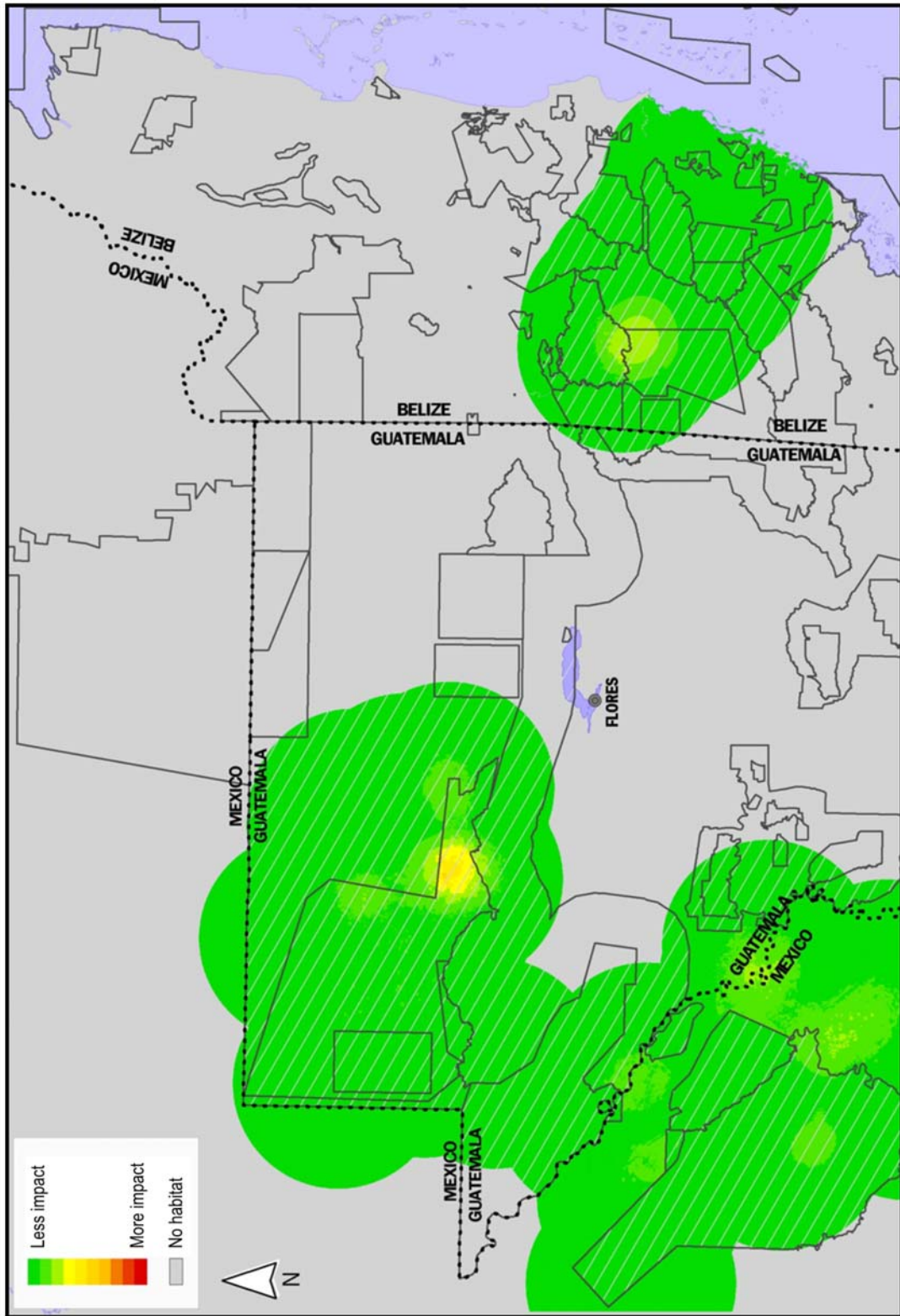
Figure 6-9. Potential Impact of Scarlet Macaw Conservation Interventions (Conservation Landscape)

Table 6-2. Nesting success (% of chicks successfully fledged) during 2007, 2008 breeding season in MBR nesting sites. (García et al. 2007, García et al. 2008)

Sites	Area	Active Nests		Eggs		Chicks		Successful		% Success	
		2007	2008	2007	2008	2007	2008	2007	2008	2007	2008
El Perú	Laguna del Tigre NP	9	10	31	26	13	17	1	5	8%	29%
Peñón de BV	Laguna del Tigre NP	4	4	15	6	11	5	2	0	18%	0%
El Burral	Central BC	5	2	20	8	6	4	1	1	17%	25%
La Corona	Central BC	7	7	19	22	12	13	4	12	33%	92%
AFISAP	MUZ	3	3	6	7	5	5	3	5	60%	100%
La Colorada	MUZ	1	1	3	2	1	2	1	0	100%	0%
Pipiles	Outside MBR	2	2	5	4	3	4	3	2	100%	50%
	TOTAL	31	29	99	75	51	50	15	25	29%	50%

Nesting sites are in Laguna del Tigre National Park; the Central Biological Corridor (formerly known as the Laguna del Tigre-Mirador Biological Corridor); the Multiple Use Zone (MUZ); or in forest patches around the rural town of Pipiles located in the Municipality of Sayaxché near the confluence of the Río Pasión and the Río Usumacinta.

The WCS scarlet macaw conservation strategy is based on maintaining the quantity and quality of the current habitat strongholds used by scarlet macaws in the Maya Biosphere Reserve, and undertaking interventions to enhance the quality from a macaw standpoint (e.g., artificial nests or nest treatment to deter bees). However, given the low number of confirmed breeding pairs in secure parts of the Maya Biosphere Reserve and an apparent downward trend (i.e. from 31 to 29 active nests over the last two breeding seasons), a second crucial aspect is now the investigation of causes leading to both the apparent reduction in the number of nesting adults, as well as the high rate of chick loss mentioned previously. Finally, we also hope to be able to identify and test management interventions that increase both of these key variables, active nests and nesting success.

One possibility for the observed reduction in the number of nesting adults within some key nesting foci is that nests are failing so frequently that the macaws are abandoning these sites (i.e., at El Perú). Another possibility is that the number of macaws in the MBR is actually decreasing and the reduction in nests is a reflection of a true population decline. The ongoing work to identify reasons behind disappearance of chicks from nests is crucial, as is further work into the efficacy of treating cavities with an insecticide with low toxicity to vertebrates (permethrin) to stave off African bee infestations. Increasing nesting success may help to stabilize the number of nesting adults in an area. However, that answer will not be at hand for a number of years. If the total population of the MBR is decreasing, perhaps due to the aging of breeding adults and low historical recruitment (resulting in a low number of younger breeding age birds due to poaching and/or nest failure), one possible management intervention could involve "reinforcing" the population through captive breeding and release of young birds into the wild population. Considering the "hows" of this technique was one of the motivations for this workshop. As our program advances, it is likely that we will apply and evaluate several management interventions that address potentially diverse causes of reduced numbers of active nests until we are able to pinpoint what the most significant causes actually are.

As described in Chapter 3, a *preliminary* population viability analysis (PVA) conducted by WCS Guatemala personnel using the VORTEX model suggested that adding an additional 5 birds per year to the MBR population could be effective at reducing the probability of extinction of the overall population (assuming no further habitat loss). Because this effort was preliminary,

and clearly incomplete, a detailed PVA analysis conducted by Nancy Clum of WCS was developed with the input of experts participating in the workshop to model different scenarios for the population of scarlet macaws in the Maya Biosphere Reserve. A full report on this PVA analysis is provided as Chapter 7. One highlight of the PVA was that one of the most important variables significantly and consistently impacting population growth was the percentage of successfully breeding females (each year). This variable corresponds to the ongoing management interventions aimed at nest protection from colonization, fire, and poaching, colonization by Africanized bees, and predation by forest falcons. Results suggested that these *in situ* management actions should have the greatest conservation impact and further, that at least some level of *in situ* management is necessary for the population to recover (see Chapter 7).

Irrespective of the conclusions of the PVA, one clear benefit associated with a scarlet macaw reinforcement program was detailed, consisting of engaging high profile national partners in the effort, consequently helping to focus strong national and perhaps international attention on the scarlet macaws struggle for survival, and encouraging a stronger governmental response to the clear threats. It was for this reason that this Workshop was convened with a number of experts to review, evaluate, and develop a protocol for restoring scarlet macaw populations in the wild.

6.3 Characteristics of Monitored Sites

WCS-Guatemala personnel suggested that the most suitable place for undertaking such an effort would be at the nesting hotspot of El Perú, where a field camp exists. The area also benefits from a long-term archaeological investigation at the site, ensuring that the Guatemalan army maintains a presence. Workshop participants felt it would be valuable to step back and review all macaw sites as well as other possible locations to see if the same conclusions would be drawn by the whole group. Donald Brightsmith facilitated the discussion about the relative suitability of the seven sites (Fig. 6-10). Sites were ranked according to the degree of each of five threats (fire, invasions, poaching, natural predation, hunting) and the logistics of working there. A summary of the conclusions was drawn up by Nancy Clum and is presented in Table 6-3.

Table 6-3. Summary of analysis of the potential sites for conducting macaw population reinforcement (N/A = information not available)

Site	Type	# Nests	Fire	Invasions	Poaching	Predation	Hunting	Logistics
El Perú	Park	7 to 15	Moderate	Moderate	Low	N/A	N/A	Good
Peñon BV	Park	6	Moderate	High	N/A	N/A	N/A	Good
AFISAP	Concession	3+	Low	Moderate	High	N/A	N/A	Okay
El Burral	Corridor	5 to 8	High	High	High	N/A	High	Okay
Pipiles	Cooperative	3+	High	N/A	High	N/A	High	Okay
La Colorada	Concession	1+	High	High	High	N/A	High	Okay
La Corona	Corridor	5 to 8	High	High	High	N/A	N/A	Poor

Figure 6-6. Don Brightsmith, with the assistance of Gabriela Ponce, facilitated a discussion on the characteristics of the seven macaw nesting regions monitored by WCS personnel and an evaluation of which would be best for first implementation of management interventions such as population augmentation through release of captive raised juveniles. El Perú was deemed the best choice.

Three sites, El Perú, Peñon de Buena Vista, and AFISAP were considered the best candidates for a release. It was pointed out that El Perú is easiest to control but that encroachment pressure is greatest to the west, possibly threatening El Perú. Releases in this area could be advantageous, drawing attention and encouraging investment that would help prevent the invasion boundary from sweeping further westward. But the site is also more at risk and could become isolated if the line of invasion eventually does sweep around it. El Perú contains the greatest concentration of known nests and is also already important for other reasons (e.g., an archeological site and a potential tourism facility at the former Las Guacamayas field station), meaning more people are concerned by its fate, and the army already has a presence. AFISAP is further east and has started to face invasion pressure, although local people are more invested in its success and hence it is less at risk. The consensus was that El Perú was the best site for a macaw restocking effort.

All of the sites considered already have an existing population of wild macaws. Some experts advise against releasing animals into an existing population because of potential disruption of that population through disease introduction or other unanticipated factors. While the group agreed there were potential hazards, the group also seemed to feel these hazards could be

adequately mitigated. A question was also raised as to whether it is preferable to do a release in an area where threats are less intense, or in an area where the presence of a release may help to decrease threats. Again, assuming the potential hazards could be mitigated, the group felt the advantage of potentially decreasing threats was important enough to take the chance of doing releases in a more threatened area.

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