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DEPARTMENT OF THE INTERIOR

Fish and Wildlife Service

50 CFR Part 17

[Docket No. FWS-R9-ES-2011-0101; 450 003 0115]

RIN 1018-AY33

Endangered and Threatened Wildlife and Plants; Two Foreign Macaw Species

AGENCY: Fish and Wildlife Service, Interior.

ACTION: Final rule.

SUMMARY: We, the U.S. Fish and Wildlife Service (Service), are listing the military macaw (*Ara militaris*) and the great green macaw (*Ara ambiguus*) as endangered under the Endangered Species Act of 1973, as amended (ESA). These species are both endemic to Central and South

America. Despite conservation efforts, these species' populations are in decline, primarily due to habitat loss, fragmentation, and degradation; small population size; poaching; and regulatory mechanisms that are inadequate to ameliorate these threats throughout their ranges.

DATES: This rule becomes effective [INSERT DATE 30 DAYS AFTER DATE OF PUBLICATION IN THE FEDERAL REGISTER].

ADDRESSES: This final rule is available on the Internet at *http://www.regulations.gov* and comments and materials received, as well as supporting documentation used in the preparation of this rule, will be available for public inspection, by appointment, during normal business hours at: U.S. Fish and Wildlife Service; 5275 Leesburg Pike, Falls Church, VA, 22041.

FOR FURTHER INFORMATION CONTACT: Janine Van Norman, Chief, Branch of Foreign Species, Endangered Species Program, U.S. Fish and Wildlife Service, 5275 Leesburg Pike, Falls Church, VA, 22041; telephone 703-358-2171. If you use a telecommunications device for the deaf (TDD), call the Federal Information Relay Service (FIRS) at 800-877-8339.

SUPPLEMENTARY INFORMATION:

Executive Summary

I. Purpose of the Regulatory Action

On January 31, 2008, the Service received a petition dated January 29, 2008, from Friends of Animals, represented by the Environmental Law Clinic, University of Denver, Sturm College of Law, requesting that we list 14 parrot species under the Endangered Species Act of 1973, as amended (ESA or Act; 16 U.S.C. 1531 *et seq.*). As part of a court-approved settlement agreement, the Service agreed to submit a determination as to whether the petitioned action is warranted, not warranted, or warranted but precluded by other listing actions for the military macaw (*Ara militaris*) and the great green macaw (*Ara ambiguus*) to the **Federal Register** by June 30, 2012. On July 6, 2012, the Service published a proposed rule (77 FR 40172) to add the military macaw and great green macaw as endangered species to the Federal List of Endangered and Threatened Wildlife. This final rule completes the listing process for these species.

II. Summary of the Major Provisions of the Regulatory Action

We are listing the military macaw (*Ara militaris*) and the great green macaw (*Ara ambiguus*) as endangered species under the Act. We are finalizing this action primarily because of the effects of poaching, habitat loss, fragmentation, and degradation on their populations; their small and declining population sizes; and inadequate regulatory mechanisms to ameliorate the threats to the species throughout their ranges.

In this final rule, we used public comments and peer review to inform our final determination, as required under the Act. When we published the proposed rule on July 6, 2012 (77 FR 40172), we opened a 60-day comment period on the proposed listing for these species. During the comment period, we sought comments from independent specialists (peer reviewers)

on the specific assumptions and conclusions in our listing proposal to ensure that the designation of these species as endangered is based on scientifically sound data, assumptions, and analyses. In addition, we sought comments from interested parties and the public. We considered all comments and information received during the comment period. In this final rule, we present and respond to peer reviewer and public comments. This rule finalizes the protections proposed for these two foreign bird species as endangered species, following careful consideration of all comments we received during the public comment period.

III. Costs and Benefits

Section 4(b)(1)(A) of the ESA directs that determinations as to whether any species is an endangered or threatened species must be made “solely on the basis of the best scientific and commercial data available.” Further, this action is not a “significant” regulatory action under Executive Order 12866. Therefore, we have not analyzed its costs or benefits.

Background

Section 4(b)(3)(B) of the ESA (16 U.S.C. 1531 *et seq.*) requires that, for any petition to revise the Federal Lists of Endangered and Threatened Wildlife and Plants that contains substantial scientific or commercial information that listing the species may be warranted, we make a finding within 12 months of the date of receipt of the petition (“12-month finding”). In this finding, we determine whether the petitioned action is: (a) Not warranted, (b) warranted, or (c) warranted, but immediate proposal of a regulation implementing the petitioned action is

precluded by other pending proposals to determine whether species are endangered or threatened, and expeditious progress is being made to add or remove qualified species from the Federal Lists of Endangered and Threatened Wildlife and Plants. Section 4(b)(3)(C) of the ESA requires that we treat a petition for which the requested action is found to be warranted but precluded as though resubmitted on the date of such finding, that is, requiring a subsequent finding to be made within 12 months. We must publish these 12-month findings in the **Federal Register**.

In this document, we announce that listing these two species as endangered species is warranted, and we are adding these two species to the Federal List of Endangered and Threatened Wildlife in title 50 of the Code of Federal Regulations.

Petition History

On January 31, 2008, the Service received a petition dated January 29, 2008, from Friends of Animals, as represented by the Environmental Law Clinic, University of Denver, Sturm College of Law, requesting that we list 14 parrot species under the ESA. The petition clearly identified itself as a petition and included the requisite information required in the Code of Federal Regulations (50 CFR 424.14(a)). On July 14, 2009 (74 FR 33957), we published a 90-day finding in which we determined that the petition presented substantial scientific and commercial information to indicate that listing may be warranted for 12 of the 14 parrot species.

In our 90-day finding on this petition, we announced the initiation of a status review to

list as endangered or threatened under the ESA the following 12 parrot species: Blue-headed macaw (*Primolius couloni*), crimson shining parrot (*Prosopeia splendens*), great green macaw (*Ara ambiguus*), grey-cheeked parakeet (*Brotogeris pyrrhoptera*), hyacinth macaw (*Anodorhynchus hyacinthinus*), military macaw (*Ara militaris*), Philippine cockatoo (*Cacatua haematuropygia*), red-crowned parrot (*Amazona viridigenalis*), scarlet macaw (*Ara macao*), white cockatoo (*Cacatua alba*), yellow-billed parrot (*Amazona collaria*), and yellow-crested cockatoo (*Cacatua sulphurea*). We initiated the status review to determine if listing each of the 12 species is warranted, and initiated a 60-day public comment period to allow all interested parties an opportunity to provide information on the status of these 12 species of parrots. The public comment period closed on September 14, 2009.

On July 21, 2010, a settlement agreement was approved by the Court (CV-10-357, D. D.C.), in which the Service agreed to submit to the **Federal Register** by July 29, 2011, September 30, 2011, and November 30, 2011, determinations whether the petitioned action is warranted, not warranted, or warranted but precluded by other listing actions for no less than 4 of the petitioned species on each date.

On August 9, 2011, the Service published in the **Federal Register** a 12-month status review finding for the crimson shining parrot (a finding that listing was not warranted) and a proposed rule for the following three parrot species: Philippine cockatoo, white cockatoo, and yellow-crested cockatoo (76 FR 49202).

On October 6, 2011, we published a 12-month status review finding for the red-crowned

parrot (76 FR 62016); on October 11, 2011, we published a 12-month status review and proposed rule for the yellow-billed parrot (76 FR 62740); and on October 12, 2011, we published a 12-month status review for the blue-headed macaw and grey-cheeked parakeet (76 FR 63480).

On September 16, 2011, an extension to the settlement agreement was approved by the Court (CV–10–357, D. DC), in which the Service agreed to submit a determination for the remaining four petitioned species to the **Federal Register** by June 30, 2012.

On July 6, 2012, the Service published in the **Federal Register** a 12-month status review finding and proposed rule for the four following parrot species: great green macaw and the military macaw (77 FR 40172), hyacinth macaw (77 FR 39965), and the scarlet macaw (77 FR 40222).

Upon publication in the **Federal Register** on July 6, 2012, of the 12-month status review finding and proposed rule for these species (77 FR 40172), we initiated a 60-day public comment period, which ended on September 4, 2012. Following publication of the proposed rule, we implemented the Service's peer review process and during the 60-day comment period, solicited scientific and commercial information on the species from all interested parties.

Previous Federal Actions

In our proposed rule, published July 6, 2012 (77 FR 40172), we announced that listing the military macaw and the great green macaw as endangered was warranted, and we issued a

proposed rule to add these two species to the Federal List of Endangered and Threatened Wildlife. The comment period ended on September 4, 2012; we received 59 comments from the public.

In response to requests received during the public comment period, we reopened another public comment period on February 21, 2013, which ended on April 22, 2013 (78 FR 12011). During the second comment period (see <http://www.regulations.gov>, docket number FWS–R9–ES–2011–0101), we received 25 more comments on these two macaw species and on the hyacinth macaw; however, only one submission provided substantive information. All comments, including names and addresses of commenters, have become part of the administrative record and are available at <http://www.regulations.gov>, docket numbers FWS–R9–ES–2011–0101 and FWS–R9–ES–2012–0013.

Summary of Comments and Recommendations

We base this finding on a review of the best scientific and commercial information available, including all information received during the public comment period. In the September 4, 2012, proposed rule, we requested that all interested parties submit information that might contribute to development of a final rule. On February 21, 2013, we reopened the public comment period where we again requested that all interested parties submit information that might contribute to development of a final rule. We also contacted appropriate scientific experts and organizations and invited them to comment on the proposed listings. We received comments from four individuals; one of which was from a peer reviewer.

Peer Reviewer Comments

(1) *Comment:* One peer reviewer provided information on military macaw population surveys confirming the presence of 100 macaws in the Tehuacan-Cuicatlan Biosphere Reserve in Mexico.

Our Response: We have reviewed the additional literature and incorporated the new information into our finding. Although the new information has been incorporated into the final rule, the new survey provided did not change our finding that the military macaw meets the definition of an endangered species. The species' overall population remains small and fragmented despite additional macaws being observed in this one location, and the species is still at risk of extinction due to habitat loss, poaching, and small population size.

Public Comments

(2) *Comment:* Several commenters expressed concerns about the potential impact the listings might have on their business.

Our Response: We acknowledge that there may be impacts to different entities involved in captive breeding of great green and military macaws. However, Section 4(b)(1)(A) requires listing decisions to be based solely on the best scientific and commercial data available, as it relates to the five listing factors in section 4(a)(1) of the Act. Therefore, the Service did not

consider the impacts on business in its listing determination. .

(3) *Comment:* Some commenters suggest that the Service is using outdated information when making the determination for the rule.

Our Response: The Service is required by the Act to make determinations solely on the basis of the best scientific and commercial data available. We based the proposed rule on all the information we received following the initiation of the 12-month status review for the military and great green macaw, as well as all of the information we found while conducting our own research. The information we use depends on field research and our ability to acquire that information. At the time of the publishing of the proposed rule, the information we compiled was considered the best available information. After publishing the proposed rule, emerging information on the great green and military macaw became available. We reviewed that information, as well as additional information submitted by the public, including more recent information and studies from a species expert and conservation organizations within the great green and military macaw's range countries. Non-English literature was professionally translated, analyzed, and is cited in this document. The information we received and subsequently reviewed did not change any of our findings, but rather further supported our conclusions. That information has been incorporated into this final rule.

(4) *Comment:* Some commenters, while not opposed to the listing of the species, asked for a special rule under section 4(d) of the Act (also called a "4(d) rule") that would allow ownership and interstate trade of the species to occur without obtaining a permit under the Act.

Our response: Ownership of a listed species is not prohibited by the Act and, therefore, does not require a permit. Because we determined that listing the great green and military macaws as endangered species under the Act is appropriate, we are not able to develop a 4(d) rule for this species. Section 4(d) of the Act allows the Service to develop a special rule to apply the prohibitions of section 9 or to provide measures that are necessary and advisable to provide for the conservation of threatened species only. A special rule cannot be promulgated for a species that is listed as endangered under the Act. The sale; offer for sale; and delivery, receipt, carrying, transport, or shipment in interstate or foreign commerce in the course of a commercial activity is prohibited. That said, not all interstate trade is prohibited under the ESA. Interstate transfer of animals that are not for sale, offered for sale, or in the course of a commercial activity is not prohibited.

We thank all the commenters for their interest in the conservation of this species and thank those commenters who provided information for our consideration in making this listing determination. Under section 4(b) of the Act, the Service is required to make listing determinations solely on the basis of the best scientific and commercial data available after conducting a review of the status of the species. When we published our proposed rule, we opened a public comment period during which we requested any additional information on the great green and military macaw. In making this listing determination, we reviewed the best available scientific and commercial information, contacted species experts, and searched for the most current information on these species with due diligence. Therefore, we have obtained and considered the “best scientific and commercial data available” in our listing determination. After

careful consideration, we conclude that these species meet the definition of an endangered species under the Act.

Species Information for the Military Macaw

Taxonomy

The military macaw (*Ara militaris*, Linnaeus 1766) is in the Psittacidae family and is also known as “guacamaya verde,” “parava,” and “ravine parrot.” Three subspecies of military macaw have been proposed and are recognized by some: *Ara militaris bolivianus* (Reichenow 1908), *Ara militaris mexicanus* (Ridgway 1915), and *Ara militaris militaris* (Linnaeus 1766). Avibase, a database of all birds of the world maintained by Bird Studies Canada, and the Integrated Taxonomic Information System (ITIS) both recognize subspecies (<http://www.itis.gov> and <http://avibase.bsc-eoc.org/avibase.jsp>, accessed August 30, 2011). The range of *A. m. bolivianus* is thought to be in Bolivia and northwestern Argentina. The range of *A. m. mexicanus* is thought to be restricted to Mexico.

Because it is a strong flyer (it has been observed traveling up to 20 kilometers (km) (12 miles [mi]) per day) and it is a semi-migratory species, the physical similarities suggest that seemingly isolated populations may be in contact (Juniper and Parr 1998, p. 423), and, therefore, their populations may be exchanging genetic material.

For the purpose of this rule, we are addressing the military macaw at the species level. Therefore, we are listing the military macaw species as an endangered species, which includes all subspecies.

Description

The military macaw is an extremely vocal species; it is described as being very noisy and is known to shriek (Birdlife International (BLI) 2011, p. 1). It is a large macaw (70 centimeters or 27.5 inches in length) and is vibrant in color. It has dark lime-green feathers mixed with blue flight feathers that are olive-colored underneath. Its forehead is red, and it has a bare white facial area and a black bill. Its lower back is blue; its tail is red and blue. The southernmost population in Bolivia, which extends into Argentina, exhibits reddish brown on their throats and cheeks (Juniper and Parr 1998, p. 423). This species is often confused with the great green macaw (*Ara ambiguus*). The great green macaw is very similar in appearance to the military macaw, but the military macaw has more prominent blue tinge on its hind neck, is smaller, and has darker plumage. These two species are separated geographically.

Habitat and Life History

Military macaws nest in tree cavities and cliffs. Cliff-nesting parrots, such as the military macaw, also nest colonially (in groups) (Bonilla-Ruz et al. 2007a, pp. 730–731). Cliff cavities located in ravines used by this species have been documented 25 and 30 meters (m) (82 to 98 feet (ft)) above ground (Arcos-Torres and Solano-Ugalde 2008, p. 71). Tree cavities used by this

species have been observed to be 18 m (60 ft) above ground and are approximately 75 cm (29.5 inches) deep (Baker 1958, p. 98). This species has also been observed to use secondary cavities, such as abandoned woodpecker holes, particularly in dead pine trees (Strewe and Navarro 2004, p. 50). Military macaws alternate nesting and foraging areas based on food availability (Bonilla-Ruz 2006, p. 1). Nesting appears to be synchronous with the peak fruiting season, which occurs during April and May (Huatatoca pers. comm. in Arcos-Torres and Solano-Ugalde 2008, p. 70). The military macaw is a social species that congregates in small flocks and is often observed in mated pairs. Its clutch size is usually two to three eggs. They begin reproducing between 3 and 4 years of age (Mexican National Commission for Protected Areas [CONANP] 2006 in Bonilla-Ruz 2006, p. 2). Colonial nesting is believed to be due to the lack of suitable dispersed nest sites, which may also explain why they are concentrated in certain sites (Salinas-Melgoza et al. 2009, p. 306).

This species prefers the lower montane wet forests of the Andes. It inhabits remaining fragmented forested area in the Neotropics. However, in the northernmost part of its range, in Mexico, it is associated with seasonally dry, semi-deciduous tropical forest, deciduous tropical forest, and slopes of pine-oak forest (Bonilla-Ruz et al. 2007b, pp. 45–47; Rivera-Ortiz et al. 2006, p. 26).

The military macaw is a seasonal migrant, based on food and nutrient availability. In some areas, it has been observed at clay licks to obtain sodium and possibly other minerals, which is a common activity in some parrot species (Lee 2010, p. 58). Its diet varies seasonally. Some of the plant species it was observed feeding on include (Rivera-Ortiz et al. 2013, p. 1211;

Carillo et al. 2013, p. 46; Huellega 2011, p. 9; Moschione 2007, in Navarro et al., 2008, p. 2; Contreras-González et al. 2006, p. 387; Renton 2004, p. 12; Juniper and Parr 1998, p. 422) :

Brosimum alicastrum (capomo, Maya nut, ramón),

Bunchosia montana (no common name (ncn)),

Bursera aptera (ncn),

Bursera schlechtendalii (ncn),

Carya illinoensis (nuez de castilla),

Cedrela species (cedar fruit),

Ceiba aescutifolia (Pochote),

Ceiba pentandra (ceiba),

Couepia polyandra (zapotillo),

Cyrtocarpa procera (Chupandilla),

Encyclia lancifolia (orchid, ncn),

Ficus species (fig),

Guaiacum coulteri (soap bush),

Hura crepitans (ochoo, arbol del diablo, acacu, monkey's dinner-bell, habillo, ceiba de leche, sand-box tree, possum wood, dynamite tree, ceiba blanca, assacu, posentri),

Hura polyandra (arbol del diablo, habillo, haba, jabillo, tetereta),

Ipomoea arborescens (palo santo, palo blanco, tree morning glory),

Juglans mollis (nogal),

Lonchocarpus rugosus (palo arco),

Lysiloma divaricata (ncn),

Lysiloma microphylla (palo corral),
Mangifera indica (mango),
Melia azedarach (Chinaberry tree),
Neobuxbaumia tetetzo (cardon, higos de teteche, tetetzo),
Orbignea guacoyula (palm),
Pinus ayacahuite (pinabete),
Pinus engelmannii (pino real),
Pinus durangensis (pino alazán),
Plumeria rubra (Frangipani),
Quercus affinis (encinos),
Quercus castanea (encinos),
Quercus crassifolia (encinos),
Spondias mombin (ciruelo),
Tecoma stans (yellow trumpetbush),
Tillandsia grandis (ncn), and
Tillandsia makoyana (ncn).

Seeds were found to be 39 percent of this species' diet. They have also been observed feeding on bromeliad stems (species unknown) and cacti (species unknown). In the northern part of its range in Mexico, military macaws have been observed in desert habitat, although they tend to have lower reproductive success in this habitat type (Rivera-Ortiz et al. 2008, p. 261). In desert habitat, which is suboptimal, it has been observed consuming some flowers (species unidentified). Despite the low seasonal abundance of food, deserts offer some refuge from

poaching due to the inhospitable dry climate, which can act as a deterrent to poachers (Rivera-Ortiz et al. 2008, p. 261). In addition, macaws tend to nest at very high locations, which can make it difficult for poachers to reach them.

Range, Observations, and Population Estimates

The military macaw is distributed in highly fragmented, small populations in Mexico and South America, with a distribution gap in Central America (BLI 2014a, pp. 1–2; Rivera-Ortiz 2013, p. 1,201; Juarez et al 2012, pp. 6–7). Its range extends from northern Mexico southward into Ecuador, Peru, Colombia, Venezuela, Bolivia, and the southern tip of Argentina (see Figure 1 for an approximation of its range and distribution). The species has been described as patchily distributed throughout the eastern foothills of the Andes Mountains (Snyder et al. 2000, p. 125). It occurs in altitudes up to 1,600 m (5,249 ft) (Strewe and Navarro 2004, p. 50; Snyder et al. 2000, pp. 102, 124–125). Although it has a large distribution (276,000 km² (106,564 mi²)), its populations are localized.

Its population is estimated to be 6,667–13,333 mature individuals (BLI 2014, pp. 1–2; Rivera-Ortiz et al. 2013, p. 1,201). Most areas where this species occurs are now estimated to have fewer than 100 individuals. However, in 2004, other populations in Colombia and Mexico were estimated to be 100–200 individuals (Flórez and Sierra 2004, p. 3). This species may have occurred in Guatemala in the past, but it is no longer found there (Gardner 1972 in Snyder et al. 2000, p. 125). Overall, its populations are fragmented and becoming more isolated (Rivera-Ortiz 2008, p. 256).



Figure 1. Distribution of Ara militaris. Courtesy of BirdLife International (2011).

The species inhabits tropical, semi-deciduous forests along the Pacific and Atlantic slopes through Central and South America. The best available information indicates there are reasonably healthy but small populations in El Cielo and Sierra Gorda Biosphere Reserves (Sierra meaning mountain range) in Mexico, Madidi and Amboró National Parks, Pilon Lajas Biosphere Reserve and Apolobamba National Integrated Management Area in Bolivia, and Manu Biosphere Reserve and Bahuaja Sonene National Park in Peru, and a small but stable remnant population in Tehuacan-Cuicatlan Biosphere Reserve, Oaxaca, Mexico (Lowry 2014, p. 3; Hosner et al. 2009, p. 222; Arizmendi 2008, p. 3; Rivera-Ortiz 2008, p. 256). The population

from Tehuacan-Cuicatlan Biosphere Reserve, Oaxaca is about 100 macaws (Bonilla et al. 2007a, p. 731).

Argentina

Argentina is the southernmost part of this species' range, and the species was never thought to have been abundant there (Navarro et al. 2008, p. 1). In fact, this species was initially thought to be extirpated (locally extinct) in Argentina, but surveys have found small populations in at least two locations in the northern province of Salta (Grilli et al 2013, p. 235; Juarez et al 2012, pp. 7–8). There are anecdotal reports of this species crossing the Itaú River (Navarro et al 2008, p. 3), which borders Bolivia and Argentina. Between 2005 and 2007, approximately 100 individuals were observed in the Salta Province. These areas include: Finca Itaguazuti, and the Acambuco Provincial Flora and Fauna Reserve (8,266 hectares [ha] or 20,426 acres [ac]) in the Tartagal Mountains and which borders Bolivia (BLI 2014; Navarro et al. 2008, pp. 1, 4; Coconier et al. 2007, p. 59). In 2008, flocks of between 4 and 40 individuals of this species were observed in three ravines in the Salta Province. These locations were the Agua Fresca (Cool Water) Ravine north of Campo Cauzuti, El Limón Ravine (which had the largest population), and the Caraparí River Ravine. These are believed to be established populations, rather than flocks crossing over from Bolivia (Navarro et al. 2008, pp. 1, 4).

Bolivia

In Bolivia, the military macaw is regularly observed in five national parks: Tambopata National Reserve, Pilón Lajas Biosphere Reserve, Madidi National Park, Apolobamba National Integrated Management Area, and Amboró National Park (Hennessey 2011, pers. comm.). This species exists in the Andean foothills in Bolivia in forested areas extending from the northern Tambopata National Reserve to the southern Pilón Lajas Reserve (Hennessey et al. 2003, pp. 319, 329). These parks are in the general vicinity of the border of southern Peru and northern Bolivia (Hosner et al. 2009, p. 222; Navarro et al. 2008, p. 2; Hennessey et al. 2003, p. 322). They are part of the Greater Madidi-Tambopata Landscape (GMTL) (also known as “Parque Nacional Madidi”). Within the GMTL, there are thought to be reasonably healthy populations of this species in the Apolobamba National Integrated Management Area, Amboró and Madidi National Parks, and Pilón Lajas Biosphere Reserve (Hennessey 2011 pers. comm.; Hosner et al. 2009, p. 225). The Greater Madidi-Tambopata Landscape is 110,074 km² (42,500 mi²) in size, and encompasses one of the largest areas of intact montane forest in the tropical Andes (WCS 2009, p. 2). This area is a high conservation priority due to its large number of endemic bird species. Pilón Lajas consists of primary evergreen tropical lowland forest, foothill forest, and lower montane forest. Pilón Lajas was recognized as a Biosphere Reserve and Indigenous Territory by the Bolivian Government in 1992; however, it did not have any actual protections in place until 1994 (Hennessey et al. 2003, p. 319).

In 2008, this species was observed at Serranía Sadiri in Madidi National Park, La Paz Department, Bolivia (Hosner et al. 2009, p. 225). Serranía Sadiri is found just inside Madidi National Park. Here, flocks of between 2 and 36 individuals have been observed (Hosner et al. 2009, p. 228). The Pilón Lajas Biosphere Reserve is primarily in La Paz Department, but

slightly overlaps into the Beni Department. Here, this species is described as uncommon (Hennessey 2003, p. 329). It was observed in Parapetiguasu-Taremakua, and Parapetiguas-Uruwigua in Santa Cruz, Cordillera Province, and at Altamachi and Madidi in Cochabamba, Ayopaya Province (MacLeod 2009, pp. 42–43). In summary, within Bolivia, there are many small populations of this species in areas that provide suitable habitat for this species (primarily large forest patches under some form of protection).

Colombia

In the late 1990s, there were approximately five disjunct populations in the central Andes Mountains (Snyder et al. 2000, p. 125). In Colombia, groups of 50 individuals have been observed, and in one case, a population was estimated to have 156 individuals (Flórez and Sierra 2004, pp. 2–3). In most cases, these individuals reside on cliff formations that are favorable for nesting (where they are less accessible to poachers), and where deforestation is having less of an impact (Flórez and Sierra 2004, pp. 2–3; Rodríguez and Hernández-Camacho 2002, p. 203). In Colombia, this species inhabits a wide range of altitudes and areas with various degrees of alteration (Flórez and Sierra 2004, pp. 1–3; Juniper and Parr 1998). In Colombia, this species has been observed between altitudes of 700 and 1,600 m (2,297 to 5,249 ft) (Flórez and Sierra 2004, pp. 1–3; Salaman et al. 2002, pp. 167, 187). Populations have been observed in Guajira peninsula, Las Orquideas, Tayrona National Park, Serranía de Perijá, Serranía de San Lucas, San Salvador Valley, Sierra Nevada De Santa Marta, La Guajira Department, and Cueva de los Guacharos National Park (Strewe and Navarro 2003, p. 3). In 1998, this species was observed in flocks of up to 12 individuals at Villa Iguana and Alto Cagadero in Serranía de los Churumbelos

(Salaman et al. 2007, pp. 33, 38, 47, 89). It has been observed in palm stands in the San Salvador valley during the breeding season (December–July) (Strewe and Navarro 2003, p. 33).

There are two small, stable populations of military macaws at Sierra Nevada de Santa Marta and Churumbelos, Cauca, with approximately 50 mature birds at each site (Fundación ProAves 2011, p. 28). In 2004, Flórez and Sierra estimated that the population in the cliffs of the Cauca River was 156 individuals and contained 54 breeding pairs and 26 nests (2004, p. 3). However, this population is subjected to impacts from poaching and deforestation (Flórez and Sierra, 2004, pp. 3–4), so the population now may be smaller. These researchers also noted that many chicks fall from the cliff nests and die. As of 2011, there were no recent records in northern Antioquia (Paramillo), Serranía de San Lucas, or Perijá ranges (Fundación ProAves 2011, pp. 28–29).

In the Frío Valley of Colombia, this species is reported to be present only during the breeding season (Strewe and Navarro 2004, p. 50). Several nests were found here in forest fragments. A population at El Congo Reserve was intensively studied in 2001. One nest was located 12 m (39 ft) above ground in a *Ceiba* tree, within open primary forest on a steep slope at 900 m (2,953 ft). A breeding population of 12 pairs, with groups of up to 28 was observed in December 2000. However, here it is still threatened in the valley by habitat loss and domestic trade (two cases noted in 2001) (Strewe and Navarro 2004, p. 50), and the population may now be decimated.

Ecuador

In Ecuador, this species is considered to be very rare (Arcos-Torres and Solano-Ugalde 2008, p. 71). This species has been observed in the areas of Sumaco and Zamora–Chinchipec in Ecuador (Snyder et al. 2000, p. 125) and at Kichwa River Reserve (Reserva Kichwa Río), within the Gran Sumaco Guacamayos Biosphere Reserve (Arcos-Torres and Solano-Ugalde 2008, p. 72). Most records of military macaw in Ecuador during the 1980s and 1990s found groups of up to 20 individuals (Ridgely and Greenfield 2001); however, lately most records have not exceeded 8 individuals (Arcos-Torres and Solano-Ugalde 2008, p. 71) except for a breeding colony of 16 individuals that was observed in the Reserva Kichwa Río (Arcos-Torres and Solano-Ugalde 2008, pp. 70–72). Prior to 1980, it was observed in the upper Upano River Valley (Ridgely 1980 p. 244). In 2006, 200 ha (494 ac) were turned into the Narupa Reserve, where this species was observed in approximately 2010 (Fundación ProAves et al. 2010, p. 42). Additionally, in 2010, a pair of military macaws was observed in northern Ecuador in the Sumaco region (Olah and Barnes 2010, p. 19).

Mexico

There are several small populations of military macaws in Mexico, each consisting of between approximately 20 and 90 individuals (Jimenez-Arcos et al. 2012, p. 864; Rivera-Ortiz et al. 2008, p. 256), although there has been an anecdotal report of a population estimated to be 130 individuals (Bonilla 2012, p. 6). This species follows seasonal food sources, so flocks move to

other areas seasonally. In Mexico, there are reasonably healthy but small populations in the following areas:

- Alamos Rio Cuchujaqui (Sonora),
- Puerto Vallarta (Jalisco),
- Tehuacan-Cuicatlan Biosphere Reserve (at the border of Puebla and Oaxaca States)
- Mineral de Nuestra Señora Reserve (Sinaloa),
- El Cielo Biosphere Reserve (Tamaulipas),
- Sierra Gorda Biosphere Reserve (Querétaro),
- Sierra Manantlán Biosphere Reserve (Jalisco),
- Vicinity of Copalillo (Guerrero) (Jimenez-Arcos et al. 2012, p. 865).

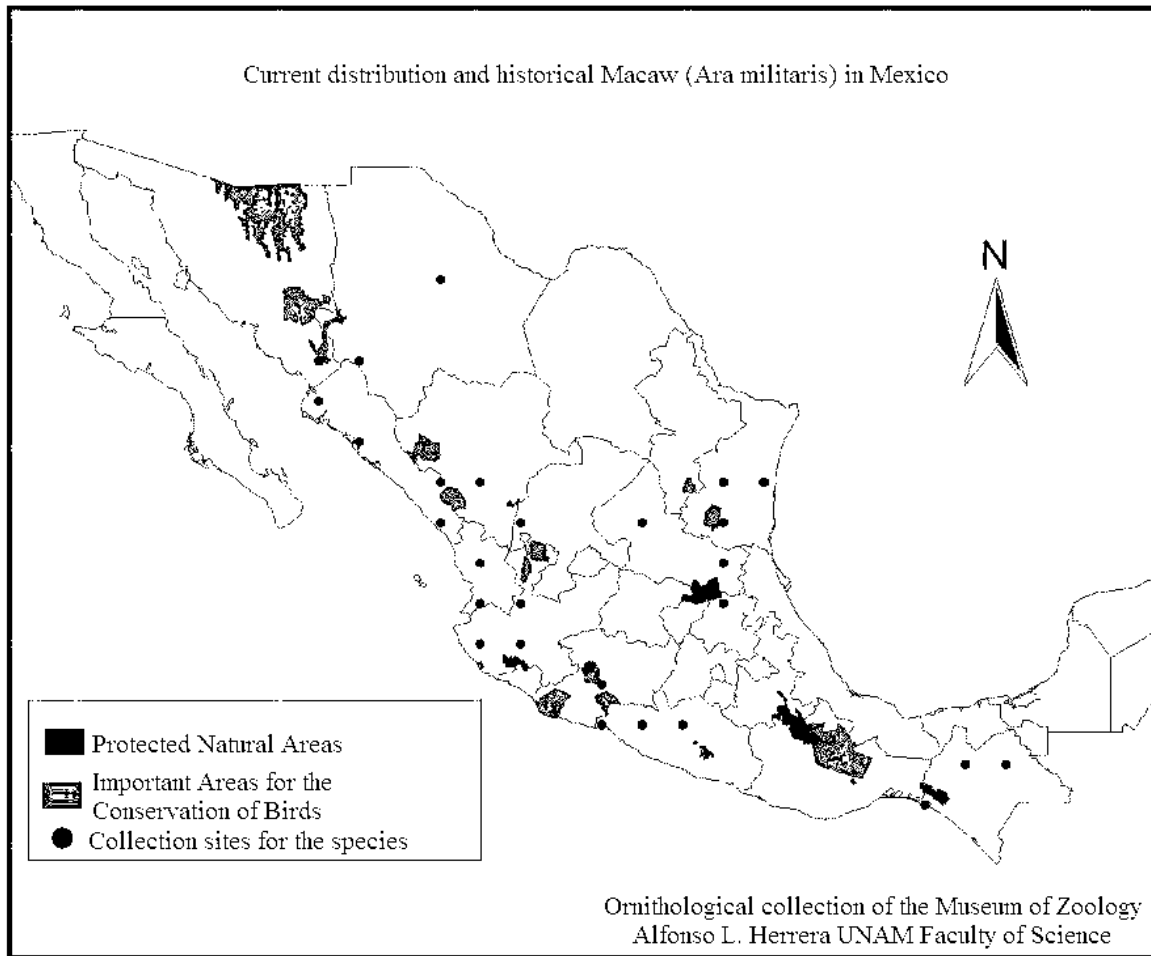


Figure 2. Current and historical distribution of *A. militaris* in Mexico. Courtesy of Arizmendi 2008.

In Mexico, there may also be isolated populations of military macaws in other States. Figure 2 shows the approximate present day and historical distribution of the military macaw in Mexico as of 2008 (Arizmendi 2008, p. 4). Other States where it may exist include Colima, Durango, Michoacán, Morelos, Nayarit (in the Valley of Flags or “Valle de Banderas”), Nuevo León, San Luis Potosí, and Zacatecas. Areas where it has been recently documented are described below.

Chihuahua

Researchers believe there is a remaining population in the Sierra Madre Occidental Mountains (north-central Mexico) in Otachique (Cruz-Nieto et al. 2006, p. 14). In 2005, 25 nests were observed (Cruz-Nieto et al. 2006, p. 14). This canyon is approximately 700 m (0.5 miles) wide by 14 km (8.6 miles) in length and consists of mature pines, firs, and oaks. Some gallery temperate forest remains in this area.

Guerrero

A colony of approximately 20 military macaws was studied between 2006 and 2010 in the vicinity of Copalillo, Guerrero (Jiménez-Arcos et al. 2012, pp. 864–865). The vegetation is tropical deciduous forest; and a canyon is present.

Jalisco

This species is found sporadically in small groups of a few to approximately 100 macaws in the western foothills of Sierra del Cuale and Sierra Cacoma in Jalisco on the western coast of Mexico (Renton 2004, pp. 13–14). Other groups of macaws in the region are in Cabo Corrientes in the Horcones river basin (approximately 100 macaws). There are other small populations in the vicinity of Puerto Vallarta (Carrillo et al. 2013, pp. 45, 47). This species was observed in 2004 near a freshwater lake, Cajón de Peña (26 by 9 km (16 by 5.6 mi) in size), which was constructed in 1976. It is found in the Chamela-Cuixmala Biosphere Reserve (132,000 ha or

32,617 ac), which is managed by Mexico's Instituto de Ecología of the National Autonomous University of Mexico (UNAM) and nongovernmental organizations (NGOs). Patches of semi-deciduous forest in this area form corridors between existing protected areas, such as the Chamela-Cuixmala and the Sierra Manatlán Biosphere Reserves (Renton 2004, p. 14). These patches likely have served as critical ecological links for this species.

Oaxaca

This species has recently been the focus of research in Sabino Canyon, Oaxaca. Sabino Canyon is in the Tehuacan-Cuicatlan Biosphere Reserve (Reserva de la Biosfera Tehuacan Cuicatlan), created in 1998, in central Mexico. The reserve spans 490,187 ha (1,211,278 ac) and is located within the Mixteca Oaxaqueña Province between the cities of Puebla and Orízaba. It is approximately 150 km (93 mi) southeast of Mexico City (<http://www.parkswatch.org>, accessed July 11, 2011) and approximately 2 hours from Tehuacan, Oaxaca, Mexico. Large mountain ranges delineate the boundaries of the reserve, and six rivers are within the protected area's boundaries.

In 2001, this species was observed in two canyons within this reserve. In both ravines, 20 pairs were observed nesting (Salazar-Torres 2001, p. 18). Here, this species nests in the canyon cliff walls in crevices that can be as high as 250 m (820 ft). Between 2002 and 2004, approximately 100 individual military macaws were observed (Bonilla-Ruz et al. 2007a, p. 729). During 2007–2008, at least 67 birds were observed during the month of August (Rivera-Ortiz et al. 2008, p. 256; Rivera-Ortiz et al. 2006, p. 26). The known nesting site locations within the

reserve increased from five to nine during the study period (Rivera-Ortiz et al. 2006, p. 28).

Currently in the Sabino Canyon, the population of military macaws is thought to be between 90 and 100 individuals (Arizmendi 2008, p. 15).

Sinaloa

This species exists in Mineral de Nuestra Señora de la Candelaria Ecological Preserve, 12 km (7.4 mi) southeast of the town of Cosala in Sinaloa, Mexico (Rubio et al. 2007, p. 52; Bonilla-Ruz et al. 2007b, p. 45). The preserve is 1,256 ha (3,104 ac) and consists of dry tropical forest. In 2002, this area was designated as a protected area by the State of Sinaloa Decree.

Sonora

Between 2008 and 2009, it was observed at the Northern Jaguar Reserve in east-central Sonora, and was described as a rare summer resident there (Flesch 2009, pp. 5, 12). In this area, this species was recently observed in small flocks in cliff areas (Flesch 2008, pp. 35–36). In 2005, it was observed in the Río Aros canyon and upper Río Yaqui valley in an area known as the Yaqui Basin (O'Brien et al. 2006, pp. 4, 27–28). Flesch suggests that the species is likely to occur only in cliffs near stands of tropical vegetation (full citation 2008, p. 27).

Tamaulipas

Historically, in Mexico's eastern State of Tamaulipas, flocks of approximately 60

individuals were noted almost daily in the area of Gómez Farías, Mexico (Sutton and Pettingill 1942, p. 14). The Gómez Farías region is on the eastern slope of the Sierra Madre Oriental mountain range, known locally as the “Sierra de Guatemala.” This area is in the general vicinity of the state-protected El Cielo Biosphere Reserve, where this species is still known to occur (Arvin 2001, p. 8). The University of Texas at Brownsville maintains a research station, Rancho del Cielo, within the 145,687-hectare (360,000-acre) reserve. The research station supports locally driven scientific research and community development (University of Texas at Brownsville, unpaginated). Activities conducted by the research station have positive impacts on this species by attracting researchers and the birding community, preserving and protecting habitat, and creating awareness in the area.

Peru

There are populations in Manu Biosphere Reserve, Tambopata National Reserve, and Bahuaia Sonene National Park in Peru. The two latter parks border one another in the southern Peruvian Amazon region (ParksWatch 2002, p. 1). This species has been observed around the Pongo de Mainique of the Urubamba River and on the upper Tambopata River (Snyder et al. 2000, p. 125). According to a 2010 paper, it was observed in the Madre de Dios department in the southeastern Peruvian Amazon (Lee 2010, p. 14). Flocks of 40 to 50 individuals have been observed in Atalya at Madre de Dios (Snyder et al. 2000, p. 125). The species has been observed seasonally in small numbers in the area of the Huállaga River Canyon (JGP Consultants 2011 pp. 1, 5, 8).

Venezuela

Within Venezuela, it has been documented primarily within protected areas. In this country, little information about the species exists (Rodriguez et al. 2004, pp. 375–376). Here it persists in the Andes in the Central Coastal Cordillera and Sierra de Perijá (Rodriguez et al. 2004, pp. 375, 378, 379). It has been found on the north slopes of El Ávila, Guatopo, Henri Pittier National Park, the State of Cojedes, Cerro La Misión, and Sierra de Perijá National Park (Desenne and Strahl 1994 and Fernandez-Badillo et al. 1994 in Snyder et al. 2000, p. 125). A new population of this species was recorded at two localities at the Catatumbo-Barí National Park along the Colombian-Venezuelan border (Avendaño 2011, p. 2). Moist forests exist as four distinct enclaves within the Catatumbo Valley, in both northwestern Venezuela and northeastern Colombia. This extends the species' previously known range from the east slope of the Serranía de Perijá southwards (Avendaño 2011, p. 2).

Summary of Range

According to several surveys, the military macaw exists in small populations ranging from a few pairs to approximately 100 individuals. It is found in protected areas in Mexico, Colombia, Bolivia, and to a lesser extent, in Ecuador, Peru, Venezuela, and Argentina (see Figure 1), and is unlikely to exist in small populations outside of protected areas where large expanses of suitable habitat still remain (Bonilla 2012, p. 9). The population in the Pilon Lajas Biosphere Reserve, Bolivia, may serve as a link to other populations of this species to the northwest and to the south (Hennessey et al. 2003, pp. 330–331). Records indicate that this

species occurs primarily in protected areas (Flesch 2009; MacLeod 2009; Flesch 2008; Flórez and Sierra 2004; Rodriguez 2004; Renton 2004; Hennessey et al. 2003), such as protected parks where there are large remaining areas of suitable habitat for nesting, feeding, and breeding (see Figure 1).

Summary of Population Estimate

There are various but imprecise population estimates for the military macaw. One report estimates the population to be fewer than 10,000 individuals (Arizmendi 2008, p. 3). BLI reports that the population is estimated to be between 10,000 and 19,999 mature individuals with a decreasing trend (BLI 2014, p. 2). We believe that the population is significantly fewer than 10,000 based on recent documented observations of this species, most of which are described in this status review. Researchers in Colombia agree with our conclusion (Botero–Delgadillo and Páez 2011, p. 13). Published literature (referenced in this document) has documented small flocks ranging from approximately 16 to 156 individuals distributed in disjunct locations in Mexico, Argentina, Ecuador, Venezuela, Peru, Colombia, and Bolivia. In situations where the species is rare or has small populations, the number of observations made per survey may be very small and the number of sites limited, and, therefore, estimates may not be accurate (Pollack 2006, p. 891).

The current total population number is unclear; however, based on these recent records, we believe that the population is between a few thousand and 10,000 remaining individuals (BLI 2014, p. 1; Bonilla 2012, p. 9).

Conservation Status

International Union for Conservation of Nature (IUCN)

There are various protections in place for this species at the international, national, and local levels. At the international level, this species is listed as vulnerable by the IUCN (2011). However, this status under IUCN conveys no actual protections to the species.

CITES

The military macaw is protected by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which is one of the most important means of controlling international trade in animal and plant species affected by trade. CITES is an international agreement through which member countries, called Parties, work together to ensure that international trade in CITES-listed animals and plants is not detrimental to the survival of wild populations by regulating their import, export, and reexport. All of the range countries for this species are Parties to CITES (<http://www.cites.org/eng/disc/parties/alphabet.php>, accessed May 7, 2014). Most psittacines (parrots), including the military macaw, were included in CITES Appendix II in 1981. An Appendix-II listing includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival. The military macaw was transferred to Appendix I of CITES in 1987, because populations were declining rapidly due to uncontrolled trapping for the international pet bird

trade. An Appendix-I listing includes species threatened with extinction whose trade is permitted only under exceptional circumstances, which generally precludes commercial trade.

WBCA

The import of the military macaw into the United States is also regulated by the Wild Bird Conservation Act (WBCA) (16 U.S.C. 4901 *et seq.*), which was enacted on October 23, 1992, in an effort to ensure that exotic bird species are not adversely affected by U.S. trade. The purpose of the WBCA is to promote the conservation of CITES-listed exotic birds by ensuring that all imports into the United States are (1) sustainable and (2) not detrimental to the species. Permits may be issued to allow imports of listed birds for scientific research, zoological breeding or display, or as personal pets when certain criteria are met. The Service may approve cooperative breeding programs and subsequently issue import permits under such programs. Wild-caught birds may be imported into the United States if the Service approves a management plan for their sustainable use. At this time, the military macaw is not part of a Service-approved cooperative breeding program and does not have an approved management plan for wild-caught birds.

Argentina

This species is considered to be a critically endangered species by the Government of Argentina (Navarro et al. 2008, p. 1). It is protected through national legislation (Law 22.421 and Decree 691/81), administered by the Dirección Nacional de Fauna y Flora Silvestres. Law 22.421 addresses the Conservation of Fauna, enacted in 1981. Decree 691/81 addresses the

protection and conservation of wild fauna and is implemented through law 22.421.

Bolivia

In Bolivia, this species is listed as vulnerable. The 1975 Law on Wildlife, National Parks, Hunting and Fishing (Decree Law No. 12,301 1975, pp. 1–34) has the fundamental objective of protecting the country's natural resources. This law governs the protection, management, utilization, transportation, and selling of wildlife and their products. It also governs the protection of endangered species, habitat conservation of fauna and flora, and the declaration of national parks, biological reserves, refuges, and wildlife sanctuaries.

Colombia

Colombia categorizes this species as “vulnerable” (Salaman et al. 2009, p. 21). A vulnerable species is considered to be one that is not in imminent danger of extinction in the near future, but it could be if natural population trends continue downward and deterioration of its range continues (EcoLex 2002, p. 10).

Ecuador

In Ecuador, this species is considered endangered, “en peligro de extinción”. Here, this species is considered to be very rare (Arcos-Torres and Solano-Ugalde 2008, p. 69).

Mexico

In Mexico, the military macaw is protected as endangered under Mexico's Wildlife Protection Act (Benetiz-Diaz 2012, p. 2) and has been highlighted as a priority species for conservation in the Mexican Parrot Conservation Plan (Rivera-Ortiz et al. 2008, p. 256; Renton 2004, p. 12). Its official list of endangered and threatened bird species is termed the Norma Oficial Mexicana 059 (NOM-059, 2010) (Benetiz-Diaz 2012, p. 2).

Peru

In Peru, this species is listed as vulnerable and its protections fall under the jurisdiction of the National Institute of Natural Resources (Instituto Nacional de Recursos Naturales, INRENA). Peru's Supreme Decree No. 034-2004-AG (2004, p. 276,855) prohibits hunting, take, transport, and trade of protected species, except as permitted by regulation.

Venezuela

In Venezuela, this species is listed as endangered (Rodriguez et al. 2004, p. 376).

NGO Involvement

In the 1980s, conservationists realized the value of identifying areas or habitat in terms of numbers of endemic bird species. BirdLife International, in partnership with countries, other

nongovernmental organizations (NGOs), and various other partners, developed the Important Bird Area (IBA) program, which is a worldwide initiative to identify and protect critical areas for bird conservation. IBAs are areas that regularly contain significant numbers of one or more globally threatened species or other species of global conservation concern. One of the criteria in identifying important regions for bird conservation is the distribution of restricted-range and globally threatened species such as the military macaw. As of 2007, more than 8,500 IBAs had been identified worldwide (García-Moreno et al. 2007, p. 324). The military macaw is included in 37 of those IBAs (BLI 2011b, pers. comm.). Note that this does not mean this species always occupies those areas; rather, the species has been identified in those areas.

A number of locally based and international conservation organizations have developed programs in connection with protected areas within this species' range, such as ecotourism, to observe clay lick areas (Lee 2010, pp. 167–168). The Wildlife Conservation Society (WCS) is implementing a range of projects aimed at strengthening the management of Greater Madidi-Tambopata Landscape in Bolivia. Its program is based on three main categories: (1) park management, (2) natural resources management, and (3) scientific research (Parks Watch 2005, pp. 2–3). The Greater Madidi-Tambopata Landscape, where the WCS is monitoring populations of the military macaw (WCS 2009, pp. 2, 8), encompasses one of the largest swaths of intact montane forest in the Tropical Andes in northern Bolivia and southern Peru. The GMTL is 110,074 km² (42,500 mi²) and includes five protected areas.

A Colombian-based NGO, Fundación ProAves, is also working to protect this species and its habitats. Fundación ProAves developed a conservation plan for 2010 to 2020 for several

parrot species, including the military macaw (Botero-Delgadillo and Páez 2011, p. 7). However, it is unclear if or when it will be adopted by the Government of Colombia.

In Mexico, several NGOs are participating in the conservation and management of this species. In 1989, a strong citizen movement began to conserve the 383,567-ha (947,815-ac) Sierra Gorda Biosphere Reserve by establishing the local group, Grupo Ecológico Sierra Gorda. In collaboration with the local community, this group has taken action to protect bird communities as well as other groups of wildlife in this area. Strategies include environmental education, establishment of private reserves, and payment for environmental services in a 25,000-ha (61,776-ac) area of this reserve (Pedraza-Ruiz, 2008 p. 1). The Chamela-Cuixmala Biosphere Reserve is managed by Mexico's Instituto de Ecología of the National Autonomous University of Mexico (UNAM) and local NGOs. Other NGOs are working with communities to obtain macaw feathers from aviaries so that indigenous people will not hunt the macaws for their feathers (Renton 2004, p. 14). In the Sinaloa area, the Universidad Autónoma de Sinaloa has been active in conservation of this species since 1998 (Rubio et al. 2007, p. 52). This university conducts research outreach activities to foster knowledge, and conservation of this species at the Mineral de Nuestra Señora de la Candelaria Ecological Preserve.

Evaluation of Threat Factors

Introduction

Section 4 of the ESA (16 U.S.C. 1533) and implementing regulations (50 CFR 424) set forth procedures for adding species to, removing species from, or reclassifying species on the

Federal Lists of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the ESA, a species may be determined to be endangered or threatened based on any of the following five factors:

- A. The present or threatened destruction, modification, or curtailment of its habitat or range;
- B. Overutilization for commercial, recreational, scientific, or educational purposes;
- C. Disease or predation;
- D. The inadequacy of existing regulatory mechanisms; and
- E. Other natural or manmade factors affecting its continued existence.

Throughout the range of this species, the factors impacting this species are generally very similar. The primary factors affecting the military macaw are habitat loss and degradation, and poaching (Carrillo et al. 2013, p. 46; Gastañaga et al. 2011, entire; Strewe and Navarro 2004, p. 50). Habitat loss is primarily due to conversion of the species' habitat (generally forests) to agriculture and other forms that are not optimal for the military macaw (Donald et al. 2010, p. 26; Flórez and Sierra 2004, p. 3). Conversion of habitat to soy plantations is now considered to be one of the principal causes of Amazon deforestation (Bonilha 2008, p. 17). Because this species has a small and fragmented population, poaching, while apparently uncommon, remains a concern (Botero-Delgadillo and Páez 2011, p. 13).

We focus primarily on where this species has been documented, particularly in parks and other areas with protected status and the peripheral zones. In some cases, we will evaluate the factor by country. In other cases, we may evaluate the factor by a broader region if we do not

have adequate information specific to a particular country about this species. This is because often the threats are the same or very similar throughout the species' range.

A. *The present or threatened destruction, modification, or curtailment of its habitat or range*

Habitat

The military macaw has a large but fragmented distribution (276,000 km² (106,564 mi²)), and not all locations where the military macaw exists are known (BLI 2014, p. 1). Habitat destruction and modification is one of the main threats to the military macaw; significant amounts of this species' habitat have been converted such that its habitat is no longer suitable and no longer provides adequate shelter (nesting sites) and food sources, and these causes of habitat loss are likely to continue (Marín-Togo et al. 2012, p. 462). Between 2000 and 2005, of all the continents, South America had the largest net loss of forested area, experiencing a loss of 4.3 million ha (10.6 million ac) per year (FAO 2006 in Mosandl et al. 2008, p. 38). In some countries, extractive activities for nontimber forest products occur, such as the removal of palm trees (*Arecaceae* family) to obtain hearts of palm (ParksWatch 2011; <http://www.tropicalforestresearch.org>).

Currently, the military macaw exists in many parks and other areas that have protected status (Marín-Togo et al. 2012, p. 465; Coconier et al. 2009, p. 63; Arizmendi 2008, p. 4; Rodriguez et al. 2004, p. 78; Renton 2004, p. 12). Studies have found that, compared with the surrounding areas, conditions inside parks were significantly better than their surrounding counterparts (Bruner et al. 2001, p. 125). One study found that, in 40 percent of tropical parks, land that had formerly been under cultivation and that was incorporated into park boundaries had recovered. This subsequently led to an increase in vegetative cover. The study found that 83

percent of parks were successful at mitigating encroachment (Bruner et al. 2001, p. 125). This was confirmed in a study published in 2007 that found that forests in conservation units were four times better at protecting against deforestation than unprotected areas (Oliveira et al. 2007, p. 1,235). However, this species still faces habitat loss (Benetiz 2012, p. 4).

We are limiting our analysis to areas where there is information available about this species. For instance, there is very little information available about this species in Argentina and Venezuela (Coconier et al. 2009, p. 63; Navarro et al. 2008, p. 1; Coconier et al. 2007, p. 52; Rodriguez et al. 2004, pp. 378–379). However, in both of these countries, the species faces similar threats (such as the lack of suitable habitat) as in other countries (Rodriguez et al. 2004, p. 373). The largest populations of this species, discussed in detail in the **Range, Observations, and Population Estimates** section, appear to be in Mexico and Bolivia. Even in these countries, its populations are small and fragmented. In other countries within its range such as Colombia, Peru, and Ecuador, it exists in smaller populations, and Argentina (Nores and Yzurieta 1994, pp. 315–316) and Venezuela have even smaller and possibly negligible populations. Additionally, the military macaw may have occurred in Guatemala in the past, but it is no longer found there (Gardner 1972 in Snyder et al. 2000, p. 125).

Argentina

In Argentina, habitat destruction, particularly deforestation for agricultural expansion for soy plantations, and timber extraction had significantly increased as of 2009 (Devenish 2009, p. 60; Chebez et al. *in litt.* in Navarro et al. 2008, pp. 7, 9; DiPaola et al. 2008, pp. 1, 8). The

species was thought to no longer exist in Argentina, which is the southernmost part of its range, but recent surveys found small populations of this species in at least two locations in the Salta Province (Navarro et al. 2008, p. 1). The primary threat to forested areas in Argentina is the expansion of agriculture, particularly soy, into remaining habitat such as the Chaco plains in the Andes mountain range (Centro de Acción Popular Olga Márquez de Aredez (CAPOMA) 2009, p. 6). The practice of drying swamps through channeling is common in northern Argentina, particularly for producing soybeans, which is experiencing increasing demand in the global market. The current rate of deforestation stands at 25,000 ha (61,776 ac) per year resulting from land converted to agricultural use (Devenish 2009, p. 60). The area converted to soy production increased from as little as 3 percent in the 1970s to 40 percent of the total crop area in 2003, covering 14 million ha (34.6 million ac) (Devenish 2009, p. 60). Conversion of lands to soy production is favored by the current political and economic climate, both at the global and national levels (Devenish 2009, p. 60). With regard to other types of land use, the area used for cattle ranching has decreased, but exotic tree plantations have doubled (Devenish 2009, p. 60).

In addition, pipeline routes and associated roads are being established in this area in connection with oil, gas, and mineral exploration (Navarro et al. 2008, pp. 7, 9). Road building operations greatly facilitate access to large, previously inaccessible forested areas (Fimbel et al. 2001, pp. 511–512). The area occupied by permanent facilities including pipelines and refineries is relatively small, but oil development areas cover large tracts of land. Oil development can have significant negative impacts on nearby habitat through construction of roads and other buildings, discharge of contaminants, and oil spills and leaks (Gay et al. undated, pp. 2–6).

Although some of this species' habitat is protected, its habitat continues to shrink in Argentina. In the area of Acambuco, where the military macaw has been observed, the designation of Acambuco Reserve as a provincial reserve provides some protective measures. The purposes of this reserve, in part, are to preserve its genetic resources, to preserve the environment surrounding catch basins of its rivers, and to guarantee the maintenance of the biodiversity living in the reserve. However, in the Salta Province, this species is primarily found in areas that are unprotected, with the exception of the Acambuco Reserve (Navarro et al. 2008, pp. 1, 7, 9). In summary, significant amounts of this species' habitat have been converted such that its habitat is no longer suitable, and these causes of habitat loss are likely to continue.

Bolivia

Madidi National Park experiences threats that are representative of threats to this species' habitat in Bolivia. The park is one of the key areas where this species likely has a viable population in Bolivia. Thus, we focused our analysis on this park. The National Service of Protected Areas (SERNAP) has authority over Bolivia's parks and protected lands. Approximately 53 percent (57.2 million ha; 141.3 million ac) of Bolivia's total area is forested (FAO 2010, p. 228). Of this area, 38.9 million ha (96.1 million ac) are within the Bolivian Amazon and constitute 5 percent of the total Amazon forest (Locklin and Haack 2003, p. 774). As of 2005, Bolivia had 12 national parks, including 6 with integrated management natural areas, 1 with indigenous territory (or communal lands), and 4 national reserves; 2 biosphere reserves; and 3 integrated management natural areas, totaling 16,834,380 ha (41,598,659 ac) (ParksWatch 2005, p. 2). A discussion of typical threats in Bolivia's parks follows. The region suffers from

chronic and intense poverty levels, which affect more than 90 percent of the population (Instituto Nacional de Estadística de Bolivia (INE) 2005). The result is intense conflict between development and conservation. In Madidi National Park, the three greatest threats to the nature preserve are the construction of a highway within the park, drilling for oil, and a planned hydroelectric dam. Other activities that are impacting or are likely to impact this park are illegal logging, gold mining, and uncontrolled tourism (ParksWatch 2011b, pp. 1–15; Chavez 2010, pp. 1–2).

Deforestation and Logging

The forests of Bolivia have mainly been subjected to selective logging (Salo and Toivonen 2009, p. 610; Fredericksen 2003, p. 10), which has been done at very low levels and with low human pressures (Pacheco 2006, p. 206), allowing them so far to remain largely intact. In the five national parks where the military macaw is regularly observed, there are some protections in place for the species' habitat (Hennessey 2011, pers. comm.). However, logging still occurs within the range of this species (ParksWatch 2011b, p. 1). Large tracts of primary forest remain in Bolivia, but it is likely that some of these will be subjected to logging (Fredericksen 2003, p. 13) due to slash-and-burn activities by indigenous communities, and because forest products are one of Bolivia's primary exports (Byers and Israel 2008, p. vi). The use of slash-and-burn practices on steep and erodible slopes has considerably affected the area's hydrological regime, particularly near the city of Santa Cruz. In many areas of human settlement, soil erosion is compounded by logging, nutrient depletion, and weed invasion.

As of 2006, 89 timber companies held the rights to 5.8 million ha (14.3 million ac) of logging concessions (Pacheco 2006, p. 208). The Bolivian Forestry Law of 1996 (Forestry Law 1700) requires the preparation and approval of management plans and adherence to best management practices (BMPs) (Fredericksen 2003, p. 10). For instance, harvesters must pre-map harvestable trees (which have minimum diameter limits), protect seed trees, and set aside areas that are designated as protected or not harvestable. Management issues still need to be addressed, including sufficient regeneration time for commercial species (Fredericksen 2003, p. 10). However, Bolivia continues to attempt to balance the use of its natural resources with competing priorities. For example, the Pílon Lajas Management Plan divided the reserve into specific zones to combine indigenous community rights with conservation initiatives (Hennessey et al. 2003, p. 320). Despite national laws and regulations, activities such as illegal timber extraction continue to spread unabated (World Bank 2006, p. 8; U.S. Forest Service 2007, p. 2; Pacheco 2006, p. 208).

Roads

There are increasing demands for road infrastructure within Bolivia for many reasons. It is one of the poorest countries in South America (MacLeod 2009, p. 6; INE 2005), and the government would like to improve its economy (ParksWatch 2011b, p. 13). The construction of the Apolo-Ixiamas Road is one way of facilitating access to its natural resources. A road has been proposed that would bisect the Madidi National Park and Natural Integrated Management Area, opening vast, currently inaccessible tropical forest areas to colonization and resource extraction (ParksWatch 2011b, pp. 1–2). This can promote illegal logging, and facilitate access

to previously inaccessible forested areas (Fimbel et al. 2001, pp. 511–512). The construction of roads through this park has been a source of controversy for several years (http://conservation-strategy.org/sites/default/files/field-file/6_Madidi_Road_Complete_Document.PDF, accessed May 6, 2014). The current status of the road and whether it will be constructed around the park or through the park remains unclear. However, regional development plans are often implemented without consideration of impacts on natural resources (WCS 2009, p. 4). Plans to connect Bolivia and Peru to Brazil's expanding markets and expand the energy industry (oil and gas) will affect fragile areas of high biodiversity (WCS 2009, p. 4). Roads constructed in the past have also been problematic. In the late 1990s, roads through Serranía Sadiri spurred an increase in unsustainable logging of the area's mahogany trees, which were the most valuable tree at the time (World Land Trust 2010, p. 1).

Hydroelectric Power

Possibly one of the greatest threats in the Madidi National Park is the proposed Bala Hydroelectric Dam Project at the Beni River in the Bala Gorge, where the Beni River goes through the Bala Mountain Range. The Bala Hydroelectric Dam, as proposed, could flood much of Madidi National Park and the adjacent biosphere reserve and indigenous territory Pilon Lajas, which is an area of about 2,000 km² (4,942 mi²) (Chavez 2010, pp. 1–2; Bolivia Supreme Decree 24191). Construction of dams can have severe impacts on ecosystems (McCartney et al. 2001, p. v). For example, a dam blocks the flow of sediment downstream. During construction of dams, disturbance to soils at the construction site is one of the largest concerns. This leads to downstream erosion and increased sediment buildup in a reservoir. Although the current status

of this dam is unclear, it is clear that the Government of Bolivia is intent on becoming more self-reliant, in part through creating its own sources of energy through hydroelectric dams.

Other Pressures

In Madidi National Park, there is limited legal hunting, but in the areas surveyed, this species was described as common and not exploited (Hosner et al. 2009, p. 226). Nine villages or communities are within the national park, and 22 are in the integrated management natural area. Of the 31 communities, 3 are located in the Andean plateau zone. In the lowlands, two of the communities occupy the zone of valleys around the municipality of Apolo. Timber extraction occurs here (WorldLand Trust 2010, p. 1). In 2010, an additional 25,090 ha (62,000 ac) of pristine tropical rainforest in Bolivia were protected, following a decision by an indigenous community to create a tourism refuge in the Sadiri rainforest (WorldLand Trust 2010, p. 6). Landless Andean farmers make a living in the lowlands, and they at times expand the agricultural frontier, increasing the risk of disease transmission between domestic animals and wildlife, bringing crops and domestic animals closer to wildlife predators, and increasing hunting pressure in surrounding forests (WCS 2009, p. 4).

In summary, threats to the species' habitat in Bolivia include unsustainable land use practices, illegal logging, road building, and exploration activities for oil extraction, which are contributing to the erosion of Bolivia's ecosystems (MacLeod 2009, p. 6; ParksWatch 2005, p. 1). Large tracts of primary forest remain in Bolivia, but it is likely that many of these will be subjected to logging and other pressures, such as extraction of non-timber forest products,

particularly because forest products contribute to Bolivia's national exports (Byers and Israel 2008, p. vi). The Government of Bolivia is attempting to balance improving its economy with conservation initiatives, and some of its development initiatives may negatively impact this species' habitat. Despite protections in place, this species' habitat in Bolivia continues to experience these threats, and we expect these pressures to continue into the future.

Colombia

In the past, human colonization, development, and exploration within the range of the species in Colombia were limited due to the exceptionally steep and high terrain of the Andes (Salaman et al. 2002, p. 160). However, researchers reported in 2004 that the Cauca River Canyon in northeastern Colombia, an area containing military macaws, was extensively deforested (Floréz and Sierra 2004, p. 3). The main threats in the lowlands are the expansion of agriculture, particularly by small farmers in the middle altitude areas, and extractive activities such as hunting (including the removal of birds to sell as pets) and wood harvesting (Salaman et al. 2007, p. 89). As resources become scarcer in the lowlands, these pressures move upland. Associated with these farming practices is the use of livestock and the erosion caused by livestock grazing on steep slopes, as well as erosion due to cultivation.

A 2010 report indicated that forest cover was largely continuous in Colombia, but deforestation had increased dramatically as of 2010 (FAO 2010, pp. 22, 106). Deforestation rates in lowland moist forest on the foothills of the eastern Andes of Colombia are rapidly accelerating. Deforestation has increased from 1.4 percent (1961–1979) to 4.4 percent (1979–

1988), and is correlated with increasing human population density (Salaman et al 2007, p. 89; Viña and Cavelier 1999, p. 31). Primary forest habitats throughout Colombia have undergone extensive deforestation. Viña et al. (2004, pp. 123–124) used satellite imagery to analyze deforestation rates and patterns along the Colombian-Ecuadorian border (in the Departments of Putumayo and Sucumbios, respectively), finding that between 1973 and 1996, a total of 829 km² (320 mi²) of tropical forests within the study area were converted to other uses. This corresponds to a nearly one-third total loss of primary forest habitat, or a nearly 2 percent mean annual rate of deforestation within the study area.

Since the 1970s, the Colombian Government has encouraged road construction and colonization projects. The goal is to create links to the vast and undeveloped Amazonian region, and to open up the Llanos and Amazonian lowlands for utilization of their natural resources (Salaman et al. 2007, pp. 10, 89; Salaman et al. 2002, p. 160). In recent years, this species' habitat has come under increased pressure with the completion of the Mocoa-Bogotá highway, the proposed Puerto Asís-Florencia road, and the discovery and exploitation of petroleum and precious metals. All of these factors contribute to an escalation in human encroachment and associated impacts that degrade this species' habitat (Salaman et al. 2007, p. 10). The few remaining forest connections between the upper and lower slopes are under pressure, even where they are minimally protected.

Five main routes link the lowlands from Colombia's high Andean interior to other areas. Infrastructure development on the eastern slope of the Andes in Colombia, as well as adjacent Ecuador, has also caused significant human population pressures and has led to much habitat

degradation. Increased and improved access roads have led to the conversion of mature tropical forests for pasture lands, petroleum products exploitation, and coca plantations (Salaman et al. 2007, p. 89). These road projects to link Colombia with Venezuela and Ecuador along the entire eastern base of the Andes have contributed to additional deforestation.

Serranía de los Churumbelos National Park

Currently, the Serranía de los Churumbelos forest is almost entirely intact and is owned by the government (Salaman et al. 2007, pp. 10, 91–92). This mountain range has largely avoided the degree of human impact that other regions have suffered. However, this is changing rapidly due to mineral exploration (petroleum and precious metals) and natural resources (timber and rich organic soils for agriculture) demands. The Serranía de los Churumbelos could become the focus of large-scale deforestation and colonization in the near future (Salaman et al. 2007, p. 89). Parque Natural Nacional Cueva de los Guácharos provides some protection to the forests in this region although it is a small park (approximately 5,000 ha or 12,355 ac), and even here, illegal encroachment occurs (Salaman et al. 2007, p. 89).

Catatumbo-Barí National Park

The primary threat in the Catatumbo-Barí National Park (at the Colombian-Venezuelan border) is deforestation and impacts associated with coca plantations surrounding the Park (Fundación ProAves 2011, pp. 28–29). Coca cultivation has fluctuated for several years. Over a 4-year study period, it contained about 100 ha (247 ac) of coca (United Nations Office on Drugs

and Crime, undated report, p. 33). A new population of this species was recently recorded at two locations in this park (Avendaño 2011 in BLI 2014a, p. 2). In addition, one population in the Cauca valley (fewer than 50 mature birds) could be affected by the construction of a dam (155 m (508.5 ft) in height) that could affect its sole breeding cliff. However, the status of the dam is still unclear (American Bird Conservancy 2012, p. 24).

Ecuador

Ecuador experiences one of the highest deforestation rates in South America (Mosandl et al. 2008, p. 37). Forested habitat within many parts of Ecuador has diminished rapidly due to logging, clearing for agriculture, and road development (Youth 2009, pp. 1–3; Mosandl et al. 2008, p. 37; Sierra 1999, p. 136; Dodson and Gentry 1991, pp. 283–293). Between the years 1990 and 2005, Ecuador lost a total of 2.96 million ha (7.31 million ac) of primary forest, which represents a 16.7 percent deforestation rate, and a total loss of 21.5 percent of forested habitat since 1990 (Butler 2006b, pp. 1–3; FAO 2003b, p. 1). Much of the primary moist forest habitat has been replaced with pastures and scattered trees (Collar et al. 1992, p. 533). Very little suitable habitat now remains for the species here, and remaining suitable habitat is highly fragmented (Bass et al. 2010, p. 2; Snyder et al. 2000, p. 122). In the area where this species exists, near the Gran Sumaco Biosphere Reserve, there are several oil reserves (Celi-Sangurima 2005, p. 22). However, specific impacts to this species as a result of oil exploration or extraction activities are unknown.

The colony in Kichwa River Reserve is currently in an area designated as protected,

although it is unclear what these protections entail. In this area, the local community group Macaw Rio is interested in conducting ecotourism. Although this colony has persisted for about 150 years (Huatatoca pers comm. in Arcos-Torres and Solano-Ugalde 2008, p. 72), it likely will be affected by logging and the resulting deforestation on nearby land. Researchers suggest that the apparent lack of this species in Ecuador is possibly related to lack of suitable sites for the formation of breeding colonies, or lack of knowledge about sites that may be located in inaccessible areas (Arcos-Torres and Solano-Ugalde 2008, p. 72). We know of no specific threats to the species in the Kichwa River Reserve, other than those associated with small population sizes, which is discussed under Small Population Size, below.

Mexico

Mexico has suffered extensive deforestation (conversion of forest to other land uses) and forest degradation (reduction in forest biomass through selective cutting, etc.) over the past several decades (Commission for Environmental Cooperation (CEC) 2010, pp. 45, 75). In recent decades, Mexico's deforestation has been rapid (Blaser et al. 2011, pp. 343–344). Between 1990 and 2000, Mexico lost forest (factoring in natural regeneration of degraded forest and planting of forest in areas that previously did not have forest) at a net rate of 344,000 ha (850,043 ac) per year (FAO 2010, p. 21). During 1990–2010, Mexico lost approximately 6 million ha (15 million ac) of forest, and had one of the largest decreases in primary forests worldwide (FAO 2010, pp. 56, 233). Although Mexico's rate of forest loss has slowed in the past decade, it still continues. The current rate of net forest loss in Mexico is 155,000 ha (383,013 ac) per year, with an estimated 250,000–300,000 ha (617,763–741,316 ac) per year degraded (Government of Mexico

(GOM) 2010b, in Blaser et al. 2011, p. 344; FAO 2010, p. 233).

As of 2010, Mexico had 64.8 million ha (160.1 million ac) of forest (Food and Agriculture Organization (FAO) 2010, p. 228), and 50 percent of these forests are considered degraded. Projections of lost forested area by the year 2030 in Mexico are between 10 percent to nearly 60 percent of mature forests lost, and approximately 0 to 54 percent of regrowth forests lost (CEC 2010, pp. 45, 75). Deforestation via forest conversion to agricultural uses remains a major driver of land transformation in Mexico (CEC 2008, p. 24). Agricultural production is projected to double within the country by 2030 (CEC 2010, pp. 34, 70). Although some of this increase in production is expected due to an increase in productivity on previously converted land, total agricultural land area in Mexico is projected to increase by 6,300 to 41,400 ha (15,568 to 102,302 ac) by 2030 (CEC 2010, p. 75).

In the range of the military macaw, such as the tropical forest along the Pacific coast of Mexico, high rates of deforestation have occurred; slash-and-burn agriculture still occurs along with grazing. In 2002, it was estimated that the species had suffered a 23 percent habitat loss within its range in Mexico using a Genetic Algorithm for Rule-set Prediction (GARP) analysis tool (Ríos-Muñoz 2002, pp. 24, 32). GARP analysis essentially uses ecological characteristics of known species locations in order to determine its likely distribution.

A 3-year study documented loss of habitat, particularly trees used by macaws, in the Tehuacan-Cuicatlan Biosphere Reserve, Sabino Canyon. In their study, researchers found a total of 170 individual plants of species consumed by military macaws in the pine forests in an area of

1,500 m² (16,146 ft²) in 2005 (Arizmendi 2008, p. 43). By January 2008, eleven (6.5 percent) of these trees had been logged. In the transitional forest between dry and pine (in an area of 1,000 m² or 10,764 ft²), 134 plants were documented in 2005, and by January 2008, fifteen (11.90 percent) of them had been logged. Arizmendi suggested that these activities are carried out by local communities, and suggested that a local environmental education campaign be implemented. A reduced number of trees limit the availability of adequate food resources across the landscape. With fewer trees remaining, the area cannot support the same number of individuals of the species and, therefore, causes a further reduction in the population. Macaws were not found in deforested areas, even where one of their important food sources, *Hura polyandra*, was left as shade for cattle (Rivera-Ortíz et al. 2008, p. 256). As further support, in Jalisco, most of the sites where macaws were present had little or no habitat loss (note that none of the sites in Jalisco where military macaws were located were in protected areas). No macaws were located in sites with more than 30 percent habitat loss, even though these sites may have had abundant trees.

Mining

At the Mineral de Nuestra Señora reserve in Cósala, where this species occurs, mining activities are occurring (Rubio et al. 2007, p. 52; Bonilla-Ruz et al. 2007b, p. 45). This reserve is 12 km (7.5 mi) southeast of Cósala in Sinaloa, Mexico. This reserve was created after a joint effort in 1999 between the state, municipal government, and the Autonomous University of Sinaloa. The Autonomous University of Sinaloa conducted technical studies to propose the area as a nature reserve. The university also conducted conservation projects here which focused on

the “Ecology and Conservation of the Military Macaw” and “Environmental Education and Ecotourism.” In 2002, the Mineral de Nuestra Señora reserve was formally designated. Since then, parrot populations and their habitat here both within and outside the preserve have been affected by mining activities taking place in the area (Rubio et al. 2007, p. 52). In early 2005, mining efforts began on underground development and drilling (Scorpio Mining 2011, p. 2). The current effect of mining on the species is unclear.

Peru

There is little to no current published information with respect to specific threats to this species in Peru (Gastañaga et al. 2011, entire; JGP Consultants 2011, entire; Lee 2010, entire; Cowen 2009, entire; Terborgh 2004, entire; Brightsmith 2004, entire). It exists in several parks that convey some measures of protection (Oliveira et al. 2007, p. 1,235; Terborgh 2004, p. 35). Peru's protected areas are managed by the General Department of Natural Protected Areas, INRENA, under the authority of Law No. 26834, Law of Natural Protected Areas, promulgated in 1997. The Peruvian national protected area system includes several categories of habitat protection. Habitat may be designated as any of the following:

- (1) Parque Nacional (National Park, an area managed mainly for ecosystem conservation and recreation);
- (2) Santuario (Sanctuary, for the preservation of sites of notable natural or historical importance);
- (3) Reserva Nacional (National Reserve, for sustainable extraction of certain biological resources);

- (4) Bosque de Protección (Protection Forest, to safeguard soils and forests, especially for watershed conservation);
- (5) Zona Reservada (Reserved Zone, for temporary protection while further study is under way to determine their importance);
- (6) Bosque Nacional (National Forest, to be managed for utilization);
- (7) Reserva Comunal (Communal Reserve, for local area use and management, with national oversight); and
- (8) Cotos de Caza (Hunting Reserve, for local use and management, with national oversight) (BLI 2008, p. 1; Rodríguez and Young 2000, p. 330).

Because the designations of national parks, sanctuaries, and protection forests are established by supreme decree that supersedes all other legal claim to the land, these areas tend to provide more habitat protection than other designations. All other protected areas are established by supreme resolution, which is viewed as a less powerful form of protection (Rodríguez and Young 2000, p. 330).

This species has been documented in the Tambopata National Reserve, which is a 275,000-ha (679,540-ac) conservation area created by the Peruvian Government in 1990. The main purpose was to protect the watersheds of the Tambopata and Candamo Rivers. This area protects some of the last pristine lowland and premontane tropical humid forests in the Amazon. Within the Tambopata National Reserve, there have been isolated human settlements along stretches of the Malinowski River, which flows into the Tambopata River. Fewer than 5,000 people inhabit the Tambopata National Reserve's border area to the north. They make a living

of slash-and-burn agriculture, small-scale gold mining, timber extraction, and hunting and fishing. One area of Tambopata, including a buffer zone, was recently described as a “crisis zone” (Lee 2010, p. 169). It has been described as being at high risk for illegal settlement, timber extraction, and mining (Lee 2010, p. 169).

Populations of this species are thought to be in the Manu Biosphere Reserve and the Bahuaja Sonene National Park in Peru (WCS 2007, p. 1; Herzog *in litt.* 2007; Terborgh 2004, pp. 40–41). The problems here are primarily due to human population growth (Terborgh 2004, pp. 40–41). Five indigenous groups reside in the Manu Biosphere Reserve—they are both legal and illegal settlers (Terborgh 2004, pp. 40–41). An ecological research station has been in place since 1973 in Manú National Park (Terborgh 2004, entire), which also adds some protection to the species. Research has shown that often simply having a long-term research presence there can help to reduce poaching (Campbell et al. 2011, p. 2). Unlike parks in the United States, in countries such as Peru, parks and protected areas were formed around the indigenous tribes that live there (Terborgh 2004, p. 51), and the management and purpose of the parks often include protection of the rights of indigenous human communities. This philosophy of park protection and mandates of parks differs from in the United States, where humans are viewed as visitors to the parks, rather than permanent residents (Terborgh 2004, p. 51). In Manu Biosphere Reserve, another potential threat is oil exploration. Both Shell and Mobil Oil have conducted oil exploration activities in this area (Terborgh 2004, p. 55; ParksWatch 2002, pp. 5, 7). Within Bahuaja, as of 2002, there were no human establishments within its boundaries (ParksWatch 2002a, p. 1). However, activities that could affect the military macaw in this area include gold mining, illegal logging, extraction of forest resources, and farming (ParksWatch 2002b, p. 1).

Venezuela

There is little published information about the military macaw in Venezuela (BLI 2014, pp. 1–2; Rodriguez 2004, entire). Here it exists in the Andes in the Central Coastal Cordillera, and Sierra de Perijá (Rodriguez et al. 2004, pp. 375, 378, 379). It has been found on the north slopes of El Ávila, Guatopo, Henri Pittier National Park, Cerro La Mision, and Sierra de Perijá National Park (Desenne and Strahl 1994 in Snyder et al. 2000, p. 125; Fernandez-Badillo et al. 1994 in Snyder et al. 2000 p. 125). Most of its range in Venezuela is within protected areas, but as of 2000, threats still were reported to exist in the protected areas (Snyder et al. 2000, p. 125). In 2000, Snyder et al. noted that Sierra de Perijá was being deforested for narcotics, land speculation, and cattle (p. 125). A population of this species was recorded for the first time at two localities at the Catatumbo–Barí National Park in the Colombian–Venezuelan border, extending the previous species’ range from the east slope of the Serranía de Perijá southwards (Avendaño 2011, p. 2).

Summary of Factor A

Habitat loss, human encroachment, and conversion to agriculture are the main threats acting on the species throughout its range. These threats are exacerbated by an inability by range country governments to adequately manage and monitor the species (see discussion under Factor D, below). South America had the largest net loss of forest area of all continents between 2000 and 2005 (Mosandl et al. 2008, p. 38), with a net loss of 4.3 million ha per year. Although

specific, detailed information about this species' remaining occupied habitat status is not available for each country, we know that much of this species' habitat has been lost through conversion of land to farming, forestry, or other activities (Bonilha and Switkes 2008, p. 17; Etter et al. 2006, p. 369; Renton 2004, p. 13). Conversion of habitat to soy plantations is now considered to be one of the principal causes of Amazon deforestation. Deforestation may already have destroyed as much as 1.2 million ha (3 million ac) in the Amazon. This, combined with pressures of capture for the pet trade, has severely impacted the wild population of military macaws. Studies have shown that, over time, resident bird diversity generally declines as remaining forest becomes smaller and more fragmented (Turner 1996, pp. 202, 206).

As with most parrots, the military macaw requires large areas of suitable habitat, including large trees or other nesting cavities for nesting, feeding, and roosting as well as food sources. Deforestation and logging is a common form of habitat loss that affects this species (Benetiz-Diaz 2012, p. 4; Ríos-Muñoz et al 2009, pp. 502–505). Deforestation via conversion of land to agricultural use is a threat to military macaws because it directly eliminates forest habitat, removing the trees that support the species' nesting, roosting, and dietary requirements. It also results in fragmented habitat that isolates military macaw populations, potentially compromising the genetics of these populations through inbreeding depression and genetic drift (Lande 1995, pp. 787–789; Gilpin and Soulé 1986, p. 27). We do not know the exact extent of deforestation in the range of the military macaw. However, the best available information indicates that deforestation continues to occur and affect the species throughout its range, despite protections that are in place.

Currently the population of military macaws is extremely small (likely a few thousand individuals), those populations are severely fragmented, and its suitable habitat is becoming increasingly more scarce. Therefore, based on the best available scientific and commercial information, we find that the present or threatened destruction, modification, or curtailment of habitat or range is a threat to the military macaw now and in the future.

B. Overutilization for commercial, recreational, scientific, or educational purposes

The trade in wild parrots is common in some areas of South America (Gastañaga et al. 2011, entire; Cantú-Guzmán et al. 2008, entire). In its Red List assessment, the IUCN indicates that the two major threats to the military macaw are habitat loss and capture for the domestic pet trade (IUCN 2011, p. 1). Many reports indicate that poaching for the pet trade is still a problem for parrot species, particularly in poorer countries (Herrera and Hennessey 2007, entire; Dickson 2005, p. 548). For perspective, in the United States, captive-bred specimens of this species were recently found offered for sale for \$699 (Basile 2010, p. 2). In 2006, four military macaws were advertised for sale with an average sale price of \$850 (Cantú-Guzmán et al. 2008, p. 72).

Although the scope of the illegal trade in the military macaw is unknown, poaching can be a lucrative and relatively risk-free source of income (Dickson 2005, p. 548).

A high percentage of birds die during the process of capturing from the wild, transporting, and selling them. Because most of these activities are illegal, it is difficult to accurately determine the actual mortality rate, but estimates vary between 31 and 90 percent (Weston and Memon 2009, p. 79; Cantú-Guzmán et al. 2007, pp. 7, 20, 22, 55, 60). Military

macaws mate for life, are long-lived, and have low reproductive rates. These traits make them particularly sensitive to the impacts of their removal from the wild (Lee 2010, p. 3; Thiollay 2005, p. 1,121; Wright et al. 2001, p. 711). Wild harvest can destroy pair bonds, remove potentially reproductive adults from the breeding pool, and have a significant effect on small populations (Kramer and Drake 2010, p. 11). These activities adversely affect a species' population numbers (Pain et al. 2006, p. 322).

Although poaching continues to occur for the pet trade, it has been found to be significantly lower at protected sites (Pain et al. 2006, pp. 322–328; Wright et al. 2002, p. 719). Other reports have found that national or local protection, particularly when local communities are actively involved in conservation efforts, can successfully reduce nest take (Pain et al. 2006, p. 328; Chassot et al. 2006, pp. 86–87). Gonzalez (2003, pp. 437–446) found evidence of poaching, particularly during nesting seasons, in the Pacaya-Samiria National Reserve, a protected area in the Loreto Department, Peru, during his 1996–1999 study. However, he also found that poaching decreased during the 1998 harvest season (Gonzalez 2003, p. 444), which he attributed to increased numbers of birds confiscated by regional authorities, which may have subsequently discouraged poaching (also see Factor D, below).

A related factor is the destruction of trees in this species' habitat due to poaching. This species primarily depends on tree-cavity nests as its habitat. Not only does nest poaching negatively affect this species by reducing the population size and the number of birds available to reproduce, it also in some cases destroys this species' habitat. Several studies have found that poachers will cut down trees to remove nests. A study conducted in the late 1990s found that in

some cases in Peru, poachers cut down the nesting tree in order to access the nestlings (Gonzalez 2003, p. 443). They also were observed “hacking” open the nest cavities to remove chicks (Bergman 2009, pp. 6–8; Low 2003, pp. 10–11). An average of 21 nests was destroyed per poaching trip (Gonzalez 2003, p. 443). Nest destruction was also reported by Bergman in Ecuador in 2009 (pp. 6–8).

The military macaw was listed in CITES Appendix II, effective June 6, 1981, and was transferred to CITES Appendix I, effective October 22, 1987. Most of the international trade in military macaw specimens consists of live birds. Data obtained from the United Nations Environment Programme—World Conservation Monitoring Center (UNEP–WCMC) CITES Trade Database show that, during the nearly 6 ½ years that the military macaw was listed in Appendix II, a total of 1,034 military macaw specimens were reported to UNEP–WCMC as (gross) exports. Of those 1,034 specimens, 1,019 were live birds and 15 were feathers. In analyzing these data, it appears that several records may be over-counts due to slight differences in the manner in which the importing and exporting countries reported their trade. It is likely that the actual number of military macaw specimens in international trade during this period was 973, including 958 live birds and 15 feathers. Fourteen of the live birds were captive-bred, and the others were reported with the source unknown. Exports from range countries included: 364 live birds from Bolivia; 320 from Mexico; 11 from Ecuador; 4 from Venezuela; and 1 from Argentina.

During the more than 25 years following the transfer to Appendix I (October 22, 1987 through December 31, 2012, , the last year for which complete data were available at the time the

following numbers were compiled, the UNEP–WCMC database shows a total of 1,894 military macaw specimens as (gross) exports, including 1,455 live birds, 224 scientific specimens, 213 feathers, 1 body, and 1 trophy (UNEP–WCMC trade database, accessed May 20, 2014). As noted above, it appears that some records may be over-counts due to differences in the manner in which the importing and exporting countries reported their trade. It is likely that the actual number of live military macaws in international trade during the 25-year period was 1,301. Of those 1,301 birds, 1,022 were captive-bred or captive-born, and 119 were reported as wild. The source of the remaining live birds is unknown. Exports from range countries included: 54 live birds from Mexico; 10 from Argentina; 4 from Venezuela; 2 from Colombia; and 1 from Peru. Annual quantities exported ranged from a low of 14 live birds during 2006, to 122 live birds (including 80 exported from South Africa) in 2009. Since 2004, none of the exports from range countries has been reported as wild origin.

Argentina, Bolivia, Ecuador, and Mexico

In Argentina, Ecuador, and Venezuela, there is little to no information available about overutilization. International trade has diminished, but local trade continues to occur. In Bolivia, a report published in 2009 indicated that of 17,609 birds (including military macaws) documented in the market studied in Department of Santa Cruz (not far from the range of this species), 64 percent of the birds were found to be adults captured in the wild. Ninety percent (24,707) of the birds were found to be from the Department of Santa Cruz. A total of 2,604 individuals were from the Department of Tarija, 176 from the Department of Beni, 20 from Peru, and 12 from Brazil (Herrera and Hennessey 2009, p. 233). The report indicated that most parrots

(some of which were military macaws) were locally sold, and found that 23,306 were in the city of Santa Cruz, and 4,156 were sent to Cochabamba.

In Mexico, the military macaw is reportedly one of the most sought-after species in the illegal pet bird trade (Cantú-Guzmán et al. 2007, p. 38), and poaching remains a concern. In 1995–2005, it was the fifth most seized Mexican psittacine species by Mexico’s Environmental Enforcement Agency, becoming the fourth most seized psittacine species in 2007–2010 (p. 52). As an example, at a sinkhole in El Cielo Biosphere Reserve, a population of approximately 50 birds was decimated by poaching in the 1980s (Aragón-Tapia *in litt.* 1989 in Snyder et al. 2000, p. 125). In many areas, it nests in relatively inaccessible cavities on cliff walls, which provide some protection against the pressures of nest poaching. However, nest poaching is a severe threat in Jalisco and Nayarit, where the species nests in tree cavities (Contreras-González et al. 2007, p. 43; Renton *in litt.* 2007 and Bonilla *in litt.* 2007 in BLI 2011a, pp. 1–2). Between 2005 and 2006 in Mexico, five military macaws were found for sale, and the average price was \$373 (Cantú-Guzmán et al. 2007, p. 76).

Local residents in Argentina indicated that young chicks are removed “for foreigners” but also noted that it is extremely difficult due to the difficulty in accessing the species’ preferred nesting sites and the aggressiveness of the macaws (Navarro et al. 2008, pp. 7, 9). Additionally, in Mexico and Ecuador, indigenous communities have used military macaw feathers for ceremonial and medicinal practices. However, NGOs are working with these communities to obtain macaw feathers from aviaries so that the indigenous people will not hunt the macaws (Renton 2004, p. 14).

Colombia

This species and other *Ara* macaws are occasionally hunted by indigenous people in Colombia. In one study, in the Catatumbo-Barí National Park, hunting was found to be concentrated around the 15 indigenous communities within the 160,000-ha (395,369-ac) park (Avendaño 2011, p. 2). In 2004, in a cliff-nesting location along the Cauca River, Colombia, threats to this species included poaching and loss of foraging trees (Flórez and Sierra 2004, pp. 2–3). They found that, at the Cauca River site, it was common for some people to remove hatchlings from the nests and sell between 20 to 30 chicks per year on the black market (p. 3). To counteract these activities, a local awareness campaign was initiated (Flórez and Sierra 2004, pp. 2–3). As a result of this project, 3,000 *Hura crepitans* trees (a species used by the military macaw) were planted by the local communities, and the awareness campaign appeared to be effective. Researchers do not believe that hunting pressure is a serious short-term threat. However, local education and awareness programs generally need to be ongoing and long-term for them to be effective, and the local communities need to be aware of the benefits of conserving species in the wild as well as having an alternative source of income (i.e., income other than that derived from poaching).

Peru

A recent study in Peru examined nest poaching and illegal trade of parrots, including the reasons for poaching, and the methods, seasons, and locations where the sale and actual poaching of parrots occurred. This study found that this species is still being poached in the wild

(Gastañaga et al 2011, pp. 79–80), even in protected areas and despite national protections in place. During the 2007–2008 study, eight military macaws were found for sale in two out of eight markets surveyed in Peru (p. 79). Seven of these birds were found in the Amazonian lowland city, Pucallpa (p. 80). The study also found that, where protections and enforcement have been implemented such as in Cusco, there were no parrots for sale in markets. This indicates that, although it still continues, poaching is becoming less frequent due to involvement by NGOs, minimal international demand for the species, and enforcement by authorities.

Summary of Factor B

Among birds, parrots are the group most subject to commercial trade (Hutton et al 2000, p. 14). Parrots have suffered a disproportionate number of extinctions, in part due to their desirability as pets. Conservation efforts by the various entities working to ensure long-term conservation of the military macaw may result in its population slowly increasing; however, it is likely that the population is still declining. Even though the military macaw is listed as an Appendix-I species under CITES and laws have been established within the range countries to protect this species, we are still concerned about the illegal capture of this species in the wild. Despite regulatory mechanisms in place and restricted international trade, poaching is lucrative and continues to occur. Additionally, because each population of military macaws is small, with usually fewer than 100 individuals, poaching is likely to have a significant effect on the species. Based on the best available scientific and commercial information, we find that overutilization for commercial, recreational, scientific, or educational purposes is a threat to the military macaw throughout its range.

C. Disease or predation

Disease

Studies of macaws indicate that this species is susceptible to many bacterial, parasitic, and viral diseases, particularly in captive environments (Kistler et al. 2009, p. 2,176; Portaels et al. 1996, p. 319; Bennett et al. 1991). Viral diseases seem to be more prevalent and subsequently more studied in parrots than bacteria and parasites. Psittacines are prone to many viral infections such as retrovirus, pox virus, and paramyxo virus, and captive-held birds seem particularly susceptible (Gaskin 1989, pp. 249, 251, 252). A highly fatal disease, Pacheco's parrot disease, is also caused by a virus (Simpson et al. 1976, p. 218). After infection from this virus, death occurs suddenly without apparent sign of sickness other than some mild nasal discharge and lethargy (Simpson et al. 1976, p. 211). However, as transmission of this disease is mainly through nasal discharge and feces, it is less likely to happen in open habitat in the wild than in a confined aviary, particularly because in the wild this species has been observed to alternate nest sites based on food availability (Chosset et al. 2004, pp. 35–39). Another disease, proventricular dilatation disease (PDD), may be one of the worst diseases known to affect parrots (Kistler et al. 2008, p. 2). PDD has been documented in several continents in more than 50 different parrot species and in free-ranging species in at least five other orders of birds (Kistler et al. 2008, p. 2). It is not clear if some diseases observed in birds in captivity also occur in the wild with the same frequency. However, because the populations of military macaws are small and widely distributed, disease is less of a concern because diseases tend to be more easily transmitted

between individuals within close range, and wild birds disperse and are not constantly in close proximity. Also, captive conditions in aviaries make birds more susceptible to disease where the stress of confinement combined with inadequate diet can reduce the ability of birds to fight disease.

We have no evidence of significant adverse impacts to wild populations of military macaws due to disease. Disease is a normal occurrence within wild populations. There is no indication that disease occurs to an extent that it is a threat. Based on the best available scientific and commercial information, we find that disease is not a threat to the military macaw in any portion of its range now or in the future.

Predation

Eggs and chicks are more susceptible to predation than adult macaws (Arizmendi 2008, p. 44). Chicks and eggs are particularly susceptible to predation by snakes (Arizmendi 2008, p. 44), but military macaws select their nests where they are likely to have a high level of reproductive success. Because military macaws generally construct their nests in high locations such as canyon cliffs, snake predation is less of a concern because snakes need tree canopy or vines to climb in order to gain access to eggs and chicks.

Other predators known to consume this species' eggs include iguanas, red-tailed hawks (*Buteo jamaicensis*), turkey vultures (*Carthartes aura*), and some mammals (Arizmendi 2008, p. 44). In the Sabino canyon, iguanas were observed near the nesting sites. Researchers suggested

that a predator control program here would benefit the macaws (Arizmendi 2008, p. 45). Macaws frequently exhibit alarmed behavior when red-tailed hawks and turkey vultures approach their nests (Arizmendi 2008, p. 44). In Argentina, a flock of parrots was attacked by a pair of peregrine falcons (*Falco peregrinus*), which also nest in ravines (Navarro et al. 2008, p. 6). However, although parrots and falcons can be combative, the peregrine falcon, which normally consumes small mammals and birds, is not thought to be a natural predator of the military macaw (Bradley et al. 1991, p. 193). Due to its large size and careful nest site selection, the military macaw is less susceptible to predation by both land and aerial predators (Floréz and Sierra 2004, pp. 2–3). However, even limited predation is still a concern in part because removal of potentially reproductive adults from the breeding pool can have a significant effect on small populations by destroying macaw mating pair bonds (Kramer and Drake 2010, p. 11). Additionally, studies on similar species in similar Andean habitats indicate that vulnerability to predation by generalist predators increases with increased habitat fragmentation and smaller patch sizes (Arango-Vélez and Kattan 1997, p. 140). Because each population of military macaws is small, with usually fewer than 100 individuals, and because this species mates for life, even low levels of predation are likely to have a significant effect on the species.

Summary of Factor C

Diseases associated with military macaws in the wild are not well documented. Although there is evidence that diseases occur in parrots in the wild, we found no information that diseases affect this species to the degree that they are negatively impacting this species in the wild. Because the populations are distributed across such a large area, these populations have

resiliency against impacts from disease if one population is affected by a disease outbreak. Conversely, although disease in the wild is not a concern, predation does remain a concern; there is evidence that predation on this species occurs often enough that it can have a significant impact. Because of the species' small and declining population size, tendency to mate for life, low reproductive capacity, and existence in isolated habitat fragments, even minimal predation renders the species more vulnerable to local extirpations. Therefore, we find that predation, compounded by ongoing habitat loss and poaching, is a threat to the military macaw.

D. The inadequacy of existing regulatory mechanisms

Regulatory mechanisms to protect a species could potentially fall under categories such as regulation of trade, wildlife management, parks management, or forestry management. Regulatory mechanisms could be at the local, national, or international levels.

International Wildlife Trade (CITES)

A specimen of a CITES-listed species may be imported into or exported (or reexported) from a country only if the appropriate permit or certificate has been obtained prior to the international trade and it is presented for clearance at the port of entry or exit. The Conference of the Parties (CoP), which is the decisionmaking body of the Convention and comprises all its member countries, has agreed on a set of biological and trade criteria to help determine whether a species should be included in Appendix I or II. The military macaw is listed in Appendix I. For Appendix-I species, both an export permit (or reexport certificate) must be issued by the

country of export and an import permit from the country of import must be obtained prior to international trade. An export permit for species listed in either Appendix I or II may only be issued if the country of export determines that:

- The export will not be detrimental to the survival of the species in the wild (CITES Article III(2) and Article IV(2));
- The specimen was legally obtained according to the animal and plant protection laws in the country of export;
- For live animals or plants, they are prepared and shipped for export to minimize any risk of injury, damage to health, or cruel treatment; and
- For Appendix I species, an import permit has been granted by the importing country.

Except in certain cases, such as specific scenarios for approved captive-breeding programs, the import of an Appendix-I species requires the issuance of both an import and export permit. Import permits are issued only after the importing country determines that it will not be used for primarily commercial purposes (CITES Article III(3)) and that the proposed recipient of live animals or plants is suitably equipped to house and care for them. Thus, with few exceptions, Appendix-I species cannot be traded for commercial purposes.

The CITES Treaty requires Parties (member countries) to have adequate legislation in place for its implementation. Under CITES Resolution Conference 8.4 (Rev. CoP15) and related decisions of the CoP, the National Legislation Project evaluates whether Parties have adequate domestic legislation to successfully implement the Treaty (CITES 2011a). In reviewing a country's national legislation, the CITES Secretariat evaluates factors such as:

- Whether a Party's domestic laws prohibit trade contrary to the requirements of the Convention,
- Whether a Party has penalty provisions in place for illegal trade, and if they have designated the responsible Scientific and Management Authorities, and
- Whether a Party's legislation provides for seizure of specimens that are illegally traded or possessed.

The CITES Secretariat has determined that the legislation of Argentina, Colombia, Mexico, and Peru is in Category 1, meaning they meet all the requirements to implement CITES. Bolivia, Ecuador, and Venezuela were determined to be in Category 2, with a draft plan, but not enacted (<http://www.cites.org>, SC62 Document 23, pp. 7–8). This means the Secretariat determined that the legislation of Bolivia, Ecuador, and Venezuela meet some, but not all, of the requirements for implementing CITES. Based on the decrease in reported international trade, CITES and the range countries for this species have effectively controlled legal international trade of this species. Therefore, we find CITES is an effective mechanism for preventing overexploitation for international trade in this species.

Parks and Habitat Management

We are focusing our evaluation of the potential threats to this species primarily to parks for the following reasons. Most suitable habitat, primary forest, only remains in these protected areas. The best available information suggests that this species is now mostly found in protected areas such as parks, in part because this is where suitable habitat remains for the species.

Additionally, the majority of the information available regarding the potential threats to the species pertains to the parks, where the species is usually found. Our rationale is supported by Cowen, who noted that encounter rates for large macaw species were generally higher in primary forests (2008, p. 15), which tend to be located in areas with protected status. Throughout this species' range, we found that many of the threats that occur to this species are the same or similar. Threats generally consist of various forms of habitat loss or degradation. Each range country for this species has protections in place, but for reasons such as limited budgets and limited enforcement capabilities, the laws and protections are generally not able to adequately protect the species.

Research has found that tropical parks have been surprisingly effective at protecting ecosystems and species within boundaries designated as parks or other protected status despite underfunding and pressures for resources (Oliveira et al. 2007, p. 1,235; Bruner et al. 2001, p. 126; Terborgh 1999, entire). Bruner's study found that protected areas are especially effective in preventing land clearing. It found that, in 40 percent of parks, land that had formerly been under cultivation and that was incorporated into park boundaries had actually recovered. This subsequently led to an increase in vegetative cover. The study also found that 83 percent of parks were successful at mitigating encroachment (Bruner et al. 2001, p. 125). It concluded that the conditions inside the parks were significantly better than in their surrounding areas (Bruner et al. 2001, p. 125). Oliveira et al. found that forests in conservation units were four times better at protecting against deforestation than unprotected areas (2007, p. 1,235). However, despite these protections, this species has experienced threats such that their populations are now so small (generally fewer than 100 in each population) that any pressure now has a more significant

effect. Parks, without management, are often insufficient to adequately protect the species. Our analysis of regulatory mechanisms is discussed essentially on a country-by-country basis, beginning with Argentina, and is summarized at the end. Conditions in specific parks are discussed below.

Argentina

In 2007, Argentina enacted a law mandating minimum standards for the environmental protection of native forests (Ley de Bosques). However, the federal government has not fully enforced the law, and provincial governments are not in full compliance with it (DiPaola *et al.* 2008, p. 2). Argentina lacks adequate protections of its natural environments; there is a lack of environmental awareness and commitment from the government to adequately protect its resources (FAO 2007, pp. 43–44, 59–60). Provinces usually allow landowners to decide whether to maintain forest cover or deforest the land. The absence of a serious land use planning strategy, particularly during the past 20 years, has led to significant habitat degradation (FAO 2007, p. 60). The threat to native forests has remained particularly high in the Salta Province. As a result, a coalition of indigenous communities and nongovernmental organizations filed for injunctive relief in Argentina's highest court to attempt to combat deforestation (DiPaola *et al.* 2008, p. 2). In this case, the court mandated deforestation activities to be halted pending the completion of a cumulative environmental impact study. The decision forced the Salta Province to comply with the deforestation moratorium imposed by the Forestry Law, and pressured the Province to comply with the other key provision of the law by completing an environmental land use plan (DiPaola *et al.* 2008, p. 2). Although the Forestry Law is in place and the court case has

set a precedent for compliance with this law, the area where this species occurs in Argentina to the best of our knowledge remains largely unprotected (Navarro et al. 2008, pp. 7, 9).

Bolivia

This species primarily inhabits the parks and protected areas in Bolivia's Andean region (Herzog 2011, pers. comm.). National parks are intended to be strictly protected; however, some areas where the species occurs are also designated as areas of integrated management, which are managed for both biological conservation and the sustainable development of the local communities. Bolivia attempts to balance natural resource uses; however, it is one of the poorest countries in South America (MacLeod 2009, p. 6; CIA World Factbook, accessed December 6, 2011), and subsequently has competing priorities. As of 2005, Bolivia had 5 national parks, 6 national park and integrated management natural areas, 1 national park and indigenous territory (or communal lands), 4 national reserves, 2 biosphere reserves, and 3 integrated management natural areas (ParksWatch 2005, p. 1). These make up Bolivia's National System of Protected Areas ((SNAP) Servicio Nacional de Areas Protegidas). Below are the designations and their relevant categorizations of protections (eLAW 2003, p. 3).

- (1) Park, for strict and permanent protection of representative ecosystems and provincial habitats, as well as plant and animal resources, along with the geographical, scenic and natural landscapes that contain them;
- (2) Sanctuary, for the strict and permanent protection of sites that house endemic plants and animals that are threatened or in danger of extinction;

- (3) Natural Monument, to preserve areas such as those with distinctive natural landscapes or geologic formations, and to conserve the biological diversity contained therein;
- (4) Wildlife Reserve, for protection, management, sustainable use, and monitoring of wildlife;
- (5) Natural Area of Integrated Management, where conservation of biological diversity is balanced with sustainable development of the local population; and
- (6) “Immobilized” Natural Reserve, a temporary (5-year) designation for an area that requires further research before any official designations can be made and during which time no natural resource concessions can be made within the area (Supreme Decree No. 24,781 1997, p. 3).

The foundation of Bolivia’s laws is largely based on Bolivia’s 1975 Law on Wildlife, National Parks, Hunting, and Fishing (Decree Law No. 12,301 1975, pp. 1–34), which has the fundamental objective of protecting the country’s natural resources. This law governs the protection, management, utilization, transportation, and selling of wildlife and their products; the protection of endangered species; habitat conservation of fauna and flora; and the declaration of national parks, biological reserves, refuges, and wildlife sanctuaries, regarding the preservation, promotion, and rational use of these resources (Decree Law No. 12,301 1975, pp. 1–34; eLAW 2003, p. 2). Later, Bolivia passed an overarching environmental law in 1992 (Law No. 1,333 1992), with the intent of protecting and conserving the environment and natural resources. Studies have shown that protected areas have been successful in providing protection from poaching, logging, and other forest damage, especially when compared to unprotected areas (Lee 2010, p. 3; Killeen et al. 2007, p. 603; Oliveira et al. 2007, p. 1,234; Asner 2005, p. 480; Ribeiro

et al. 2005, p. 2; Gilardi and Munn 1998, p. 641). However, pressures on the parks' resources are increasing; these are described below.

Within the Greater Madidi-Tambopata Landscape, activities that could negatively affect this species occur, and there are competing priorities within these protected areas. The GMTL is divided into three contiguous areas, with two different management categories: a strictly protected National Park in two sections that total 1,271,000 ha (3,140,709 ac), and a natural integrated management area with 624,250 ha (1,542,555 ac), where conservation and sustainable development of the local communities is the main purpose (Conservation Strategy Fund (CSF) 2006, p. 29). The most significant activities that are having a negative impact or could in the future in this area are the construction of a highway within Madidi, mining for natural resources such as gold, drilling for oil, and a planned hydroelectric dam (ParksWatch 2011b, p. 8; <http://www.amazonfund.eu/art-oil-madidi.html>, accessed September 13, 2011; Chavez 2010, pp. 1–2). There is limited legal hunting of this species occurring here, but in the areas surveyed, this species was described as common and not exploited (Hosner et al. 2009, p. 226). Timber extraction still occurs in some areas (WorldLand Trust 2010, p. 1). In the rainforest and foothill forest of Serranía Sadiri within Madidi, roads in the late 1990s spurred a rise in the unsustainable logging of the area's mahogany trees, which were the most valuable tree at the time (World Land Trust 2010, pp. 1–2). Within the Apolobamba protected area, uncontrolled clearing, extensive agriculture, grazing, and “irresponsible” tourism are ongoing (Auza and Hennessey 2005, p. 81). Habitat degradation and destruction from grazing, forest fires, and timber extraction are ongoing in other protected areas, such as Tunari National Park (Department of Cochabamba), where suitable habitat exists for this species (De la Vie 2004, p. 7).

Bolivia's national policy is to decentralize decisionmaking, and responsibility for land planning and natural resource management is increasingly shifting to local and regional governments (Wildlife Conservation Society (WCS) 2009, pp. 2–5). However, the decentralization process is occurring without sufficient personnel, staff training, and operational funds. There is little information as to the actual protections that Bolivia's laws and protected areas confer to military macaws, despite the laws in place at the national level for its wildlife. Threats to the species and its habitat include unsustainable land use practices, illegal logging, mining, road building, oil extraction, illegal animal trade, and hunting, which are all still occurring within this species' habitat (MacLeod 2009, p. 6; WCS 2009, pp. 2–5). The mechanisms in place are inadequate at reducing the threat of habitat destruction and human disturbance within these protected areas.

Colombia

The Colombian Government has enacted and ratified numerous domestic and international laws, decrees, and resolutions for managing and conserving wildlife and flora. Colombia currently has 54 areas that have protected status (El Sistema Nacional de Areas Protegidas (SINAP); National Natural Parks of Colombia 2011). Of those, 33 have been declared Important Bird Areas (IBAs). The protected area designations are as follows: national parks (parques nacionales), flora and fauna sanctuaries (santuarios de fauna y flora), flora sanctuaries (santuarios de flora), nature reserves (reserva natural), and unique natural areas (área natural única) (Law 165 of 1994). Small populations of this species occur in several reserves

and protected areas in Colombia (Strewe and Navarro 2003, p. 32). These protected areas in Colombia offer various degrees of protection to the species.

In 2003, conservation priorities were identified for its bird species, a conservation corridor was designed, and a habitat conservation strategy within the San Salvador valley was developed (Strewe and Navarro 2003, p. 29). The private Buena Vista Nature Reserve was established and protects approximately 400 ha (988 ac) of tropical wet lowland forest and wet premontane forest on the northern slope of the Sierra Nevada. It encompasses extensive primary forests along an altitudinal gradient of 600 to 2,300 m (1,968 to 7,545 ft) and forest patches and secondary forest at elevations between 450 to 600 m (1,476 to 1,968 ft). The reserve is adjacent to the Sierra Nevada de Santa Marta National Park and the Kogi-Malayo Indian reserve (Strewe and Navarro 2003, p. 29).

A conservation project focusing on the coffee zone of the middle Río Frío is ongoing, and its goal is to create a conservation corridor connecting natural habitats and shade-grown coffee plantations (Strewe and Navarro 2004, p. 51). The establishment of the private nature reserve, Buena Vista, was the first step to conserve the foothill forest ecosystems. This was done in close cooperation with a local organization, Grupo Ecologico Defensores de la Naturaleza—Campesinos de Palomino (Strewe and Navarro 2003, pp. 34–35). The Pro-Sierra Nevada de Santa Marta Foundation (FPSNSM) maintains a permanent monitoring station at Buena Vista nature reserve. FPSNSM is working toward sustainable development projects in cooperation with local communities, national park units, and coffee-grower committees in the region. This includes educational campaigns to limit hunting. Habitat management takes place on private

lands in the lowlands and foothills of the San Salvador valley to reduce the pressure on the remaining natural forest habitats, including a reforestation program using native tree species. Additionally, forest reserves have been established as part of a network of private nature reserves in the valley (Strewe and Navarro 2003, pp. 35–36).

Resource management in Colombia is highly decentralized. Colombian environmental management has been divided between the national and regional levels since the 1950s. Governmental institutions responsible for oversight appear to be under resourced (ITTO 2006, p. 222) and unable to adequately manage species such as the military macaw. Resources are managed within local municipalities by one of 33 “Autonomous Regional Corporations” known as CARs (Corporaciones Autónomas Regionales) (Blackman et al. 2006, p. 32). CARs are described as corporate bodies of a public nature, endowed with administrative and financial autonomy to manage the environment and renewable natural resources, implemented through Law 99 of 1993 (p. 32). Each department (analogous to U.S. state designations) within Colombia is managed by a separate local entity. These corporations grant concessions, permits, and authorizations for forest harvesting (ITTO 2006, p. 219).

As of 2005, 40 percent of Colombia’s public resources were managed by local municipalities, making Colombia one of the most decentralized countries in terms of forestry management in Latin America (Blackman et al. 2006, p. 36). Monitoring of resource use and forest development authorized by these corporations is conducted mostly by local nongovernmental organizations. The International Tropical Timber Organization (ITTO) considers the Colombian forestry sector to be lacking in law enforcement and on-the-ground

control of forest resources, with no specific standards for large-scale forestry production, no forestry concession policies, and a lack of transparency in the application of the various laws regulating wildlife and their habitats (ITTO 2006, p. 222). Consequently, there is currently no effective vehicle for overall coordination of species management for multijurisdictional species such as the military macaw. Fundación ProAves developed a conservation plan for 2010 to 2020 for several parrot species, including the military macaw (Botero-Delgadillo and Páez 2011, p. 7). However, it is unclear if or when it will be adopted by the Government of Colombia.

Additionally, despite protections, forest loss continues almost unabated in the mountains of the Sierra Nevada, demonstrating that formal protections and regulatory mechanisms are inadequate. In this area, El Congo Reserve currently may be the only secure nesting site for the military macaw, but it is too small (40 ha; 99 ac) to conserve viable populations.

Efforts are occurring in Colombia to protect and monitor its species, although they do not appear to be adequate to combat the threats to this species. One management tool that Colombia has recently developed is a bird-watching strategy in these protected areas to monitor and report on bird species such as the military macaw, in conjunction with ecotourism (National Natural Parks of Colombia 2011). Despite the efforts in place, there is a lack of information available about the status of this species and its habitat in Colombia. There is no clear information about the status of the species in Colombia, particularly its population trend. We are unable to determine that this conservation strategy will sufficiently mitigate threats to the military macaw, nor are we able to find that the regulatory mechanisms in place in Colombia are adequate. The species population is small in Colombia, and threats to its habitat still exist.

Ecuador

In Ecuador, the military macaw is considered to be very rare (Arcos-Torres and Solano-Ugalde 2008, p. 72). It has been observed in the areas of Sumaco and Zamora-Chinchipec (Youth 2009, p. 1; Snyder et al. 2000, p. 125) and recently at Kichwa River Reserve (Reserva Kichwa Río), within the Gran Sumaco Biosphere Reserve Guacamayos (Arcos-Torres and Solano-Ugalde 2008, p. 72). This species is categorized as endangered “en peligro de extinción” (Arcos-Torres and Solano-Ugalde 2008, p. 69) in Ecuador. It is protected by Decree No. 3,516 of 2003 (Unified Text of the Secondary Legislation of the Ministry of Environment) (EcoLex 2003b, pp. 1–2 and 36). This decree summarizes the laws governing environmental policy in Ecuador and provides that the country's biodiversity be protected and used primarily in a sustainable manner.

Habitat destruction is ongoing and extensive in Ecuador (Mosandl et al. 2008, p. 37; Butler 2006b, pp. 1–3; FAO 2003b, p. 1). Unsustainable forest harvest practices likely continue to impact the military macaw's habitat. In 2004, Ecuador Law No. 17 (Faolex 2004, pp. 1–29) amended the Forest Act of 1981 (Law No. 74) to include five criteria for sustainable forest management: (i) Sustainable timber production; (ii) the maintenance of forest cover; (iii) the conservation of biodiversity; (iv) co-responsibility in management; and (v) the reduction of negative social and environmental impacts (ITTO 2006, p. 225; Aguilar and Vlosky 2005, pp. 9–10). In 2001, the Ecuadorian Government worked with the private sector to develop a system of monitoring and control of forest harvest practices. However, in 2003, the Supreme Court of Ecuador declared the control system unconstitutional, and new control systems were being

developed (ITTO 2006, p. 225). Approximately 70 percent of the forest products harvested are harvested illegally, or are used as fuel wood, or are discarded as waste (ITTO 2006, p. 226; Aguilar and Vlosky 2005, p. 4). Because the extractive harvesting industry is not monitored, the extent of the impact is unknown; however, the best available information indicates that habitat degradation negatively affects this species in Ecuador.

The Ecuadorian Government recognizes 31 different legal categories of protected lands (e.g., national parks, biological reserves, geo-botanical reserves, bird reserves, wildlife reserves, etc.). The colony in Kichwa River Reserve Macaw receives some legal protections by being in a Reserve. However, a study published in 2002 concluded that, although 14 percent of Ecuador is categorized as national reserve network (Sierra et al. 2002, p. 107), the system does not provide adequate protection for its ecosystems. As of 2006, the amount of protected land (both forested and nonforested) in Ecuador totals approximately 4.67 million ha (11.5 million ac) (ITTO 2006, p. 228). However, only 38 percent of these lands have appropriate conservation measures in place to be considered protected areas according to international standards (i.e., areas that are managed for scientific study or wilderness protection, for ecosystem protection and recreation, for conservation of specific natural features, or for conservation through management intervention) (IUCN 1994, pp. 17–20). The ITTO, as of 2006, considered ecosystem management and conservation in Ecuador, including effective implementation of mechanisms that would protect the military macaw and its habitat, to be lacking (ITTO 2006, p. 229).

Although this colony has persisted for about 150 years (Huatatoca, pers. comm. in Arcos-Torres and Solano-Ugalde 2008, p. 72), it may be affected by logging and the resulting

deforestation on nearby land (Arcos-Torres and Solano-Ugalde 2008, p. 72). The best available information indicates that on-the-ground enforcement of Ecuador's laws, oversight of the local jurisdictions, and implementing and regulating activities are ineffective in conserving the military macaw and its habitat in Ecuador. Researchers suggest that the apparent lack of this species in Ecuador is related to lack of existing suitable sites (large areas containing appropriate feeding, nesting, and breeding habitat) for the formation of breeding colonies. The governmental institutions responsible for natural resource oversight in Ecuador appear to be under-resourced, and to our knowledge, there is a lack of law enforcement on the ground. Despite the creation of a national forest plan, the best available information indicates there is a lack of capacity to implement this plan due to inconsistencies in application of regulations, and discrepancies between actual harvesting practices and forestry regulations. These inadequacies have facilitated logging, clearing for agriculture, subsistence farming, and road development. Habitat conversion and alteration are ongoing within Ecuador, including within protected areas.

Mexico

This species is listed as endangered and is regulated under the general terms of the General Law of Ecological Balance and Environmental Protection (Ley General del Equilibrio Ecológico y Protección al Ambiente (LGEEPA)), the General Wildlife Law (Ley General de Vida Silvestre (LGVS)), and also under CITES (CEC 2003, unpaginated). NOM-059-ECOL-2010 establishes a list of wildlife species classified as either in danger of extinction (endangered), threatened, under special protection, or probably extinct in the wild (Government of Mexico 2002, p. 6). All use of endangered and threatened species requires a special permit

from the Secretariat of the Environment and Natural Resources (Secretaría del Medio Ambiente y Recursos Naturales (SEMARNAT). SEMARNAT's main goal is to protect, restore, and conserve its ecosystems and natural resources. Under Mexico's General Wildlife Law, the use of these protected species, including the military macaw, may be authorized only when priority is given to the collection and capture for restoration, repopulation, and reintroduction activities (Comisión Nacional Para El Conocimiento y Uso de la Biodiversidad 2009, unpaginated; CEC 2003, unpaginated).

International trade of Mexico's wildlife is also managed by SEMARNAT. In 2008, Mexico passed Article 60_2 to amend its General Wildlife Law. The article bans the capture, export, import, and reexport of any species of the Psittacidae (parrot) family whose natural distribution is within Mexico (Cantú and Sánchez 2011, p. 1). It allows authorizations for the removal of individuals from the wild to be issued only for conservation purposes, or to accredited academic institutions for scientific research. However, it does not appear to be adequate based on investigations of trade of Mexico's native parrot species.

The military macaw falls under the jurisdiction of several other laws in Mexico. The General Law on Sustainable Forest Management (Ley General de Desarrollo Forestal Sustentable (LGDFS 2003)) governs forest ecosystems in Mexico, including military macaw habitat. This law formalizes the incorporation of the forest sector in a broader environmental framework. Under this law, harvesting of forests requires authorization from SEMARNAT. It also requires that harvesting forests is based on a technical study and a forest management plan (GOM 2010, p. 24). A number of additional laws complement the 2003 law in regulating forest use. The

LGEEPA regulates activities for protecting biodiversity and reducing the impact on forests and tropical areas of certain forest activities; the LGVS governs the use of plants and wildlife found in the forests; the General Law on Sustainable Rural Development (Ley General de Desarrollo Rural Sustentable) provides guidance for activities aimed at protecting and restoring forests within the framework of rural development programs; and the Agrarian Law (Ley Agraria) governs farmers' ability to use forest resources on their land (Anta 2004, in USAID 2011, unpaginated).

Another law regulating portions of the military macaw's habitat is the National System of Protected Natural Areas (Sistema Nacional de Áreas Naturales Protegidas (SINANP)). These protected natural areas are created by presidential decree, and the activities in them are regulated under the LGEEPA, which requires that the protected natural areas receive special protection for conservation, restoration, and development activities (Comisión Nacional de Áreas Naturales Protegidas (CONANP) 2011, unpaginated). These natural areas are categorized as: Biosphere Reserves, National Parks, Natural Monuments, Areas of Natural Resource Protection, Areas of Protection of Flora and Fauna, and Sanctuaries (CONANP 2011, unpaginated).

Conservation strategies in Mexico rely heavily on natural protected areas, and biosphere reserves comprise most of the designated protected area in the country (Figueroa and Sanchez 2008, pp. 3324, 3234). The military macaw occurs in or near at least four biosphere reserves. Although some areas where this species occurs have protected status, Figueroa and Sanchez (2008, entire) found that, for example, the Sierra Gorda Biosphere Reserve was ineffective (as opposed to effective or weakly effective). This study specifically evaluated the effectiveness of

Mexico's protected areas for preventing land use and land cover change. It assessed the effectiveness of national protected areas (NPAs) by quantifying (1) the rate of change and (2) the total extent of change, between 1993 and 2002, as well as (3) the percentage, in 2002, of areas transformed by human use; transformed areas included agriculture, cultivated and induced pastures, human settlements, and forestry plantations. The rate of change of transformed areas inside each NPA was also compared with that estimated for an equivalent area surrounding the NPA. They selected 69 federal decreed NPAs (out of 160 NPAs decreed in Mexico) that were 1,000 ha (2,471 ac) or larger, which is the minimum area for conserving ecosystems in Mexico (Figuroa and Sanchez 2008, p. 3,225; Ordóñez and Flórez-Villela 1995, p. 11). The study found that, overall, only approximately 54 percent of protected areas, including 65 percent of biosphere reserves, were effective.

Peru

In Peru, this species is listed as vulnerable under Supreme Decree No. 034–2004–AG (2004, p. 276,855), and its protections fall under the jurisdiction of the National Institute of Natural Resources (Instituto Nacional de Recursos Naturales, INRENA). This Decree prohibits hunting, take, transport, and trade of protected species, except as permitted by regulation. The military macaw is thought to occur in at least three areas with protected status in Peru. The Peruvian national protected area system includes several categories of habitat protection (refer to Factor A). National reserves, national forests, communal reserves, and hunting reserves are managed for the sustainable use of resources (IUCN 1994, p. 2). The designations of national parks, sanctuaries, and protection forests are established by supreme decree that supersedes all

other legal claim to the land and, thus, these areas tend to provide some form of habitat protection (Rodríguez and Young 2000, p. 330). However, limited information is available with respect to the status of this species in Peru. We do not know if the occurrence of the military macaw within protected areas in Peru actually protects the species or mitigates threats to the species, and to what extent these protections are effective.

Venezuela

In Venezuela, the military macaw is thought to exist in two parks: El Ávila National Park and Henri Pittier National Park. Limited information about the status of this species is available in Venezuela. Henri Pittier National Park (107,800 ha; 266,380 ac) was declared the first national park in Venezuela in 1937. This park is the largest national park of the Cordillera de la Costa (Coastal Mountain Range) region. The principal threats to this park include: fire, human encroachment, solid waste buildup, pollution, hunting, and limited resources for effective park management (ParksWatch 2011g, unpaginated). In many cases, the intensity of threats has increased. Prior to 1994, a team of government representatives, NGOs, universities, and aviculturists in Venezuela had developed both an action plan for the conservation of parrots and a book containing information on parrot biology (Morales et al. 1994, in Snyder 2000, p. 125). However, currently, it is unclear what conservation initiatives are occurring.

El Ávila National Park (81,800 ha; 202,132 ac in size), is located along the central stretch of the Cordillera de la Costa Mountains in northern Venezuela. The most immediate threats to the park are forest fires and illegal settlements, which occur primarily near Caracas (ParksWatch

2011f, unpaginated). ParksWatch notes that the areas closest to the city have experienced more problems in the more isolated northern slope and eastern sector of El Ávila. Other threats in this park include the presence of nonnative plants and poaching.

Summary of Factor D

In Argentina, Ecuador, Peru, and Venezuela, we recognize that conservation activities are occurring, and that these activities may have a positive effect on the species at the local population level. Parrots, in general, are long-lived with low reproductive rates, traits that make them particularly sensitive to poaching and other threats such as habitat loss (Lee 2010, p. 3; Thiollay 2005, p. 1,121; Wright et al. 2001, p. 711). The primary threats to this species historically have been the loss of habitat and capture for the pet trade (Strewe and Navarro 2003, p. 33). Since regulatory mechanisms such as CITES and the WBCA have been put into place, particularly since 1992, much of the legal international trade in the military macaw has declined (see Factor B discussion, above). However, those pressures prior to the military macaw's listing under CITES and the WBCA contributed significantly to the decline in population numbers for this species. Since then, the species' habitat has become fragmented, its range has reduced, and its populations have more difficulty finding suitable habitat.

Each of these countries has enacted laws to protect its wildlife and habitat. The populations of this species in these four countries are likely to number from fewer than 100 to a few hundred individuals. There are numerous threats acting on this species; its populations have severely declined. In some cases, the actual causes of decline may not be readily apparent and a

species may be affected by more than one threat in combination. Habitat conservation measures within these range countries do not appear to sufficiently mitigate future habitat losses. Habitat loss and degradation continue to occur within these countries; the best available information does not indicate that the existing regulatory mechanisms have mitigated these threats in the range of this species. Because these populations of this species are very small in these countries, any impact is likely to have a significant impact on the species; therefore, we are unable to conclude that regulatory mechanisms in place for this species and its habitat are adequate.

Bolivia, Colombia, and Mexico have enacted various laws and regulatory mechanisms for the protection and management of this species and its habitat. Although information available is limited, the best evidence suggests that the military macaw exists in small populations in several large protected areas within these countries. As discussed under Factor A, the military macaw prefers primary forests and woodlands and complex habitat that offers a variety of food sources. Its suitable habitat has been severely constricted due to deforestation. In these three countries, there is evidence of threats to this species due to activities such as habitat destruction and degradation, poaching, construction of roads, and mining, as well as decreased viability due to small population sizes, despite the regulatory mechanisms in place. We acknowledge that research and conservation programs are occurring in these countries. However, based on the best available information, we find that the existing regulatory mechanisms for these countries are either inadequate or inadequately enforced in order to protect the species or to mitigate ongoing habitat loss and degradation, poaching, and the severe population decline of this species. Habitat conservation measures within these range countries do not appear to sufficiently mitigate future habitat losses.

Based on the best available information, we are unable to conclude that the existing regulatory mechanisms currently in place sufficiently mitigate threats to the military macaw throughout its range. Therefore, we find that the existing regulatory mechanisms are inadequate to mitigate the current threats to the continued existence of the military macaw throughout its range now and into the future.

E. Other natural or manmade factors affecting its continued existence

Small Population Size

Small, declining populations can be especially vulnerable to environmental disturbances such as habitat loss (O’Grady 2004, pp. 513–514). Removal of a few birds from a population of 100 can have a greater effect than removal of a few birds from larger populations. In order for a population to sustain itself, there must be enough reproducing individuals and habitat to ensure its survival. Conservation biology defines this as the “minimum viable population” requirement (Grumbine 1990, pp. 127–128). This requirement may be between 500 and 5,000 individuals depending on variability, demographic constraints, and evolutionary history. The military macaw occurs in relatively small populations (ranging from a few pairs to approximately 100 individuals, with the total population size that is likely no greater than a few thousand). The military macaw relies on specific habitat to provide for its breeding, feeding, and nesting. Historically, the military macaw existed in much higher numbers in more continuous, connected habitat. Its suitable habitat is becoming increasingly limited, and is not likely to expand in the

future.

The combined effects of habitat fragmentation and other factors on a species' population can have profound effects and can potentially reduce a species' respective effective population by orders of magnitude (Gilpin and Soulé 1986, p. 31). For example, an increase in habitat fragmentation can separate populations to the point where individuals can no longer disperse and breed among habitat patches, causing a shift in the demographic characteristics of a population and a reduction in genetic fitness (Gilpin and Soulé 1986, p. 31). This is especially applicable for a species such as the military macaw that was once wide-ranging. It has lost a significant amount of its historical range due to habitat loss and degradation. Furthermore, as a species' status continues to decline, often as a result of deterministic forces such as habitat loss or overutilization, it will become increasingly vulnerable to other impacts. If this trend continues, its ultimate extinction due to one or more stochastic (random or unpredictable) events becomes more likely. The military macaw's current occupied and suitable range is highly reduced and severely fragmented. The species' small population size, its reproductive and life-history traits, and its highly restricted and severely fragmented range increase this species' vulnerability to other threats.

Climate Change

Consideration of ongoing and projected climate change is a component of our analysis under the ESA. The term "climate change" refers to a change in the mean, variability, or seasonality of climate variables over time periods of decades or hundreds of years

(Intergovernmental Panel on Climate Change (IPCC) 2007, p. 78). Forecasts of the rate and consequences of future climate change are based on the results of extensive modeling efforts conducted by scientists around the world (Solman 2011, p. 20; Laurance and Useche 2009, p. 1,432; Nuñez et al. 2008, p. 1; Margeno 2008, p. 1; Meehl et al. 2007, p. 753). Climate change models, like all other scientific models, produce projections that have some uncertainty because of the assumptions used, the data available, and the specific model features. The science supporting climate model projections as well as models assessing their impacts on species and habitats will continue to be refined as more information becomes available. While projections from regional climate model simulations are informative, various methods to downscale projections to more localized areas in which the species lives are still imperfect and under development (Solman 2011, p. 20; Nuñez et al. 2008, p. 1; Marengo 2008, p. 1). The best available information does not indicate that climate change is impacting this species such that it is a threat.

Summary of Factor E

A species may be affected by more than one threat acting in combination. Impacts typically operate synergistically, particularly when populations of a species are decreasing. Initial effects of one threat factor can later exacerbate the effects of other threat factors (Gilpin and Soulé 1986, pp. 25–26). Further fragmentation of populations can decrease the fitness and reproductive potential of the species, which will exacerbate other threats. Within the preceding review of the five factors, we have identified multiple threats that may have interrelated impacts on this species. The most significant threats are habitat loss and poaching, particularly because

the species has such a small and fragmented population, and it requires a large range and variety of food sources. Lack of a sufficient number of individuals in a local area or a decline in their individual or collective fitness may cause a decline in the population size, despite the presence of suitable habitat patches. For example, the species' behavior of not nesting in areas where depredation or disturbance is likely may mean that a nest site is "abandoned" before nesting is even attempted. Thus, the species' productivity may be reduced because of any of these threats, either singularly or in combination. These threats occur at a sufficient scale so that they are affecting the status of the species now and will in the future.

In addition, the species' current range is highly restricted and severely fragmented. The species' small population size, its reproductive and life-history traits, and its highly restricted and severely fragmented range increase the species' vulnerability to adverse natural events and manmade activities that destroy individuals and their habitat. The susceptibility to extirpation of limited-range species can occur for a variety of reasons, such as when a species' remaining population is already too small or its distribution too fragmented such that it may no longer be demographically or genetically viable (Harris and Pimm 2004, pp. 1,612–1,613). Therefore, we find that the species' small population size, in combination with other threats identified above, is a threat to the continued existence of the military macaw throughout its range now and in the future.

Finding and Status Determination for the Military Macaw

We find that this species is endangered based on the above evaluation, and we are listing this species as endangered due to the threats described above that continue to act on this species. Within the preceding review of the five factors, we identified multiple threats that may have interrelated impacts on the species. For example, the productivity of military macaws may be reduced because of the effects of poaching and habitat loss, which are expected to continue to act on the species in the future. In cases where populations are very small, species mate for life, and birds produce small clutch sizes, these effects are exacerbated. The susceptibility to extirpation of species with small and declining populations can occur for a variety of reasons, such as when a species' remaining population is already too small or its distribution too fragmented such that it may no longer be demographically or genetically viable (Harris and Pimm 2004, pp. 1,612–1,613). This species exists generally in very small and fragmented populations, usually in areas with some form of protected status in Mexico, Bolivia, Peru, and Colombia, and to a limited extent Ecuador, Venezuela, and Argentina. Its life-history traits (such as mating for life and small clutch size) make it particularly susceptible to extinction because its populations are so small. Based on our review of the best available scientific and commercial information pertaining to the five factors, we found that many of these threats are similar throughout the species' range.

In four of the countries (Argentina, Ecuador, Peru, and Venezuela), the populations are extremely small, and very little information about the status of the species is available in many parts of its range. It is not necessarily easy to determine (nor is it necessarily determinable) which potential threat is the operational threat. However, we believe that these threats, either individually or in combination, are likely to occur at a sufficient geographical scale to

significantly affect the status of the species. Additionally, although we do not have precise genetic information about populations throughout this species' range, it is likely that there is some genetic transfer between populations. We believe this based on its demonstrated ability to fly long distances in search of food sources (Chosset and Arias 2010, p. 5). The most significant threat, habitat loss and degradation, is prevalent throughout this species' range. Its suitable habitat has severely contracted, and habitat loss is likely to continue into the future. We do not find that the factors affecting the species are likely to be sufficiently ameliorated in the foreseeable future. Therefore, we find that listing the military macaw is warranted throughout its range, and we propose to list the military macaw as endangered under the ESA.

Great Green Macaw

Taxonomy

The great green macaw (*Ara ambiguus* or *ambigua*, Linnaeus, 1766; Bechstein, 1811) is in the parrot (Psittacidae) family. It is known by various common names such as lapa verde, Buffon's macaw, Guacamayo verde mayor, Guara verde, and Papagayo de Guayaquil. It occurs as two subspecies. The nominate subspecies, *Ara a. ambiguus*, occurs from Honduras to north-west Colombia. The subspecies *A. a. guayaquilensis* occurs in western Ecuador (Rodriguez-Mahecha et al. 2002, p. 116; Fjeldsa et al. 1987, pp. 28–31). There are believed to be only around 100 individuals of *A. a. guayaquilensis* in two areas in Ecuador. This subspecies has a smaller bill with greener underside of the flight and tail feathers than the nominate subspecies (Juniper and Parr 1998, p. 423). Avibase and ITIS both recognize these subspecies

(<http://www.itis.gov> and <http://avibase.bsc-eoc.org/avibase.jsp>, accessed May 5, 2014).

There is no universally accepted definition of what constitutes a subspecies, and the use of the term subspecies varies among taxonomic groups (Haig and D'Elia 2010, p. 29). To be operationally useful, subspecies must be discernible from one another (i.e., diagnosable) and not merely exhibit mean differences (Patten and Unitt 2002, pp. 28, 34). This element of discernibility is a common thread that runs through all subspecies concepts. Regarding the great green macaw, all populations or subspecies of *Ara ambigua* essentially face similar threats, all are generally in the same region (Central and northern South America), and all have small populations. In other words, they are not discernible between populations. For the purpose of this proposed rule and based on the best available information, we recognize all populations of great green macaws as a single species.

Description

This species ranges between 77 and 90 cm (30 and 35 inches) in length and has a red frontal band above a large black bill, bare facial features with black lines, blue flight feathers on the superior feathers and olive inferior feathers, blue lower back, and orange tail (Juniper and Parr 1998, pp. 423–424). It is the second largest New World macaw. This species is not sexually dimorphic, meaning there are no differences in appearance between males and females of the same species. The great green macaw is very similar in appearance to the military macaw, but the military macaw has more prominent blue coloring on its hind neck, has darker plumage, and is smaller. These two species are also separated geographically.

Range, Observations, and Population Estimates

The great green macaw is patchily distributed in a 100,000-km² (38,610-mi²) area (BLI 2014b, p. 2). In addition to occupying humid tropical forests primarily in Central America (Costa Rica, Honduras, Nicaragua, and Panama), there are small remnant populations in western Ecuador, as well as northern Colombia (Berg et al. 2007, p. 1; Chassot et al. 2006, p. 7). Although there may be some interaction between populations, the great green macaw is fragmented into seven isolated populations throughout its distribution due to habitat loss (Monge et al. 2009, pp. 159, 174).

Deforestation has reduced this species' habitat and concentrated its population into primarily five areas: the border of Honduras and Nicaragua, the border of Nicaragua and Costa Rica, the Darién region of Panama and Colombia, and two very small populations in Ecuador (Hardman 2011, p. 8; Monge et al. 2009, p. 159).

Population estimates were made in the 1990s and early 2000s. In 1993, the population estimate was 5,000 individuals; in 2000, the population was estimated to be between 2,500 and 10,000 birds (BirdLife International 2014b, p. 4; Rodríguez-Mahecha 2002a). The global population is now likely less than 2,500 mature individuals (or less than 3,700 with juveniles included) (Monge et al. 2009, pp. 213, 256); however, the actual population is far from clear. Although historical observations are useful for assessing the range of the species, they may also be biased because surveys may not have sampled randomly. Thus, historical population

estimates of this species may not be accurate. Although the population in Costa Rica is increasing, the population continues to be very small (Monge et al. 2010, p. 16), and researchers believe that the global population of this species is decreasing (Botero-Delgadillo and Páez 2011, p. 91). Specific information about the range and population estimate for each country is discussed below.



Figure 3. Distribution of Ara ambigua. BirdLife International 2011.

Colombia

Historically in Colombia, it was found in the north of the Serranía de Baudó, the West

Andes, and east of the upper Sinú valley (Snyder et al. 2000, pp. 121–123). In the late 1990s, this species was observed in Los Katíos National Park, around Utría National Park in Serranía de Baudó (Salaman *in litt.* 1997), and the Chocó area of western Colombia (Angehr *in litt.* 1996 in Snyder et al. 2000, pp. 121–123; Ridgley 1982). This species' potential geographical range is 51,777 km² (19,991 mi²), which includes two core areas in Sierra Nevada de Santa Marta and in the center of Antioquia Department of Columbia (Salaman et al. 2009, p. 21; Monge et al. 2009, unpaginated; Quevado-Gill et al. 2006, p. 15). The total Colombian population is currently unclear but it is now believed to primarily exist in Los Katíos National Park, which borders the Darién region in Panama. It was also recently observed in the area of Sabanalarga, Antioquia (Quevado-Gill et al. 2006, p. 15). Even though the largest population is thought to be in the northern Darién border region with about 1,700 adults, researchers believe this is an estimate without a strong basis (Botero-Delgadillo and Páez 2011, p. 91). The populations in Colombia are highly localized, and this number could be an overestimate (Botero-Delgadillo and Páez 2011, p. 91).

Costa Rica

The great green macaw historically inhabited forests along the Caribbean lowlands of Costa Rica (Chosset et al. 2004, p. 32). The population has increased in that area since 1994, when there was an estimate of 210 birds. The population appears to have fluctuated; in 2004, it was estimated that a maximum of 35 pairs were breeding in northern Costa Rica (Chosset et al. 2004, p. 32). A survey conducted in 2009 reported a population estimate of 302 in Costa Rica (Monge et al. 2009, p. 12); another estimate was that there was a total of 275 birds in Costa Rica

in 2010 (Chassot 2010 pers. comm. in Hardman 2011, p. 11).

Approximately 67,000 ha (165,561 ac) of great green macaw breeding territory now remains in Costa Rica (Chun 2008, p. v), which is less than 10 percent of its original suitable habitat (Monge et al. 2010, p. 15; Chosset et al. 2004, p. 38). Potential great green macaw breeding habitat, excluding Ecuador, is defined by the density of almendro trees, which this species uses for its primary feeding and nesting substrate. Almendro trees are found only on the Atlantic coast from southern Nicaragua down through Costa Rica and Panama and into Colombia, primarily at altitudes below 900 m (2,953 ft). Based on the assumption that great green macaw breeding pairs require 550 ha (1,359 ac) of non-overlapping habitat, Chun postulated that northern Costa Rica could support about 120 breeding pairs (2008, p. 110). Chun notes that even the forested areas identified as individual “patches” through a geographic information system (GIS) program do not necessarily represent areas of forest with continuous canopy cover (indicating complex, fairly undisturbed habitat that is likely to contain nutritional needs for this species). Although these patches of forest are technically connected at some level, they are for the most part highly porous and discontinuous, and no analysis was performed to filter out stands that might be porous or discontinuous. There are some areas in its potential range that are above the elevation threshold for almendro trees, and do not meet the criteria for suitable habitat.

Ecuador

In Ecuador, there may only be one viable population. This population exists in the Cerro

Blanco Protected Forest, which is 6,070 ha (15,000 ac) outside of Guayaquil in Guayas Province (Villate et al. 2008, p. 19). This population is believed to be approximately 10 individuals. An overall estimate of 60 to 90 individuals in Ecuador in 2011 may be optimistic (Horstman pers comm. in Hardman 2011, p. 12). Ecuador's population in 2002 was estimated to be between 60 and 90 individuals (Monge et al. 2009, p. 256), but the population was reported to be rapidly decreasing. In addition, this is a decline from 1995, when the population was estimated to be approximately 100 birds in Esmeraldas Province alone (Waugh 1995, p. 10). Between 1995 and 1998, some individuals were observed in the Playa de Oro area along the Santiago River (Jahn 2001, pp. 41–43). In 2005, the species was described as being found in scattered forest remnants in coastal Ecuador from Guayas to Esmeraldas Province (Horstman 2005, p. 3).

In addition to the small population in the Cerro Blanco Protected Forest, recently reported to be about 10 individuals, there may be another small group in the Rio Canande Reserve, which is a humid tropical forest and is located in the Esmeraldas province in coastal northern Ecuador (Horstman pers comm. in Hardman 2011, p. 12). Rio Canande Reserve (1,813 ha or 4,478 ac) is one of eight reserves managed by another NGO, the Jocotoco Foundation. The most recent population census in Ecuador was conducted in the provinces of Esmeraldas, Santa Elena, and Guayas. Five individuals were recently observed in the Bosque Protector Chongón Colonche; one macaw was observed at the Hacienda El Molino, near the Cerro Blanco Protected Forest; and two macaws were seen at Rio Canande (Horstman 2011, p. 16). The Cordillera (mountain range) de Chongón-Colonche is on the central pacific coast of Ecuador, located in the provinces of Guayas and Manabi. Some individual great green macaws have also been observed at Hacienda Gonzalez 40 km (25 mi) northwest of Guayaquil; however, these individuals may be

part of the same population found in Cerro Blanco. In summary, the majority of individuals are believed to be in Esmeraldas Province, and very small numbers remain in the Chongón-Colonche mountain range, Guayas.

Honduras

In 1983, the great green macaw was common in lowland rain forests in the Moskitia (Mosquitia) area and eastern Olancho (Marcus 1983, p. 623). The region known as the Moskitia includes both eastern Honduras and northern Nicaragua. Historically, the species was reported to occur in the areas of Juticalpa and Catacamas in Olancho (Marcus 1983, p. 623). The species was observed daily in the Plátano River area in flocks of more than 10 individuals and almost daily in the Patuca River area, usually in pairs (Barborak 1997 in Snyder et al. 2000, pp. 121–123). In August 1992, macaws were recorded on the Patuca River at Pimienta upstream from Wampusirpe (Wiendenfeld in Monge et al. 2009, p. 242). Currently, this species exists in the Rio Plátano Biosphere Reserve (800,000 ha or 1,976,843 ac), which has been described as one of the most important reserves in Central America (Anderson et al. 2004, p. 447).

Nicaragua

In Nicaragua, the great green macaw is found primarily in lowland, tropical, and rain forest, as well as pine barrens, primarily in the Bosawas Reserve in the north and around the Indio-Maíz and San Juan rivers in the south (Stocks et al. 2007, p. 1503; Martínez-Sánchez 2007; Chassot 2004, p. 36). The name Bosawas is derived from three significant geographic landmarks

that delineate the reserve's core zone limits: the Bocay River, Mount Saslaya, and the Waspuk River. The Bosawas protected area contains habitat that is vital to the species. In the buffer zone of the Indio-Maíz Biological Reserve, great green macaw nesting locations have been identified. The Indio-Maíz Biological Reserve is located in Nicaragua just across the San Juan River at the northern border of Costa Rica, and is nearly 264,000 ha (652,358 ac) in size. The Nicaragua and Costa Rica macaw populations intermix; macaws have been observed crossing the San Juan River, which separates Nicaragua and Costa Rica. As of 2006, in the Quezada, Bijagua, Samaria, and La Juana communities, five macaw nests had been located during surveying. As of 2010, 35 active nests had been documented in the Indio-Maíz Biological Reserve (Monge et al. 2010, p. 16).

In 1999, Powell et al. estimated that the Nicaraguan great green macaw population could be 10 times the size of the population in Costa Rica. In 2008, a population viability analysis was conducted that indicated the size of the great green macaw population in Nicaragua was 661 individuals (Monge et al. 2010, p. 21). In 2009, a population census was conducted, during which 432 macaws were observed. The researchers suggest that the "average population" in Nicaragua is 532 (Monge et al. 2010, p. 13). This 2009 study yielded an estimated population of 834 individuals in Costa Rica and Nicaragua combined (Monge et al. 2010, p. 21).

Panama

In Panama, the great green macaw is believed to inhabit the following areas: Bocas del Toro, La Amistad, northern Veraguas, Colon, San Blas, Darién, and Veraguas South (Monge et

al. 2009, unpaginated). The species has been described as locally fairly common near Cana, Alturas de Nique, in 2005 (Angehr *in litt.* 2005). As of 2009, the historical distribution in Panama was described as not well known due to lack of information (Monge et al. 2009, p. 68). The most viable population is believed to be in Darién National Park, Panama, which borders Colombia (Monge et al. 2009, p. 68; Angehr *in litt.* 1996 in Snyder et al. 2000, pp. 121–123; Ridgley 1982). Researchers believe the Darién area may contain the largest overall population of the great green macaw. However, there is little recent information to confirm this (Monge et al. 2009, p. 68). Darién National Park is the largest national park in Panama, and one of the largest tropical forest protected areas in Central America (The Nature Conservancy (TNC) 2011, p. 1). The Darién region encompasses nearly 809,371 ha (2 million acres) of protected areas, including Darién National Park and Biosphere Reserve, Punta Patiño Natural Reserve, Brage Biological Corridor, and two indigenous reserves (TNC 2011, p. 1). La Amistad, an area that may have a fairly viable population, connects suitable habitat in Panama such as Cerro Punta, Rio Plátano, and the Darién region, and connects the remote hills of Bocas del Toro Province with habitat in Costa Rica. La Amistad is approximately 200,000 ha (500,000 acres) in area.

Summary of Population Estimate

The global population of great green macaws is estimated to be between 2,500 and 3,700 mature individuals (BLI 2014b, p. 4; Chassot and Arias 2012, p. 61; Monge et al. 2009, p. 213; Jahn *in litt.* 2005, 2007, unpaginated). Based on the best available information from experts, the total population is likely between 1,000 and 3,000 individuals (Botero-Delgadillo and Páez 2011, p. 91; Monge et al. 2009, p. 213; Monge et al. 2009b, p. 68). In Ecuador, the population is

estimated to be between 30-40 individuals (Horstman *in litt* in BLI 2014, p. 3). In 2009, a census was conducted in Costa Rica and Nicaragua (Monge et al. 2010, p. 13). A total of 173 individuals were observed in the Costa Rican study area, and 432 individuals were observed in the Nicaraguan study area during the breeding season (Monge et al. 2010, p. 22), with the areas of Mónico, Romerito, and Bartola having the highest estimated abundance at the time of each census. The population of the great green macaw for Costa Rica is currently estimated to be approximately 302 individuals, and the population for Nicaragua is roughly estimated to be 834 individuals (Monge et al. 2010, p. 22). Species with strict habitat requirements such as the great green macaw are particularly subject to population size overestimation, because they are unlikely to be present in suboptimal habitat despite those habitats being included as part of the species range (Jetz et al. 2008, p. 116-117). Thus, additional surveys are needed, and ground-truthing (gathering data regarding where the species is located) is essential to obtain accurate population estimates for this species.

Habitat and Life History

The great green macaw inhabits humid lowland foothills and deciduous forests generally below 600 m (1,968 ft), but also may occur between 1,000 and 1,500 m (3,281 and 4,921 ft) depending on suitable habitat, which is primarily based on the presence of almendro (*Dipteryx panamensis*) trees. The type of habitat preferred by the great green macaw is an ecosystem where the almendro tree and *Pentacletra maculosa* (oil bean tree) dominate (Chassot et al. 2006, p. 35). This species' nests have been found in *Carapa nicaraguensis* (caobilla), *Enterolobium schomburgkii* (guanacaste blanco), *Goethalsia meiantha*, *Prioria copaifera*

(cativo), and *Vochysia ferruginea* (botarrama) trees (Chosset and Arias 2010, p. 14; Powell et al 1999). Nests have been observed in large trees, with cavities that are nearly 20 m (66 ft) above ground (Rodriguez-Mahecha 2002, p. 119). Great green macaws have been observed to use the same nesting cavity for many years if they are undisturbed, although they may alternate nest sites each year (Chun 2008, p. 102). Reproductive capability is generally reached between ages 5 and 6 years (Chassot et al. 2004, p. 34). The great green macaw mates for life, and nests in deep cavities (usually of almendro trees) from December to June (Chassot et al. in Villate et al. 2008, p. 19; Monge et al. 2002, p. 39). The incubation time is 26 days and the nesting period is 12 to 13 weeks (Rodriguez-Mahecha et al. 2002, p. 119). After the breeding season, individuals disperse from the lowlands to higher forests in the mountains in search of food (Powell et al. 1999 in Chosset et al. 2004, p. 38).

The great green macaw has been observed in flocks of up to 18 individuals, and has been observed traveling long distances on the Caribbean slope. Macaws are strong fliers and are known to travel hundreds of kilometers (Chosset and Arias 2010, p. 5; Chossett et al. 2004, p. 36). During a study in the late 1990s, macaws fitted with radio transmitters demonstrated that macaws migrate seasonally based on food availability, and were found to travel between 40 and 58 km (25 to 36 mi) while in search of food (Chosset et al. 2004, p. 35).

Diet

The great green macaw has been observed feeding on fruits of 37 tree species (Berg et al. 2007, p. 2; Chassot et al. 2006, p. 35). While it is closely associated with the almendro tree, its

diet varies based on location. In Ecuador, it was observed feeding on the following tree species: *Cordia eriostigma* (totumbo), *Cynometra* sp. (cocobolo), *Ficus trigunata* (matapalo), *Ficus* sp. (higuerón), *Psidium acutangulum* (Guayaba de monte), *Chrysophyllum caimito* (caimito), and *Vitex gigantea* (tillo blanco or pechiche) (Berg et al. 2007, p. 2; Waugh 1995, p. 7). In other parts of its range, it has also been observed feeding on *Cavanillesia platanifolia* (NCN), *Cecropia litoralis* (pumpwood or trumpet tree), *Centrolobium ochroxylum* (amarillo de guayaquil), *Cochlospermum vitifolium* (buttercup tree), *Lecythis ampla* (sapucaia), *Leucaena trichodes* (NCN), *Odroma pyramidalis* (NCN), *Pseudobombax guayasen* (NCN), *Pseudobombax millei* (beldaco), *Rafia* species (believed to be palms), *Sloanea* spp., *Symphonia globulifera* (NCN), and *Terminalia valverdeae* (guarapo) (Berg et al. 2007, p. 6). One preferred plant species, *Cynometra bauhinifolia* (NCN), produced more food than nine other species (Berg et al. 2007, p. 1). In another study, two of the most important sources of food for the great green macaw, in addition to the almendro tree, were found to be *Sacoglottis trichogyna* (titor, rosita, or manteco) and *Vochysia ferruginea* (NCN) (Herrero-Fernandez 2006, p. 9; Chassot et al. 2006, p. 35). *S. trichogyna* fruits were observed to be its preferred food when *D. panamensis* was scarce or unavailable in Costa Rica (Chassot et al. 2004, p. 34).

Almendro Trees

The great green macaw is closely associated with almendro trees (*Dipteryx panamensis*) for feeding and nesting in the majority of its range (Chun 2008, p. iv; Chosset et al. 2004, p. 34). Because the great green macaw is highly dependent on the almendro tree, we are describing almendro tree habitat, its life history, and factors that affect its habitat. The almendro tree (also

known as the tropical almond or mountain almond tree) is a member of the pea family (Fabaceae; Papilionoideae) and bears compact, single-seeded drupes. The seeds are encased in a thick woody endocarp that has been observed to persist on the forest floor for up to 2 years (Hanson 2006, p. 68). This tree species is only located in southern Nicaragua, Costa Rica, Panama, and Colombia, where it grows primarily in the lowlands of the Atlantic plains. They require an annual rainfall of 3 to 5 m (approximately 10 to 16 ft) (Schmidt 2009, p. 14) for optimal growth. A 2008 study reported that nearly 90 percent of all great green macaw nests identified in northern Costa Rica are located within hollowed cavities of large almendro trees (Chun 2008, p. 109). Additionally, almendro trees were found to provide 80 to 90 percent of both the macaw's food and nesting needs. Great green macaw pairs tend to select nesting trees that are surrounded by relatively dense stands of reproducing almendro trees (Chun 2008). Almendro tree fruit sustains the adults, chicks, nestlings, and fledglings over the course of the breeding and development season, which coincides with the peak production of almendro fruit (November through March).

Likely pollinators of the almendro tree are bees within the genera *Bombus*, *Centris*, *Melipona*, *Trigona*, and *Epicharis* (Thiele 2002 in Hanson 2006, p. 3; Flores 1992, pp. 1–22; Perry et al. 1980, p. 310). These trees are referred to as “emergent” because they are the tallest trees in the forest. Almendro trees can grow to over 46 m (150 ft) and reach a diameter of 1.5 m (4.92 ft). Three hundred-year-old trees have been documented, but research suggests that the almendro tree has a maximum potential age of 654 years (Fichtler et al. 2003 in Schmidt 2009, p. 15).

Wood from the almendro tree is heavy, commercially valuable, and yields the highest prices on local markets (Rodriguez and Chaves 2008, p. 5). It is used for furniture, floorings, bridges, railroad ties, boats, marine construction, handicrafts, veneers, industrial machinery, sporting equipment, springboards, and agricultural tool handles (Schmidt 2009, p. 16). Almendro outsells every other tree species on the Costa Rican timber market (Grethel and Norman 2009 in Schmidt 2009, p. 77; Rodriguez and Chaves 2008, p. 5). It was listed in Appendix III of CITES by Costa Rica in 2003 and by Nicaragua in 2007 (<http://www.cites.org>). A species is unilaterally listed in Appendix III by a country in the native range of that species, at the request of that country. Article II, paragraph 3, of CITES states that “Appendix III shall include all species which any Party identifies as being subject to regulation within its jurisdiction for the purpose of preventing or restricting exploitation, and as needing the cooperation of other parties in the control of trade.” For the export of specimens of an Appendix-III species from a country that has listed the species, the Management Authority in that country of export needs to determine that the specimens were not obtained in contravention of that country’s laws. In addition to CITES protections, a recent decision by the fourth Chamber of Costa Rica’s Supreme Court in 2008 required the Ministry of Environment and Energy (MINAE, or Ministerio de Ambiente y Energia) to abstain from the use, exploitation, or extraction of almendro trees (Chun 2008, p. 113).

Recent research found that this tree species is much more restricted to lowland habitat than previously described; it is predicted to occur between 45 and 125 m (147 to 410 ft) in elevation, in part based on its soil requirements (Schmidt 2009, p. iv; Chun 2008, p. 109). The almendro tree is best adapted to areas with high levels of rainfall and acidic clay soils with good

drainage below elevations of 500 m (1,640 ft) such as the Atlantic lowlands of Costa Rica (Schmidt 2009, p. iv). Almendro trees require at least 2,000 millimeters (mm) (79 inches) of rainfall per year for optimal growth (Schmidt 2009, p. 69).

Great green macaw breeding pairs are believed to require a home range of 550 ha (1,359 ac) (Chun 2008, p. 105). Because the great green macaw requires such a large range, and is strongly associated with almendro trees, range countries such as Nicaragua and Costa Rica have developed conservation plans for the almendro tree. Almendro trees commonly occur at a density of less than one adult tree per hectare (Hanson et al. 2008 in Schmidt 2009, p. 14; Hanson et al. 2006, p. 49). The highest density recorded was 4 trees per hectare (Chaverri and López 1998). In one area of Costa Rica that was surveyed for almendro trees, of 140,178 ha (56,728 ac) surveyed, 20 percent exhibited densities of 0.50 almendro trees per hectare or more, and 50 percent had densities of 0.20 trees per ha or more (Chun 2008, p. 103).

Due to their important role in the ecosystem, particularly with respect to the great green macaw, conservation efforts have focused on the almendro tree. These trees not only provide habitat to many wildlife species such as the great green macaw, but they also play a significant role in the ecosystem. One conservation strategy for the great green macaw is to protect 30,159 ha (74,493 acres) of primary, secondary, and mangrove forest that remains in this species' nesting habitat. Another conservation strategy has been to establish almendro tree plantations. Due to its open crown structure, almendro has a relatively translucent canopy that produces only moderate shade, which allows for the production of shade canopy crops such as pineapple and cacao (Schmidt 2009, p. 19). These almendro plantations are being researched for several

reasons, particularly due to the almendro tree's ability to resist decay, its ability to capture carbon dioxide, and its role in the ecosystem (Schmidt 2009, p. 11). Additionally, almendro trees have been identified as the most promising species for long-term carbon sink reforestation projects in Costa Rica (Redondo-Brenes 2007, p. 253; Redondo-Brenes and Montagnini 2006, p. 168).

In Ecuador, the great green macaw is not dependant on almendro trees, although it still inhabits humid lowland areas (Juniper and Parr 1998, p. 424). In this habitat, the great green macaw prefers *Lecythis ampla* (salero) in the Esmeraldas rainforest, *Cynometra bauhiniaefolia* (cocobolo) as a primary food source, and pigio (*Cavanillesia platanifolia*) as a nest tree (Chassot et al 2007, p. 1; Berg et al 2007, pp. 1–3).

Conservation Status

There are various protections in place for the great green macaw at the international, national, and local levels. At the international level, this species is listed as endangered on the IUCN Red List due to continuous loss of habitat, hunting, and poaching of this species for the pet trade (BLI 2013). IUCN's Red List classifies species as endangered (extinction probability of 20 percent within 20 years) or critically endangered (extinction probability of 50 percent within 10 years) based on several criteria, including limited or declining ranges or populations. However, the status under IUCN conveys no actual protections. This species is listed in Appendix I of CITES. Appendix I includes species threatened with extinction that are or may be affected by international trade, and are generally prohibited from commercial trade. Refer to the

discussion above for the military macaw for additional information about CITES. The great green macaw's conservation status in each country is discussed below and in more detail under Factor D.

Colombia

The great green macaw is listed as Vulnerable on Colombia's Red List (Renjifo et al. 2002, p. 524). It has protected status in Los Katíos National Park, Utría National Park, Paramillo National Park, and Farallones de Cali National Natural Park (Rodriguez et al. 2002, pp. 120–121). The largest population of the great green macaw is believed to exist in the Darién Endemic Bird Area (EBA) 023, which encompasses southern Panamá and northwestern Colombia. However, there are no reliable population estimates for this area (Botero-Delgadillo and Páez 2011, p. 91; Jahn *in litt.* 2004). Colombia developed a National Action Plan for the Conservation of Threatened Parrots (Plan Nacional de Acción para la Conservación de los Loros Amenazados), which was in effect until 2007. The ProAves Foundation, an NGO in Colombia, has been active in parrot conservation since 2005. Other than NGO involvement, it is unclear what proactive, effective protections are in place for this species.

Costa Rica

The great green macaw is considered to be endangered in Costa Rica (Monge et al. 2010, p. 22; Herrero 2006, p. 6; Executive Order No. 26435–MINAE). Several intense conservation initiatives are underway for this species in Costa Rica. In 2001, a committee was formed to

investigate a corridor for the conservation of this species' habitat. As a result, the San Juan–La Selva Biological Corridor was formed to connect the Indio Maíz Biological Reserve in southeastern Nicaragua with the Central Volcanic Cordillera Range in Costa Rica. This links Costa Rica's La Selva Biological Station in the north to the Barra del Colorado Wildlife Reserve and National Park and Protective Zone of Tortuguero on Costa Rica's Caribbean coast. In addition, the conservation team lobbied for the establishment of the Maquenque National Wildlife Refuge to protect the macaw's breeding habitat (Hardman 2011, p. 10; Chun 2008, p. 98). This corridor makes up a part of the larger MesoAmerican Biological Corridor, which has been proposed to connect protected habitat from the Yucatan Region in southern Mexico and Belize to the Darién National Park in Panama (<http://www.greatgreenmacaw.org/BiologicalCorridor.htm>, accessed October 25, 2011).

The San Juan–La Selva binational corridor links existing protected wild areas. There is also an extended part to the northwest that includes the El Castillo area. The goal of this initiative is to provide linkages to 29 protected areas involving 1,311,182 ha (3,240,001 ac) (Chassot et al. 2006, p. 85). Because macaws are known to move hundreds of kilometers (Chosset and Arias 2010, p. 5), these linkages should allow this species better access to different habitats so that it is able to meet its nutritional and nesting requirements. In addition to containing key conservation sites for the great green macaw, the corridor connects the vast expanse that includes Punta Gorda Natural Reserve, Cerro Silva Natural Reserve, and Fortaleza Inmaculada Concepción de María Historic Monument (Chassot et al. 2006, p. 85). The corridor also provides connections among unprotected forest patches in Costa Rica in addition to providing connections to protected areas. Many of these areas may not be pristine habitat; some

areas are either inhabited by humans or used by local communities to extract resources. However, there are conservation awareness programs in place throughout the corridor, and the great green macaw is being intensely managed and monitored in the San Juan–La Selva Biological Corridor.

Ecuador

This species is categorized as critically endangered in Ecuador (Monge et al. 2009, p. 256), primarily due to deforestation and hunting pressures. In Ecuador, the only potentially population is believed to exist in the Cerro Blanco Protected Forest, which is 6,070 ha (15,000 ac) in size. The Guayaquil subspecies of the great green macaw (*Ara a. guayaquilensis*) is thought to be in imminent danger of extinction (Berg 2007, p. 1). In 2008, the National Preservation Strategy for the Great Green Macaw in Ecuador was described at the Great Green Macaw Population Viability Assessment and Habitat Conservation Workshop held in Costa Rica; however, funding is still lacking for many of the initiatives in Ecuador that have been prescribed as necessary for the conservation of this species.

Honduras

The great green macaw is categorized as endangered in Honduras (List of Wildlife Species of Special Concern, Resolution No. Gg-003-98 APVS). In 1990, the Government of Honduras prohibited the capture and sale of wildlife, including the great green macaw in Honduras. Currently, this species exists in the Rio Plátano Biosphere Reserve (which consists of

800,000 ha or 1,976,843 ac). The official designation of the Biosphere as a reserve is to protect and conserve biodiversity; however, this designation has not halted deforestation within the protected area (UNESCO 2011, p. 1; ParksWatch 2011; Wade 2007, p. 65). Additionally, as of 2009, there were 23 areas in Honduras identified as Important Bird Areas (IBAs) (Devenish et al. 2009, p. 1) that may provide additional protections to this species in part by serving as ecotourism sites that can increase conservation efforts in the areas. For additional information on IBAs, see the discussion above for the military macaw.

Nicaragua

Nicaragua follows the IUCN categorization of endangered for this species (Castellon 2008, pp. 13, 19; Lezama-López 2006, p. 90). The great green macaw exists in the Indio-Maíz Biological Reserve, which has had protected status since 1990, although threats to the species still exist in this Reserve (Herrera 2004, pp. 5–6). Nicaragua is also participating in the bi-national conservation strategy for this species (Monge et al. 2009, pp. 11, 16).

Panama

There is little information available regarding the status of this species in Panama (Monge et al. 2009, p. 67); however, Panama follows the IUCN categorization for this species (Devenish et al. 2009, p. 294). The great green macaw is believed to be in Darién National Park (Monge et al. 2009, p. 68). Panama's wildlife law of 1995, Law No. 24, establishes the standards for wildlife conservation.

NGO involvement

There are many nongovernmental organization (NGO), private, and government efforts to protect this species, although not all of the projects and NGOs are identified in this document. NGOs have conducted collaborative efforts, such as training workshops, that are community-focused and aimed at the conservation of the habitat. In Nicaragua, Fundación Cocibolca is active in this species' conservation. This NGO first signed an agreement with Nicaragua's Natural Resources Ministry (MARENA) in 1996, at which time the conservation group was the first NGO to have been granted responsibility to manage a national protected area in Nicaragua (<http://www.marena.gob.ni>; accessed November 9, 2011; <http://www.planeta.com>, accessed November 9, 2011). The Nicaraguan conservation organization, Fundación del Río, works in the buffer zone of the Indio-Maíz Biological Reserve, which borders the San Juan River (Villate 2008, p. 39). In 1999, Fundación del Río began an environmental education program in this buffer zone to promote awareness of the great green macaw and its habitat. In another area, as a result of conservation efforts, the local government of El Castillo declared this species the official municipal bird, and the city established sanctions to those intending to harm this species (Chassot et al. 2008, p. 23).

Since 2001, Fundación del Río and the Tropical Science Center in Costa Rica have coordinated a binational campaign focused on promoting the awareness of the ecology of the great green macaw in the lowlands of the San Juan River area (Chassot et al. 2009, p. 9). Between 2002 and 2005, at least 11 workshops on great green macaw biology and preservation

were held within communities of the buffer zone of Indio-Maiz Biological Reserve in Costa Rica (Chassot et al. 2006, p. 86). Some examples of projects initiated by NGOs include installation of nest boxes to increase nest availability and community heritage festivals that are focused on the great green macaw. Some NGOs are providing training to local communities to monitor populations, and some researchers are studying this species via satellite transmitters to determine the species' home range and specific habitat used (Chosset et al. 2004, p. 35). In Costa Rica and Nicaragua, 20 communities are participating in monitoring and protection activities of the great green macaw (Chosset and Arias 2010, p. 3). The primary objectives of the campaign have been to improve awareness by conducting workshops on the importance, threats, and conservation of the great green macaw and its habitat; to strengthen natural resources management by environmental authorities of both Nicaragua and Costa Rica, focusing on the local and international biological corridors; and to organize joint activities (Chassot et al. 2006, p. 83).

In Colombia, the NGO ProAves has made great progress in forming partnerships at the local, regional, and international levels to carry out bird conservation initiatives (Chassot et al. 2008, p. 23; Quevado-Gill et al. 2006, p. 18). Additionally, reforestation efforts have occurred (Monge et al. 2009, p. 263). These efforts have focused primarily within the reserves of the Colombian Civil Society Association Network (Quevado-Gill et al. 2006, p. 17). Conservation efforts and these workshops have been important because they have trained the community in sustainable development by linking local agricultural activities to the protection of natural resources (Quevado-Gill et al. 2006, p. 17).

Three NGOs are active in the conservation of this species in Ecuador: Pro-Forest Foundation in Guayas Province, Fundación Natura, and the Jocotoco Foundation at the Rio Canande Reserve in Esmeraldas Province. The Pro-Forest Foundation (Fundación ProBosque) was created in 1992, through a decree of the Ecuadorian Ministry of Agriculture. Its mission is to protect areas with an emphasis in reforestation, agroforestry, investigation, environmental education, and ecotourism programs, all in order to support the conservation of biodiversity.

In Panama, the Asociación Nacional para la Conservación de la Naturaleza (ANCON) began conservation work in 1991. The project has jointly worked on conservation efforts with Panama's Instituto Nacional de Recursos Naturales Renovables (INRENARE). ANCON has worked on training park rangers, marking and patrolling paths and park boundaries, acquiring property around parks and tree nurseries, and improving agricultural techniques (TNC 2011, p. 2).

Additionally, members from several NGOs participated in the great green macaw conservation workshop held in 2008. The purpose of the workshop was to bring together experts, to determine the priorities for the conservation of the species, and to develop a plan for its conservation (Monge et al. 2009, entire). We acknowledge the substantial effort under way by various NGOs in the range countries of this species to protect it and its habitat. Despite many efforts in place, the populations of the great green macaw continue to face many threats to its habitat.

Evaluation of Threat Factors

Introduction

Section 4 of the ESA (16 U.S.C. 1533) and implementing regulations (50 CFR 424) set forth procedures for adding species to, removing species from, or reclassifying species on the Federal List of Endangered and Threatened Wildlife and Plants. Under section 4(a)(1) of the ESA, a species may be determined to be endangered or threatened based on any of the following five factors:

- A. The present or threatened destruction, modification, or curtailment of its habitat or range;
- B. Overutilization for commercial, recreational, scientific, or educational purposes;
- C. Disease or predation;
- D. The inadequacy of existing regulatory mechanisms; and
- E. Other natural or manmade factors affecting its continued existence.

In making this finding, information pertaining to the great green macaw in relation to the five factors in section 4(a)(1) of the ESA is discussed below. In considering what factors might constitute threats to a species, we must look beyond the exposure of the species to a particular factor to evaluate whether the species may respond to that factor in a way that causes actual impacts to the species. If there is exposure to a factor and the species responds negatively, the factor may be a threat, and, during the status review, we attempt to determine how significant a threat it is. The identification of factors that could impact a species negatively may not be sufficient to compel a finding that the species warrants listing. The information must include evidence sufficient to suggest that these factors, singly or in combination, are operative threats

that act on the species to the point that the species may meet the definition of endangered or threatened under the ESA.

This rule focuses primarily on where this species has been documented, which is generally in parks and other areas with protected status and the peripheral zones. In some cases, we will evaluate the factor by country. In other cases, we may evaluate the factor by a broader region or context, for example, if we do not have adequate information specific to a particular country about this species. This is because often threats are the same or very similar throughout the species' range.

A. The present or threatened destruction, modification, or curtailment of its habitat or range

Throughout the range of this species, the factors impacting the great green macaw are generally very similar. The main factors affecting this species are habitat loss and degradation, and poaching (McGinley et al. 2009, p. 11; Berg et al. 2007; Chassot et al. 2006; Quevado-Gill et al. 2006, p. 16; Guedes 2004, p. 280). Both Central and South America continue to experience high levels of deforestation (FAO 2010, p. xvi). Habitat loss is primarily due to conversion of the species' habitat (generally forests) to agriculture and other forms that are not optimal for this species (Chosset and Arias 2010, p. 3; Monge et al. 2009, entire).

Almendo habitat, this species' primary food and nesting source, has declined significantly (Schmidt 2009, p. 16), particularly since the 1980s. Almendo and other tree species used by the great green macaw have been selectively cut down and removed from this

species' habitat. Selective logging is the practice of removing one or two generally large, mature trees and leaving the rest. Throughout the range of the great green macaw, its habitat has declined primarily due to competition for resources and human encroachment (Guedes 2004, p. 279; Rodríguez-Mahecha and Hernández-Camacho 2002; Chassot and Monge 2002 in Rothman 2008, p. 509). Its habitat has continuously been clear-cut and converted to agriculture or human establishments, which is discussed in more detail below.

Logging

Tree species used by macaws tend to be large, mature trees with large nesting cavities. The practice of selective logging often targets old, large trees that macaws depend upon for nesting. In selective logging, the most valuable trees from a forest are commercially extracted (Asner et al. 2005, p. 480; Johns 1988, p. 31), and the forest is left to regenerate naturally or with some management until being subsequently logged again. Johns (1988, p. 31), looking at a West Malaysian dipterocarp forest, found that mechanized selective logging in tropical rainforests, which usually removes a small percentage of timber trees, causes severe incidental damage. He found that the extraction of 3.3 percent of trees destroyed 50.9 percent of the forest. Selective logging can cause widespread collateral damage to remaining trees, subcanopy vegetation, and soil, and the practice impacts hydrological processes, erosion, fire, carbon storage, and plant and animal species (Chomitz et al. 2007, pp. 117, 119; Asner et al. 2005, p. 480). Forests that were selectively logged 15 years prior became an open forest with skeletons of incidentally killed trees, serious gully erosion, and vegetation on waterlogged sites that had been compacted by heavy vehicles (Edwards 1993, p. 9). Additionally, the availability of food sources for

frugivores (fruit-eaters, such as the great green macaw) is reduced because the trees that contain nutritional sources are no longer there.

Selective logging is particularly devastating to the almendro tree, which is slow growing and may take centuries to reach sufficient size to harbor cavities (Schmidt 2009, p. 15), and which great green macaws need for both food and shelter. The almendro tree's wood is of great commercial value due to its strength and durability for flooring, roofing, and irrigation systems (Madriz-Vargas 2004, p. 8). Concern for this tree species was significant enough that the species was listed as CITES Appendix III by both Costa Rica and Nicaragua. Listing species in Appendix III enhances conservation measures enacted for the species by regulating international trade in the species. In general, shipments containing CITES-listed species receive greater scrutiny from border officials in both the exporting and importing countries. The elimination of almendro trees is possibly the most severe threat for the species in its range countries with the exception of Ecuador, where the decrease in availability of other tree species used by the great green macaw is a concern.

Although the nest cavities that the macaws prefer (deep and dry) may take 10 to 20 years to form, the nests themselves can last for several decades (Chun 2008, p. 101). Even in undisturbed forests, suitable tree cavities are usually limited. As a result, each loss of a nest site can represent the loss of potentially many future chicks that could have been raised in each tree cavity.

Agriculture

Habitat degradation, particularly due to conversion of forest habitat to agriculture or plantations, is a major factor affecting great green macaws. The clearing of forests and buffer zones for the development of plantations for bananas, oil palms, cacao, coffee, soybeans, and rice destroys great green macaw nesting sites and exposes chicks to poaching for the pet trade (Botero et al. 2011, p. 92; Monge et al. 2009, pp. 26, 29, 43, 54; Waugh 1995, p. 2). By 2005, the world's tropical forest biomes had decreased to less than 50 percent tree cover (Donald et al. 2010, p. 26), in part due to the above activities. Tropical forest fragmentation due to these activities continues to be a concern. A discussion of habitat loss and degradation for each country follows.

Colombia

Very little information is available about the great green macaw's status in Colombia (Botero-Delgadillo and Páez 2011, pp. 86, 90; Monge et al. 2009; Jahn *in litt.* 2004). A large population is believed to exist in Los Katíos National Park, which borders the swampy and sparsely populated Darién region in Panama; however, there are no recent reported observations of the species in this area. Population surveys need to be conducted (Botero-Delgadillo et al. 2011, pp. 88, 90; Monge et al. 2009). At least 40 percent of the great green macaw's original distribution area in northwestern Colombia was deforested by 1997 (Etter 1998 in Jahn *in litt.* 2004). Threats to this species in Colombia have been identified as: agriculture (particularly illegal coca cultivation), agroindustrial farms, large forest plantings of exotic trees, wood

extraction, development of infrastructure, and hunting, capturing, and harvesting of this species (Botero-Delgadillo and Páez 2011, pp. 91–92). Threats specific to Los Katíos National Park are illegal deforestation and hunting (UNEP–WCMC 2009, p. 1). In 2009, the threats in this park were so severe that the park was added to UNESCO’s List of World Heritage Sites in Danger (<http://whc.unesco.org/en/list/711>, accessed January 17, 2012).

Deforestation

Colombia has experienced extensive deforestation in the last half of the 20th century as a result of habitat conversion for human settlements, road building, agriculture, and timber extraction (FAO 2010, p. 233; Armenteras et al. 2006, p. 354). A 23-year study, conducted from 1973 to 1996, found that these activities reduced the amount of primary forest cover in Colombia by approximately 3,605 ha (8,908 ac) annually, representing a nearly one-third total loss of primary forest habitat (Viña et al. 2004, pp. 123–124). More than 70 percent of rural land of Colombia located in former forestlands is now devoted to cattle grazing (Etter and McAlpine 2007, pp. 89–92). Beginning in the 1980s, habitat loss increased dramatically as a result of influxes of people settling in formerly pristine areas (Perz et al. 2005, pp. 26–28; Viña et al. 2004, p. 124). More recent studies indicate that the rate of habitat destruction is accelerating (FAO 2010, p. xvi). Between the years 1990 and 2005, Colombia lost approximately 52,800 ha (130,471 ac) of primary forest annually (Butler 2006a, pp. 1–3).

Primary forest habitats such as those used by the great green macaw throughout Colombia have undergone extensive deforestation. Viña et al. (2004, pp. 123–124) used satellite

imagery to analyze deforestation rates and patterns along the Colombian-Ecuadorian border (in the Departments of Putumayo and Sucumbios, respectively) and found that between 1973 and 1996, a total of 829 km² (320 mi²) of tropical forests within the study area were converted to other uses. This corresponds to a nearly one-third total loss of primary forest habitat, or a nearly 2 percent mean annual rate of deforestation within the study area. Habitat loss and degradation, including conversion of this species' habitat to other forms of use such as agriculture, plantations, or harvesting of this species' plant food sources, continue to occur and affect the quality of this species' habitat.

In addition to the direct detrimental effect of habitat loss, there are several indirect effects of habitat disturbance and fragmentation, such as road building (Brooks and Strahl 2000, p. 10). Roads increase human access into habitat, facilitating further exploitation, erosion, and habitat destruction (Chomitz et al. 2007, p. 88; Hunter 1996, pp. 158–159). Research has documented that road building and other infrastructure developments in areas that were previously remote forested areas have increased accessibility and facilitated further habitat destruction and human settlement (Etter et al. 2006, p. 1; Álvarez 2005, p. 2,042; Cárdenas and Rodríguez-Becerra 2004, pp. 125–130; Viña et al. 2004, pp. 118–119; Hunter 1996, pp. 158–159). A study conducted on the effects of habitat fragmentation on Andean birds within western Colombia determined that 31 percent of the historical bird populations in western Colombia had become extinct or locally extirpated by 1990, primarily as a result of habitat fragmentation from deforestation and human encroachment (Kattan and Álvarez-Lopez 1996, p. 5; Kattan et al. 1994, p. 141). Greater exposure of soil to direct sunlight leads to factors such as drier soils and also creates a different growing environment. For example, the creation of roads changes the

habitat by altering the distance of nesting and feeding habitat to the forest “edge,” increasing the amount of light exposure, and creating stress on (breeding) individuals in part due to noise and visual stimuli (Benítez-López et al. 2010, p. 1,308).

Coca Cultivation

Ongoing coca cultivation has had a significant impact on forest cover in Colombia (Armenteras et al. 2006, p. 355; Fjeldså et al. 2005, p. 205; Page 2003, p. 2; Álvarez 2002, pp. 1,088–1,093). Colombia is one of the leading producers of coca, the plant species that provides the main ingredient of cocaine. Between 1998 and 2002, cultivation of illicit crops increased by 21 percent each year, with a parallel increase in deforestation of formerly pristine areas of approximately 60 percent (Álvarez 2002, pp. 1,088–1,093). Much of Colombia's coca is grown by farmers because it generates more income than any other crop (Butler 2006, pp. 1–2). Illegal drug crops are cultivated within the great green macaw's range (BLI 2014b, p. 4). Large-scale coca production has moved into the extensive rainforests of the Chocó state, which is considered to be a biodiversity hotspot in northwest Colombia and in the range of the great green macaw.

A 1990 United Nations study estimated that coca growers can make about \$4,000 U.S. dollars per hectare (Tammen 1991, p. 12 in Page 2003, pp. 15–16). A farmer can only earn about \$600 per hectare growing an alternative crop such as coffee, which is the most often cited potential substitute crop for coca (Page 2003, pp. 15–16). Page (2003, pp. 15-16) notes that production of coffee and tea requires 3 to 4 years from planting to first harvest and then can only be harvested once per year, while coca can be harvested 8 months after it is planted and can be

harvested every 90 days thereafter. The coca bushes themselves do not require much care and can be cultivated on plots of land that are much smaller than those required for crops other than coca (Tammen 1991, p. 6 in Page 2003, p. 16). Unfortunately, not only do coca crops displace native habitat and species assemblages that are important for the great green macaw, but they also deplete the soil of nutrients, which hampers regeneration following abandonment of fields (Van Schoik and Schulberg 1993, p. 21).

Drug eradication efforts in Colombia have further degraded and destroyed primary forest habitat by using nonspecific aerial herbicides to destroy illegal crops (BLI 2007d, p. 3; Álvarez 2005, p. 2,042; Cárdenas and Rodríguez Becerra 2004, p. 355; Oldham and Massey 2002, pp. 9–12). For example, in 2006, eradication efforts were undertaken on over 2,130 km² (822 mi²) of land, which included spraying of 1,720 km² (664 mi²) and manual eradication on the remaining land. These eradication efforts occurred over an area 2.7 times greater than the net cultivation area (UNODC et al. 2007, p. 8). Herbicide spraying has introduced harmful chemicals into great green macaw habitat and has led to further destruction of the habitat by forcing growers to move to new, previously untouched forested areas (Álvarez 2007, pp. 133–143; BLI 2007d, p. 3; Álvarez 2005, p. 2042; Cárdenas and Becerra 2004, p. 355; Oldham and Massey 2002, pp. 9–12; Álvarez 2002, pp. 1,088–1,093).

The ecological impacts of coca production are significant. Farmers clear forest to plant coca seedlings. Not only does each hectare of crop production result in the clearing of roughly 1.6 ha (4 ac) of forest, this practice also results in secondary effects such as the pollution of land and local waterways with the chemicals used to process coca leaves, including kerosene, sulfuric

acid, acetone, and carbide (Butler 2006, pp. 1–2).

Costa Rica

Most of the research on this species has been conducted in Costa Rica, where a very small population of this species remains. Despite Costa Rica's progress in conservation of this species, the historical breeding area for this species in Costa Rica has been reduced by 90 percent (Villate et al. 2008, p. 19; Chosset et al. 2004, p. 38). In 2004, approximately 30 reproductive pairs remained in the wild in Costa Rica (Madriz-Vargas 2004, p. 4). Up until the 1960s, Costa Rica's human population was growing by approximately 4 percent annually (World Bank 2011, unpaginated; Chun 2008, p. 6). Logging in the 1960s and 1970s decimated this species' habitat (Hardman 2011, p. 8). In the 1980s, the area near Puerto Viejo de Sarapiquí experienced severe deforestation and conversion to banana and pineapple plantations. By 1996, 52,000 ha (128,495 ac) of lowland forest had been converted to banana plantations (Brewster 2009, p. 8). The loss of forested area in the north has primarily been due to the production of livestock, forestry products, sugar cane, and (in more recent years) pineapple (Villate et al. 2008, p. 15).

In the mid-1980s, policies changed from granting incentives for livestock and cattle ranching to reforestation for forest management. However, these incentives led initially to the clearing of forests for conversion to exotic species plantations. As a result, forestry in Costa Rica (and Panama) has been dominated by the use of exotic species such as *Tectona grandis* (teak) or *Gmelina arborea* (melina) (Schmidt 2009, p. 10). This trend changed in 1986 with the Forestry Act 7472. In the 1990s, the government began to create incentives for small farm

owners to establish and maintain native tree species plantations (Piotto et al. 2003, p. 427). By 1992, a project was implemented to improve the use of forested areas; however, it estimated that by this time only 5 percent of original forest area remained intact (Chassot et al. 2001 in Villate et al. 2008, p. 15). Reforestation projects began initially through an agreement between Costa Rica and Germany. The program was implemented by the Agribusiness Association and Forestry Producers (APAIFO) and the Cooperation for Forestry Development San Carlos (CODEFORSA).

In Costa Rica's border zone with Nicaragua, Landsat TM satellite images from 1987, 1998, and 2005 showed a fragmented landscape with remnants of natural ecosystems, which has implications for the conservation of this species. The images identified several classes of cover and land use (natural forest, secondary forest, water, agriculture and pasture, banana and pineapple plantations, and bare ground) (Chassot et al. 2009, pp. 8–9). These researchers noted that the annual rate of deforestation was 0.88 percent for the 1987–1998 period, and 0.73 percent for the 1998–2005 period, taking into consideration recovery of secondary forest. The researchers also noted that, in the area studied, deforestation rates were higher than national averages for the same time span (Chassot et al. 2009, p. 9).

In the 1990s, plans to form the San Juan-La Selva Biological Corridor began in response to the significant decrease in habitat available to the great green macaw and its decline in population numbers. In 1993 and 1994, about 1,000 km² (386 mi²) were identified as important nesting areas for this species in Costa Rica. In 2002, the San Juan-La Selva Biological Corridor, an area of 60,000 hectares (148,263 ac), was established to protect the nesting sites and

migration flyway of the great green macaw in Costa Rica, up to the Nicaragua border (Guedes 2004, p. 280). Although this corridor is in place, recent reports indicate that habitat degradation and other factors continue to affect the great green macaw (Monge et al. 2009, p. 121).

Costa Rica was the only country in Central America that had a positive overall increase in forest area during the period 2000–2005 (FAO 2010, p. 19; FAO 2007). Intense efforts are under way in Costa Rica to conserve and recover this species, in part by addressing habitat degradation. In some areas, the commercial use of the almendro tree is now being replaced by synthetic material due to conservation efforts focused on the great green macaw. In some areas, landowners are being paid to protect and “adopt” almendro trees, and several ecotourism projects have developed using these trees and the macaws as part of the ecotourism attraction. As of 2009, 12 nesting trees had protection agreements (Brewster 2009, p. 10). Still, habitat degradation continues to impact the great green macaw (Villate et al. 2008, p. 14), and even trees that are designated as protected are either cut down or targeted for poaching (Chun 2008). Logging still occurs in the remnant forests of both the northern zone of Costa Rica and southeast Nicaragua (Chassot and Arias 2011, p. 1; Monge et al. 2009, pp. 128–129). Logging, while it may be illegal, has also been documented in the buffer zone of the Indio-Maíz Biological Reserve (Monge et al. 2006, p. 10). The buffer zone is within the breeding range of the great green macaw and likely affects the species’ viability. Additionally, both primary and regrowth forest in the San Juan–La Selva Biological Corridor continue to be threatened by timber extraction and agricultural expansion (Chassot and Arias 2011, p. 1; Monge et al. 2009, pp. 128–129).

Mining

Gold mining may also affect conservation efforts for the great green macaw in Costa Rica. In 2001, the Ministerio del Medio Ambiente y Energía (MINAE) granted a mining concession (Resolution R-578-2001-MINAE) in San Carlos to clear nearly 202 ha (500 ac) of old-growth rainforest for a project (Villate 2009, p. 57; <http://www.infinito.co.cr> and <http://www.nacla.org>, both accessed November 15, 2011). The Crucitas mining project is located in the Northwest Corridor of San Juan-La Selva, a few miles from the San Juan River (which separates Costa Rica from Nicaragua). The Crucitas area is part of a major zone for bird conservation initiatives, partly implemented by BLI, that includes both the Water and Peace Biosphere Reserve and the San Juan-La Selva Biological Corridor (Chassot et al. 2009, p. 9), including the El Castillo extension. It is reported that 72 percent of the area that had been proposed for implementation of the project is forested and contains almendro tree (and consequently great green macaw) habitat. The company proposed to clearcut the area in order to establish the open pit mine.

In adjacent Nicaragua, the area of influence of the mining project is also part of the buffer zone of the two reserves: San Juan River Biosphere Reserve and the Indio-Maíz Biological Reserve. These areas contain features of endemism and species compositions that are unique (Sistema Nacional de Áreas de Conservación (SINAC) 2007 in Villate et al. 2008, p. 58). Although Crucitas is not part of the current nesting area of the great green macaw, it is only about 10 km (3 mi) southeast of the historical distribution of the species. The mining activities are likely to affect the current population of the great green macaw by impacting its habitat as

well as ongoing conservation efforts. The project lies within a geographical area that is of critical importance to the conservation of this species. Additionally, the removal of more primary forest cover would further reduce the ability to maintain connectivity along the San Juan–La Selva Biological Corridor, which continues to be subjected to fragmentation (Villate 2008, p. 58). As of November 2010, a court ruled that the open-pit gold mine was improperly permitted

(http://centralamericadata.biz/en/article/home/Crucitas_Mining_Concession_Cancellation_Confirmed, accessed January 12, 2012). However, prior to the court ruling, 121 ha (300 ac) of primary forest had already been cleared (http://www.santuariolapas.com/profile_003.html, accessed December 14, 2011). The ultimate impacts and outcome of the mining project are unclear; however, the species is and will continue to be impacted by pressures for resources that affect its habitat.

Ecuador

Although the population of great green macaw is reported to be stable and slowly increasing in the Cerro Blanco Protected Forest, it is an extremely small population (Monge et al. 2009, p. 256). There are likely fewer than 100 individuals remaining in Ecuador. In this part of its range, three tree species are noted as crucial for the survival of the species: *Lecythis ampla* (salero) and *Cynometra bauhiniaefolia* (cocobolo) as primary food sources, and *Cavanillesia platanifolia* (pigio) as a nest tree (Horstman 2011 pers. comm. 2011). Logging, poaching, and illegal land settlements continue to occur in the great green macaw's range and are threats to the population in Ecuador, particularly in the Cerro Blanco Protected Forest

(<http://www.worldlandtrust-us.org>, unpaginated; World Wildlife Fund 2011, p. 5; Horstman 2011, p. 12). Between 1960 and 1980, the human population in Ecuador grew from 4 to 10.2 million, which resulted in more than 90 percent of Pacific lowland and foothill forest below 900 m (2,953 ft) being converted to agriculture (Dodson and Gentry 1991, p. 279). Much of the species' habitat was converted to plantations of bananas, oil palms, cacao, coffee, soybeans, and rice (ELAW 2005, p. 1; Dodson and Gentry 1991, p. 279).

In 2002, the Government of Ecuador authorized the conversion of 50,000 ha (123,553 ac) of tropical forest in the Choco region of western Ecuador into oil palm plantations (ELAW 2005, pp. 1–2). As of 2005, 374 ha (924 ac) of native forests were being cut daily (Horstman 2005, p. 8). Clearing forests for this monoculture crop has threatened thousands of endemic species and introduced dangerous pesticides to local ecosystems (Albán and Cárdenas 2007, p. 43). For example, in Esmeraldas Province, pesticides are used intensively in a 36,000-ha (88,958-ac) area of oil palm plantations (ELAW 2005, pp. 1-2). Local villages cite problems from the pesticides and effluents from the processing plants.

The Food and Agriculture Organization of the United Nations (FAO) reported in 2010 that, in Ecuador, “planted forests are predominantly composed of introduced species,” such as rubber plantations and other nonnative species (FAO 2010, p. 93), which do not provide appropriate habitat and nutritional needs for the great green macaw. Despite these activities, due to the efforts of the ProForest Foundation—the NGO in charge of the reserve—the population in the Cerro Blanco forest preserve is reported to be stable (Horstman 2011, p. 17). The Cerro Blanco forest preserve is a small area that is being managed particularly for this species. It is

jointly owned by the ProForest Foundation and a cement company, Holcim, as mitigation for its nearby limestone quarries. Reserve managers are converting former cattle pasture to native tree farms, which they use to help restore dry tropical forest in other locations, including a corridor to nearby patches of forested areas (Horstman 2009 pers. comm.). Despite the conservation efforts in place, logging, poaching, and illegal land settlement continue to affect the population in the Cerro Blanco Protected Forest (Horstman 2011, p. 17; Fundacion Pro-Bosque, undated, p. 3). A conservation strategy for this species recommends that a ban be instituted on the cutting and commercialization of the three tree species described above that were noted as crucial for the great green macaw's survival (Monge et al. 2009, pp. 256–258). However, deforestation, encroachment, and habitat degradation activities such as these continue (Horstman 2011, p. 17).

Another threat to the macaw's population in this reserve is the rapid expansion of the city of Guayaquil. Squatter settlements develop on the city's outskirts and encroach the forest (Fundacion ProBosque undated, p. 3). Illegal settlements are a problem, and squatter communities have attempted to take over property within Cerro Blanco. The local NGO conducts educational awareness programs to mitigate these activities. An example of awareness campaign activities is educating the local communities about the effect on their water supply when they destroy forested areas (Horstman pers. comm. in Hardman 2011, p. 13). However, pressures to this species' habitat continue to impact the species.

Honduras

In Honduras, threats have included illegal trafficking of this species and deforestation due to agriculture, cattle grazing, and logging (Devenish et al. 2009, p. 256). The threat of deforestation is particularly important because a recent study found that 87 percent of Honduras is only suitable for forest (Larios and Coronado 2006, p. 13) due to its generally mountainous terrain. There is very little information available on the status of this species in Honduras, particularly scientific literature (Monge et al. 2009, p. 122). Only six papers on avian diversity and avian population surveys in Honduran forests were published between 1968 and 2004 (Anderson et al. 2004, p. 456). However, we do know that the threats in Honduras are similar to those in other countries within the range of this species (McCann et al. 2003, pp. 321–322), and the most significant threat is deforestation. In 2008, the Departamento de Áreas Protegidas y de Vida Silvestre (DAPVS) in Honduras estimated that 80,000 ha (197,684 ac) of natural areas were being destroyed annually (DAPVS 2008 in Devenish et al., 2009 p. 256).

The great green macaw is believed to exist in the Río Plátano Biosphere Reserve within the watershed of the Plátano River (Monge et al. 2009, p. 8). The area is also known as the “Mosquitia Hondureña,” which is 500,000 ha (1,235,527 ac) in size. The reserve serves as protection to the 100-km (62-mi) long Plátano River watershed in addition to protecting parts of the Paulaya, Guampu, and Sicre rivers (Devenish 2009, p. 256). Several indigenous tribes such as the Miskito, Tawahka, Pech, Garífunas, and “Mestizos” use this area for their traditional livelihoods. Although this reserve was designated as a World Heritage Site, pressures to the reserve area for its resources continue (TNC 2011, unpaginated). In 2011, the Río Plátano Biosphere Reserve was added to the list of World Heritage Sites in danger due to encroachment (UNEP–WCMC 2011, p. 1).

In the Río Plátano Biosphere Reserve of Honduras, the unregulated extraction of timber and mass production of bananas has caused an alarming decline of great green macaw populations (Devenish et al. 2009, p. 256). The deforestation in Honduras is occurring as a result of an increase in the human population, which requires clearing areas for home development as well as wood products (Devenish et al. 2009, p. 256). The annual human population growth rate as of 2011 was estimated to be 1.09 percent (U.S. Department of State 2011, unpaginated). Palacios and Brus Laguna, towns on the coast approximately 5 km (3.1 mi) from the park on either side of the reserve, are likely contributing to the pressures such as agriculture and logging that are occurring illegally in the reserve.

Nicaragua

In Nicaragua, great green macaws face reductions in populations due to illegal extraction of timber and agricultural expansion (McGinley et al. 2009, pp. 13, 33, 35; Jeffrey 2001, pp. 1–5). Overall, there is a lack of information about the status of the great green macaw population and its habitat in Nicaragua (Monge et al. 2010; Monge et al. 2009, pp. 52–53). However, a population of the great green macaw is known to occur in the Indio-Maíz Biological Reserve, located in Nicaragua just across the San Juan River at the northeastern border of Costa Rica (Monge et al. 2009, p. 51), where suitable habitat for this species remains. This reserve, which is believed to be one of the few strongholds for the great green macaw, is nearly 264,000 ha (652,358 ac) in size. It is likely that the Indio-Maíz Biological Reserve contains extensive forest areas with high densities of almendro trees (Chun 2008, p. 94) and, therefore, is critical to this

species' survival. Chun suggests that many areas in Nicaragua may exceed the minimum great green macaw nesting requirement of 0.20 trees per hectare within the breeding territory.

Although the Indio-Maíz Biological Reserve is considered one of Nicaragua's best preserved forested areas and has limited access, its buffer zone has recently been under assault from activities such as loggers in search of lumber and illegal farming of *Elaeis guineensis* (African palm) trees for biofuel (Chosset and Arias 2010, p. 3; Ravnborg et al. 2006, p. 2). As resources become scarcer in the buffer zones, illegal activities push farther into the lesser disturbed and lesser accessible areas. Despite the existence of this protected area, deforestation continues to occur.

Deforestation is one of the major threats to biodiversity in this region; one steadily increasing form is the conversion of forest into agricultural or pastoral lands (Chassot et al. 2006, p. 84). In Nicaragua, between 1990 and 2005, 1.35 million ha (3.34 million ac) of forested areas were converted to agriculture or were deforested due to other reasons such as logging (FAO 2010, p. 232; FAO 2007). Much of Nicaragua has protected status. In 2005, approximately 36 percent of Nicaragua's forested area was designated as protected or in some form of conservation status (FAO 2007). Additionally, in 2007, there were 72 protected areas in Nicaragua's National System of Protected Areas (Castellon 2008, p. 19). However, 88 percent of Nicaragua's area designated as forest is privately owned (FAO 2010, p. 238) and, therefore, is not protected. Additionally, much of the logging that occurs is illegal and is not monitored (Pellegrini 2011, p. 21; Richards et al. 2003, p. 283).

As an example, the Bosawas Reserve is one of the areas believed to contain great green macaws as well as suitable habitat for a viable population. It was designated a reserve in 1979, in response to the advance of the agricultural frontier (Cuéllar and Kandel 2005, p. 9). However, during the 1980s, the area was not managed; it was the battleground for the armed conflict between the Sandinistas and the Contras (Cuéllar and Susan Kandel 2005, p. 9). In October 1991, Bosawas was declared a National Natural Resource Reserve through Executive Decree No. 44-91. Despite its designation as a protected area, encroachment and habitat degradation still occur (McCann et al. 2003, p. 322). In Bosawas, indigenous tribal communities have rights to use the forests under the Autonomy Statute of 1987 (Cuéllar and Kandel 2005, p. 11). As of 1998, the indigenous population was approximately 9,200 in or near the Bosawas reserve (Stocks et al. 2007, p. 1,497). In 2005, the Nicaraguan Government granted land titles to 86 indigenous Miskitu and Mayangna groups in Bosawas and contiguous indigenous areas (Stocks et al. 2007, p. 497). Generally, these indigenous communities manage the forests well and want to maintain their traditional way of life. However, “mestizo” communities were encouraged to settle in the area that is now the reserve’s buffer zone during the period when lands were being converted to plantations. Both the mestizo and indigenous communities depend on access to land to ensure their livelihoods. However, the mestizo communities convert primary forest to agricultural or livestock uses (Cuéllar and Kandel 2005, p. 13), while the indigenous communities have less impact on the ecosystem. Land rights disputes are common in these areas, and land use rights are often unclear. The Government of Nicaragua is attempting to manage these issues (Pellegrini 2011, p. 21), but conflict and practices that degrade the great green macaw’s habitat persist both in the Bosawas Reserve and in other areas within the range of the species.

One of the factors contributing to deforestation in this area is a high rate of poverty (Pacheco et al. 2011, p. 4). Nicaragua is the poorest country in Central America (CIA World Factbook 2014). In part, due to the high rate of poverty, the great green macaw continues to face threats to its habitat. Communities living within the range of the great green macaw practice unsustainable activities, such as conversion of habitat to agriculture or logging, which contribute to deforestation of the species' remaining habitat in Nicaragua (McGinley 2009, p. 36; Castellon 2008, pp. 21, 30; Richards et al. 2003, p. 282). Much of the Indio-Maíz Biological Reserve is described as being intact and unlogged (Chun 2008, p. 116). Despite this, some loggers cross the border into Nicaragua to harvest the almendro tree (Schmidt 2009, p. 16; Chassot et al. 2006, p. 84). Anecdotal reports indicate that Costa Rican loggers pay Nicaraguan farmers about \$15 for each almendro tree, bring the logs to Costa Rica, and sell them for about \$1,450 in Costa Rica (Arias 2002, p. 4). Because incomes in the Bosawas region of Nicaragua were found to average under \$800 per family per year (Stocks et al. 2007, p. 1,498), the almendro trees are quite valuable. Consequently, a binational biological corridor between Nicaragua and Costa Rica was proposed in an attempt to prevent the extinction of the almendro tree (Chassot et al. 2006, p. 84). Although this corridor exists and efforts are in place (refer to discussion under Factor D, below) to mitigate border issues (Hernandez et al., undated, pp. 1–14) in this region, habitat degradation continues.

Panama

In Panama, this species is believed to primarily exist in the Darién region, which borders northern Colombia (Angeher 2004, *in litt.*). Deforestation was estimated to exceed 30 percent of

the species' original range in Panama (Angehr 2004, *in litt.*). Although there is limited information available on the threats affecting great green macaw populations in Panama, deforestation is known to occur within this species' range (Monge et al. 2009, p. 68; Angehr 2004, *in litt.*). Conflict regarding land rights of indigenous communities has become one of the most critical issues in the Darién region. The most significant threats to tropical forests in Panama overall include road construction and road improvement, especially in the Darién region, and agricultural expansion, particularly in the Darién and Bocas del Toro regions, which results in increased access to forests (Parker et al. 2004, p. V-2). Roads have been found to be one of the leading causes of global biodiversity loss (Benítez-López et al. 2010, p. 1,307). The construction of the Pan-American Highway and other roads are affecting the Darién forest area (TNC 2011, p. 1). When roads are constructed, they increase access to previously inaccessible areas. This leads to more pressures on the forested areas, such as conversion to agriculture, competition for resources (such as the extraction of plant species that may be consumed by the great green macaw), and more logging.

A 2006 report indicated that the advance of the agricultural frontier and “spontaneous colonization” occurring at a rate of 50,000 to 80,000 ha (123,500 to 197,700 ac) per year is rapidly shrinking Panama’s forests and protected areas (McMahon et al. 2006, p. 8). Prior to its formal designation in 1990, La Amistad National Park, which spans the border between Costa Rica and Panama, experienced impacts from cattle ranching, timber extraction, burning, and illegal settlements (UNEP–WCMC 2011, p. 7). Trails, human encroachment, roads, grazing, and hunting continue in this area and affect this species’ habitat (TNC 2012, unpaginated; UNEP–WCMC 2011, p. 7). Soil and water resources have been depleted due to traditional agricultural

practices and inadequate conservation measures. Indigenous production systems, with their low-intensity land use, long rotation periods, and plentiful forests for hunting and gathering, are increasingly becoming unsustainable due to economic pressures. These indigenous production systems are being replaced by farming systems that emphasize monoculture without rotation, which leads to depleted soils and encourages greater expansion of the agricultural frontier. These threats are exacerbated by rural poverty that drives populations in search of areas with high levels of globally significant biodiversity (Pacheco et al. 2011, pp. 4, 18). As a result of competition for resources, many farmers and indigenous people have emigrated to the Darién and Bocas del Toro provinces, where the great green macaw is believed to exist in larger numbers than in other parts of the species' range. Unsustainable land practices, the lack of capacity by both public and private stakeholders to encourage sustainable land use, infrastructure development, and the lack of management plans further exacerbate the degradation of this species' habitat.

Darién forests are under pressure from the expanding agricultural frontier and related colonization (TNC 2011, p. 1; McMahon 2006, p. 8). The region's human population is growing at a rate of about 5 percent a year. Loss of forest cover is often linked to agricultural expansion, which often follows new or improved roads, and which results in increased access to forests. Slash-and-burn agriculture has resulted in huge tracts of deforested land. Other factors that affect the stability of great green macaw populations include the National Authority for the Environment's (ANAM) inability to fund programs for protected areas and buffer zones, and the extraction of other minerals and building materials, whether legal or illegal (Angehr et al. 2009, p. 291). Logging and mining is legally restricted in the area; however, logging still occurs

outside the Darién reserve, and the practice encroaches on remaining forest cover in the buffer zone. Problems in or adjacent to protected areas include illegal clearing for development, agriculture, and cattle grazing; road construction; and extraction of minerals or construction materials (Devenish et al. 2009b, p. 291).

The presence of gold mines in the Darién Region, particularly the Cerro Pirre area, was also indicated to be a threat to the species. Significant mining activities in this area were conducted prior to the 18th century. The clearing of forests to create roads for mining facilitates the transport of materials and personnel in and out of the mining zones (Robbins et al. 1985, pp. 200, 202). Roads exacerbate deforestation practices such as logging and conversion to agriculture or other land uses, as well as colonization. This area is now an ecotourism site; as of 1985, there is now second-growth forest recovery from the gold mines that had been abandoned during the 18th century. It does not appear that mining in this area still occurs, and, therefore, mining is not currently impacting the species.

Summary of Factor A

The global population of great green macaws is decreasing due to the loss of much of the older forested areas, thus reducing high-quality habitat for this species, and relegating it to relatively small and isolated patches throughout its range; however, suitable habitat remains in some protected areas in Central and South America. Habitat degradation poses a significant threat throughout the range of the great green macaw, which is especially vulnerable to the

effects of isolation and fragmentation because it tends to mate for life, it has a small clutch size and specialized habitat requirements, and its populations are small and decreasing.

The great green macaw is naturally associated with unfragmented, mature, forested landscapes, and is considered a habitat specialist that selects areas of contiguous mature forest in Central America and parts of northern South America (Monge et al. 2009; Madriz-Vargas 2004, p. 7). This species requires large areas for its feeding requirements and is not well adapted to fragmented landscapes. Deforestation results in fragmented forests with high ratios of edge to forested area, and the original biodiversity upon which this species depends is lost. Greater exposure of soil to direct sunlight leads to factors such as drier soils and also creates an altered growing environment. Because there are fewer remaining older, complex forest stands providing adequate habitat for breeding, feeding, and nesting, great green macaw populations are in decline. The great green macaw is threatened by the impacts of both past and current habitat loss, including ongoing habitat modification that results in poor quality and insufficient forest habitats, habitat fragmentation, and isolation of small populations. The ability of the great green macaw to repopulate an isolated patch of suitable habitat following decline or extirpation is particularly unlikely due to the species' large home range requirements, and this is exacerbated by its small overall population size and the large distances between the remaining primary forest fragments. Despite the existence of the binational corridor in Nicaragua and Costa Rica and a multitude of conservation efforts, we find that the present or threatened destruction, modification, or curtailment of habitat is a threat to the great green macaw now and in the future.

B. Overutilization for commercial, recreational, scientific, or educational purposes

Because this species has an extremely small and fragmented population, poaching, while apparently uncommon, remains a concern (Botero-Delgadillo and Páez 2011, p. 13; Monge et al. 2009, pp. 26, 40, 106). Removal of this species from the wild has a significant detrimental effect to this species because this species tends to mate for life and only produces 1 or 2 eggs annually. The species has been heavily poached in the wild historically and is still trafficked for the pet trade in Honduras and Nicaragua (Anderson 2004, p. 453; <http://www.lafeberconservationwildlife.com/?p=1714>, accessed December 14, 2011). Although there are no known current reports of poaching in all parts of its range, poaching was raised as a concern at the 2008 workshop held in Costa Rica on this species (Monge et al. 2009, various). After regulatory mechanisms such as CITES and the WBCA were put into place, particularly since 1992 when the WBCA went into effect, much of the legal trade in the great green macaw declined (see discussion of military macaw for more information about WBCA) (UNEP-WCMC CITES trade database, accessed September 6, 2011). The great green macaw was listed in CITES Appendix II, effective June 6, 1981, and was transferred to Appendix I, effective August 1, 1985. Most of the international trade in great green macaw specimens consists of live birds.

Data obtained from the United Nations Environment Programme–World Conservation Monitoring Center (UNEP–WCMC) CITES Trade Database show that, during the 4 years the great green macaw was listed in Appendix II, 26 live great green macaws (and an additional eight feathers) were reported to UNEP–WCMC as (gross) exports. In analyzing the data, it appears that several records may be overcounts due to slight differences in the manner in which

the importing and exporting countries reported their trade. It is likely that the actual number of live great green macaws in international trade during this period was 22. All of the live birds were reported with the source “unknown.” Exports from range countries included six live birds from Panama and five live birds from Nicaragua (UNEP–WCMC 2011).

During the more than 28 years following the transfer of the species to Appendix I (August 1985 through December 2013, the last year for which complete data were available at the time the following numbers were compiled), the UNEP–WCMC database shows 920 live birds in international trade. However, because it is some over-counts likely occurred in the database due to slight differences in the manner in which the importing and exporting countries reported their trade, it is likely that the actual number of live great green macaws in international trade during this period was 831 (U.S. CITES Management Authority 2015). Of these, 776 were reported to be captive-bred or captive-born, 5 were reported as wild, and 15 were reported as “pre-Convention.” The source of the remaining live birds is unknown. Exports of live birds from range countries included 17 from Costa Rica, 10 from Ecuador, 12 from Nicaragua, and 6 from Panama. Note also that some of these birds may be personal pets that are counted more than once.

Historically, the pressure to remove this species from the wild for the pet trade has contributed significantly to the decline in population numbers for this species. Poaching continues to occur in this species’ range, particularly in Nicaragua (Castellon 2008, pp. 20, 25; Kennedy 2007, pp. 1–2; BLI 2007, p. 1). The majority of information available for Central America regarding poaching and the sale of parrot species were focused in Nicaragua (Herrera-Scott 2004, pp. 1–2). A study published in 2004 assessed the origin and local sale and export of

parrots and parakeets in Nicaragua (Herrera-Scott 2004, pp. 1–2), and focused on the buffer zone of the Indio-Maíz Biological Reserve, a critical area for the great green macaw. The study followed the marketing chain from rural areas to the capital city. Most of the wildlife trade was found to occur in Managua. As of 2000, poaching was still occurring in the buffer zone of the Indio-Maíz Biological Reserve (Herrera-Scott 2004, p. 6). An estimated 7,205 parrots were sold during that year (Herrera-Scott 2004, p. 1). The legal export of wildlife species from Nicaragua in general decreased significantly between 2002 and 2006 (McGinley 2009, p. 16). Despite the decrease in legal trade, in 2007, a number of parrot species could be still found for sale along roads to tourists (Kennedy 2007, pp. 1–2; BLI 2007, p. 1). Nicaragua is the poorest country in Central America and the second poorest in the Hemisphere, and has widespread underemployment and poverty (CIA World Factbook 2011, unpaginated; FAO 2011, p. 1). Approximately 17 percent of its population lives in extreme poverty (Castellon 2008, p. 21). Many of Nicaragua’s citizens live in rural areas where they usually earn a living from agriculture and fishing, and the sale of a parrot can significantly increase their earnings. As mentioned above under the Factor A discussion, incomes in the Bosawas region of Nicaragua were found to average under \$800 per family per year as of 2007 (Stocks et al. 2007, p. 1,498). The great green macaw was found for sale at an average of \$200 to \$400 U.S. dollars (USD) (Fundacion Cocibolca in BLI 2007, p. 1). For perspective, in the United States, captive-bred specimens can sell for up to \$2,500 USD (Basile 2009, p. 6). The high commercial value, especially in relation to the average family income, indicates that it is still worthwhile to poach and sell this species. Due to the extreme poverty in Central America, particularly in Nicaragua, and due to the high commercial value of great green macaws, poaching continues to be a significant concern for this species.

Poaching can be intertwined with habitat destruction (Factor A). Some poachers still cut down trees to obtain nestlings (Hardman 2011, p. 13; Chun 2008, p. 105). This practice of cutting down trees to remove nestlings is particularly devastating to small populations reliant upon certain types and sizes of nesting trees. Not only are poachers removing vital members of the population, they are destroying a nest site that may have taken a breeding pair several years to find and cultivate. One study looked at 51 nest sites that had been identified between 1994 and 2003 (Chun 2008, p. 105). The study evaluated potential habitat by examining the presence and density of almendro trees by aerial survey. It examined portions of two protected areas—the San Juan–La Selva Biological Corridor and the Maquenque National Wildlife Refuge (Chun 2008, p. 117). Of 51 nest sites, 10 trees had been cut by the end of the survey period. In some cases, the nests had been deliberately cut even after the tree had received protection status and had been distinguished as a nesting tree with a plaque. Nest destruction has also been reported in Ecuador (Bergman 2009, pp. 6–8), where it is estimated to have an extremely small population. Another study confirmed the presence of nest destruction, although this was a different parrot species, and found an average of 21 nests was destroyed per poaching trip (Gonzalez 2003, p. 443).

Poaching for the pet bird trade can destroy pair bonds, remove potentially reproductive adults from the breeding pool, and have a significant effect on small populations (Kramer and Drake 2010, pp. 511, 513). This is in part because this species mates for life, is long-lived, and has low reproductive rates. These traits make them particularly sensitive to the effects of poaching (Lee 2010, p. 3; Thiollay 2005, p. 1121; Wright et al. 2001, p. 711). In some areas in

Costa Rica, there were no recent reports of nest poaching due to conservation efforts (Villate et al. 2008, p. 23). However, despite conservation efforts in place, the conservation workshop for *Ara ambiguus* held in 2008 indicated that poaching of this species is still a concern throughout its range (Monge et al. 2009, pp. 18, 26, 29, 40).

Summary of Factor B

Conservation efforts by various entities working to ensure the long-term conservation of the great green macaw may result in its population slowly increasing (Monge et al. 2010, pp. 12–13). However, overall, the best available information indicates that the population is still declining (Botero-Delgadillo and Páez 2011, p. 91; Monge et al. 2009). The species still faces threats such as habitat loss and poaching. Often, there is a lag time after factors have acted on a species (i.e., poaching and habitat loss) before the effect is evident (Sodhi et al. 2004, p. 325). Even though the great green macaw is listed as an Appendix-I species under CITES and commercial international trade is now significantly reduced, there is still concern about the illegal capture of this species in the wild. This species is desirable as a pet, and its native habitat is in impoverished countries, where the sale of an individual bird can significantly increase an individual's income. Despite regulatory mechanisms in place, poaching is lucrative and still occurs. Additionally, because each population of great green macaws is small, with possibly between 10 to 500 individuals (Monge et al. 2010, pp. 21, 22), poaching is likely to have a significant effect on the species. The populations are distributed widely throughout the range of the species (see Figure 3) and are highly fragmented, and the amount of interaction between populations is unknown but likely infrequent. Based on the best available information, we find

that overutilization, particularly due to poaching, is a threat to the great green macaw throughout its range now and in the future.

C. Disease or predation

We have no evidence of significant adverse impacts to wild populations of great green macaws due to disease. Diseases are a normal occurrence within wild populations. They do not occur to an extent that they are a threat to this species, particularly because the populations are widely dispersed, which provides an element of resiliency to the overall population. We conclude, based on the best available scientific and commercial information, that disease is not a threat to the great green macaw now or in the future.

In addition, we have no information indicating that predation threatens the great green macaw. This is the second largest New World macaw, and the best available information does not indicate that predation is a factor that negatively affects this species. While predators undoubtedly have some effect on fluctuations in great green macaw numbers, there is no evidence to suggest that predation has caused or will cause long-term declines in the great green macaw population. Therefore, we have determined that this factor does not pose a threat to the great green macaw, now or in the future.

D. The inadequacy of existing regulatory mechanisms

Regulatory mechanisms affecting this species that we evaluated could potentially fall under categories such as wildlife management, parks management, or forestry management. We primarily evaluated these regulatory mechanisms in terms of nationally protected parks because this is where this species generally occurs. A summary of the status of forest policies, regulatory mechanisms, and laws in the range countries of the great green macaw is below. The most authoritative source for assessing the state of forests is the United Nations Food and Agriculture Organization's Forest Resources Assessment (FAO) (Chomitz et al. 2007, p. 42). FAO's 2010 study found that each range country for this species has a national forest law, policy, or program in place, and Table 1 indicates the year it was last evaluated. However, the study found that few forest policies at the subnational level (such as jurisdictions equivalent to states in the United States) exist in these countries.

Table 1. Adapted from FAO Global Forest Resource Assessment 2010, pp. 302–303.

Country	National Forest Policy		National Forest Program			Forest Law National		
	Exists	Year	Exists	Year	Status	National – type	Year	Subnational Exists
Colombia	Yes	1996	Yes	2000	Under revision	Incorporated in other law	1974	No
Costa Rica	Yes	2000	Yes	2001	Under revision	Specific forest law	1996	No
Ecuador	Yes	2002	Yes	2002	In implementation	Specific forest law	1981	No
Honduras	Yes	1971	Yes	2004	In implementation	Specific forest law	–	No
Nicaragua	Yes	2008	Yes	2008	In implementation	Specific forest law	2003	Yes
Panama	Yes	2003	Yes	2008	Unclear	Specific forest law	1994	No

In 2007, FAO noted that many countries (in the range of the great green macaw) had enacted new forest laws or policies within the past 15 years, or had taken steps to strengthen their

existing legislation or policies. Among countries that had enacted new forest legislation were Costa Rica, Honduras, Nicaragua, Panama, Colombia, and Ecuador (FAO 2007, p. 43). Despite the existence of these laws and policies, the populations of the great green macaw are still negatively affected by habitat loss, encroachment, and, to a lesser extent, poaching.

Parks and Habitat Management

Throughout this species' range, we found that many of the threats that occur to this species are the same or similar. Threats generally consist of various forms of habitat loss or degradation (see Factor A discussion, above). Each range country for this species has protections in place, but for reasons such as limited budgets and limited enforcement capabilities, the laws and protections are generally not able to adequately protect the species. Our analysis of regulatory mechanisms is discussed essentially on a country-by-country basis, beginning with Colombia, and is summarized at the end.

Colombia

Colombia has enacted numerous laws to protect species and their habitats. This species exists predominantly in areas that are protected, and Colombia has several laws that pertain to protected areas. Some of these laws include:

- Natural Resources and Decree Law number 2811/74.
- Decree 1974/89: Regulation of Article 310 of Decree 2811, 1974, on integrated management districts of natural renewable resources.

- Law number 99/93: Creates the Ministry of the Environments and the National Environmental System.
- Law number 165/94: Biological Diversity Treaty.
- Decree 1791/96: Establishment of the Forest Use Regime.

A list of legislation that applies to protected areas in Colombia is available at <http://www.humboldt.org.co/ingles/en-politica.htm> and at <http://www.regulations.gov> in Docket No. FWS-R9-ES-2011-0101. A discussion of Colombia's regulatory mechanisms with respect to the great green macaw follows.

The great green macaw is listed as vulnerable on Colombia's Red List (Renjifo et al. 2002, p. 524). Resolution No. 584 of 2002 provides a list of Colombian wildlife and flora that are considered "threatened." Colombia defines threatened as those species whose natural populations are at risk of extinction if their habitat, range, or the ecosystems that support them have been affected by either natural causes or human actions. Threatened species are further categorized as critically endangered, endangered, or vulnerable. Colombia defines a critically endangered species as one that faces a very high probability of extinction in the wild in the immediate future, based on a drastic reduction of its natural populations and a severe deterioration of its range. An endangered species is one that has a high probability of extinction in the wild in the near future, based on a declining trend of its natural populations and a deterioration of its range. A vulnerable species is one that is described as not in imminent danger of extinction in the near future, but it could be if natural population trends continue downward and deterioration of its range continues (EcoLex 2002, p. 10).

Colombian Law No. 99 of 1993 created the Ministry of the Environment and Renewable Natural Resources and the National Environmental System (SINA). SINA sets out the principles governing environmental policy in Colombia, and provides that the country's biodiversity is protected and used primarily in a sustainable manner (Humboldt Biological Resources Research Institute 2011, unpaginated; EcoLex 1993, p. 2). SINA is a set of activities, resources, programs, and institutions that allow the implementation of environmental principles. Consistent with the Constitution of 1991, this management system was intended to be decentralized. However, an environmental assessment study conducted for the World Bank in 2006 found that Colombia's current decentralized system is inadequate as implemented (Blackman et al. 2006, p. 15). Although Law 99 assigns the role of leading and coordinating environmental management in Colombia to the Ministry of Environment (Ministerio del Medio Ambiente, MMA), Colombia's Autonomous Regional Corporations (CARs) have the role of implementing environmental laws (Blackman et al. 2006, pp. 39–40, 42). CARs have responsibility for both management of natural resources and economic development (Ministry of Environment et al. 2002).

In 2006, an analysis of the effectiveness of Colombia's CARs was conducted for the World Bank. In Blackman et al. 2006's analysis, they reported that many individuals both inside and outside the government felt there was a lack of effectiveness of SINA. For example, Colombia's efforts to eradicate the coca trade has not been effective at reducing the amount of coca being cultivated (Page 2003, p. 2; also see *The present or threatened destruction, modification, or curtailment of its habitat or range*). In addition to not adequately addressing the coca cultivation, which destroys the great green macaw's habitat, aerial fumigations of the coca crop have destroyed banana fields and polluted the environment (Page 2003, p. 2). The

effectiveness of these regional management groups varied; the study found that the effectiveness was correlated with the CARs' age, geographic size, and level of poverty (Blackman et al. 2006, p. 16). Due to the decentralized structure, CARs were found to be ineffective at environmental management in Colombia (Blackman et al. 2006, p. 14).

This species' habitat occurs to some extent in areas designated as protected by SINA, including five national parks (Rodríguez-Mahecha 2002a). Two parks are particularly significant: Katíos National Park and Utría National Park. Although this species likely exists in at least these two parks (Botero-Delgadillo and Páez 2011, p. 92), no protective measures have been actually implemented to curb human impacts on the species' habitat by the indigenous and farming residents within these protected parks (Botero-Delgadillo and Páez 2011, p. 92). Cultivation of plants for cocaine production is known to occur within the boundaries of Katíos National Park. The cultivation of illegal crops (particularly coca) poses additional threats to the environment beyond the destruction of montane forests (Balslev 1993, p. 3). Coca crop production destroys the soil quality by causing the soil to become more acidic, depletes the soil nutrients, and ultimately impedes the regrowth of secondary forests in abandoned fields (Van Schoik and Schulberg 1993, p. 21; also see *The present or threatened destruction, modification, or curtailment of its habitat or range* discussion, above). As of 2007, Colombia was the leading coca producer (United Nations Office of Drugs and Crime (UNODC) et al. 2007, p. 7). Since 2003, cocaine coca cultivation has remained stable at about 800 km² (309 mi²) of land under cultivation (UNODC et al. 2007, p. 8). This activity continues to degrade and destroy great green macaw's habitat. With respect to Utría National Park, little to no information is known about the status of the species in this area (Botero-Delgadillo and Páez 2011, p. 91). Although it

is extremely remote, human communities reside within and around the park, and continue to use the resources within the park.

Despite Colombia's numerous laws and regulatory mechanisms to administer and manage wildlife and their habitats, the great green macaw continues to face many threats to its habitat. There is little information available about the species (Botero-Delgadillo and Páez 2011, p. 90), and the most recent information indicates that no conservation action has been proposed for this species (Botero-Delgadillo and Páez 2011, p. 88). On-the-ground enforcement of existing wildlife protection and forestry laws, and oversight of the local jurisdictions implementing and regulating activities, are ineffective at mitigating the primary threats to the great green macaw. As discussed under *The present or threatened destruction, modification, or curtailment of its habitat or range* (above), habitat destruction, degradation, and fragmentation continue throughout the existing range of the great green macaw. Therefore, we find that the existing regulatory mechanisms currently in place are inadequate to mitigate the primary threats of habitat destruction to the great green macaw in Columbia.

Costa Rica

In Costa Rica, there are more than 30 laws related to the environment (Peterson 2010, p. 1). A list of the environmental laws in Costa Rica is available at: <http://www.costaricalaw.com/costa-rica-environmental-laws.html>. As deforestation is the most significant factor affecting the great green macaw, some laws applicable to the conservation of the great green macaw are:

- Law No. 2790 Wildlife Conservation Law (“Ley De Conservación De La Fauna Silvestre,” July 1961).
- Law No. 7317 Wildlife Conservation Law (“Ley De Conservación De La Vida Silvestre,” December 1992).
- Law 7554 Law of the Environment (“Ley Orgánica del Ambiente,” October 1995).
- Law No. 7575 Forestry Law (“Ley Forestal,” February 1996).
- Law 7788 Biodiversity Law (In 1998, the National System of Conservation Areas (SINAC) was created through this law (Canet-Desanti 2007 in Villate et al. 2008, p. 24).

In the early 1990s, Costa Rica had one of the highest deforestation rates in Latin America (Butler 2012, p. 3). Forest cover in Costa Rica steadily decreased from 85 percent in 1940, to around 35 percent today, according to the FAO's State of the World's Forests (Butler 2012, unpaginated; FAO 2010, pp. 227, 259; FAO 2007). Historically, clearing for agriculture, particularly for coffee and bananas, in addition to cattle pastures was the main reason for Costa Rica's rainforest destruction. During the 1970s and early 1980s, vast expanses of rainforest had been burned and converted to cattle pastures. Today, although deforestation rates of natural forest have dropped considerably, Costa Rica's remaining forests still experience illegal timber harvesting (in protected areas) and conversion to agriculture (in unprotected zones) (Butler 2012, unpaginated; Monge et al. 2009, p. 121; FAO 2007). Despite its abundance of conservation legislation, Costa Rica has undergone significant periods of deforestation (Butler 2012, unpaginated; FAO 2007, p. 38), which have had a severe effect on the great green macaw.

Almendro Tree Protection

In Costa Rica and Nicaragua, the great green macaw is highly dependent on the almendro tree. This tree species is now protected by law in Costa Rica; cutting any almendro tree over 120 cm (47.2 in) or less than 70 cm (27.6 in) in diameter is prohibited (Rainforest Biodiversity Group 2008, p. 1). The remaining Costa Rican populations of almendro trees are concentrated in the northeastern corner of the country from the San Juan River south to Braulio Carrillo National Park (Hanson 2006, p. 3). Although little forest remains undisturbed in this region, many almendro trees were left standing in fragments or pastures, partly due to the extremely dense nature of the tree's wood and the difficulty in cutting down these trees.

As a result of the great green macaw's dependence on almendro trees, conservation efforts for the great green macaw have focused on this tree species. A decree was enacted in 2001 to limit extraction of the almendro tree. Harvest was temporarily suspended until a study could be conducted to evaluate the status of this primary food and nesting source in relation to the great green macaw (Chosset et al. 2002, p. 6). According to Costa Rican legislation (Decree No 25167-MINAE), the removal or logging of almendro trees had been illegal in the area between the San Carlos and Sarapiquí Rivers (Madriz-Vargas 2004, p. 9). The objective of the restrictions placed on extraction of almendro trees was to increase the number of nesting sites for the great green macaw and to prevent the tree from becoming extinct; however, forest clearings continued to occur at an alarming rate due to the lack of resources to protect biological reserves (Madriz-Vargas 2004, p. 8). For example, researchers reported in 2003 that, of the 60 great green macaw nests identified since the great green macaw conservation project was initiated in

1994, 10 had been cut down by forest engineers working in forest management plans (Monge and Chassot 2003, p. 4). In 2008, Costa Rica's Supreme Court stated that MINAE must abstain from the continuation or initiation of the use, exploitation, or extraction of the almendro tree (Chun 2008, p. 113). In Costa Rica, fines for those who cut down almendro trees have been proposed as a measure, although penalties reportedly have not been instituted (Botero-Delgado and Páez 2011, p. 92).

Great Green Macaw Conservation

In the two core areas where the great green macaw exists in Costa Rica, conservation activities are under way, and the breeding populations are being closely monitored. Quebrada Grande is a community-operated, 119-ha (294-ac) reserve in the center of great green macaw habitat. Additionally, the National Green Macaw Commission was formed in 1996 to protect and manage this species' habitat. This commission was formed in response to the severe decline of the great green macaw population, and included 13 government agencies, NGOs, and the Sarapiquí Natural Resources Commission (CRENASA). This conservation effort was formalized by Executive Order No. 7815-MINAE of 1999. The group served as an advisory body to MINAE regarding environmental issues in the northern zone of Costa Rica that affect the great green macaw (Chassot and Monge 2008 in Villate et al. 2008, p. 22). Conservation efforts are still in progress; in 2008, a workshop was held to bring together species experts and government officials to identify priorities and goals in order to conserve the species (Monge et al. 2009, entire).

Additionally, a corridor was created in 2001, with the goal of maintaining connectivity and biodiversity between protected areas in southeastern Nicaragua, the Protected Conservation Area Arenal Huetar North (ACAHN), and Conservation Area of the Central Volcanic Cordillera (ACCV) in Costa Rica. The primary purpose was to promote the creation of protected wilderness and encourage habitat protection necessary to preserve and increase the great green macaw population (Villate et al. 2008, p. 24).

In 2005, the Maquenque National Wildlife Refuge (MNWR) was established primarily to protect breeding habitat for the great green macaw. Approximately 43,700 ha (107,985 ac) of land identified as potential great green macaw breeding habitat lies within the boundaries of MNWR (Chun 2008, p. 113). This region was targeted because it contains several large nesting trees used by great green macaw breeding pairs. MNWR protects foraging habitat that may be critical during the great green macaw's breeding season. MNWR is within the larger San Juan La Selva (SJLS) Biological Corridor, and its goal is specifically to connect protected areas in southern Nicaragua to those in central Costa Rica (Chun 2008, p. 98). However, even in this refuge, habitat degradation continues to occur. A RAMSAR (the Convention on wetlands) report on this refuge (which is a RAMSAR site), indicated that the main threats there are agricultural and forestry activities, which are most prevalent near the Colpachí and Manatí lagoons (RAMSAR 2012, p. 1).

In summary, as of 2002, less than 10 percent of the great green macaw's original range was estimated to exist in Costa Rica (Chosset et al. 2002, p. 6). The great green macaw greatly depends on the almendro tree as its primary food and nesting resource. However, due to Costa

Rica's complex deforestation history, the great green macaw remains imperiled primarily due to habitat fragmentation, degradation, and habitat loss. In 2004, a maximum of 35 pairs were estimated to be breeding in northern Costa Rica (Chosset et al. 2004, p. 32), and the population in this country appears to have increased since a conservation program and regulatory mechanisms have been in place. Costa Rica's population was estimated to be approximately 300 birds in 2010 (Chassot 2010 pers. comm. in Hardman 2011, p. 11; Monge et al. 2010, pp. 13, 22). Despite the apparent increase in the population in Costa Rica, the population is extremely small and has experienced significant decline in available habitat over the past 60 years.

Habitat Degradation

In addition to the historical loss of habitat, the species continues to face threats such as habitat degradation. This species requires a complex suite of plant species over the course of a year for its nutritional needs. Pressures to its habitat such as logging, encroachment, habitat degradation, and likely other factors continue within this species' range. Despite conservation efforts in place, such as conservation awareness programs, research, and monitoring, the population has declined significantly over time and is still only estimated to be approximately 300 individuals. Because this species mates for life and has a small clutch size, the loss of any one individual can have a significant effect on the population. Costa Rica has implemented many environmental laws in conjunction with conservation efforts to protect species, particularly the great green macaw and its habitat. The situation of this species is still precarious, and any of the threats acting on the species, such as habitat loss and degradation, poaching, or other unknown factors, could have a significant effect on the population in Costa Rica because it is so

small, and because of its life-history characteristics. The existing regulatory mechanisms, as implemented, are insufficient in Costa Rica to adequately ameliorate the current threats to this species.

Ecuador

As of 2006, the Ecuadorian Government recognized 31 various legal categories of protected lands (e.g., national parks, biological reserves, geobotanical reserves, bird reserves, wildlife reserves, etc.). The amount of protected land (both forested and non-forested) in Ecuador as of 2006 was approximately 4.67 million ha (11.5 million ac) (ITTO 2006, p. 228). However, only 38 percent of these lands had appropriate conservation measures in place to be considered protected areas according to international standards (i.e., areas that are managed for scientific study or wilderness protection, for ecosystem protection and recreation, for conservation of specific natural features, or for conservation through management intervention) (ITTO 2009, p. 1). Moreover, only 11 percent had management plans, and less than 1 percent (13,000 ha or 32,125 ac) had implemented those management plans (ITTO 2006, p. 228).

In 2004, the Ecuadorian Minister of the Environment signed a ministerial decree forming the National Strategy for the In-Situ Conservation of the Guayaquil Macaw (*Ara a. guayaquilensis*) into law (ProForest 2005, p. 3). The strategy included the following components to be implemented within 10 years. Aspects of this conservation plan, which focuses on the Cerro Blanco Protected Forest, a stronghold for great green macaw, include:

- Applied investigation for the conservation of the species;

- Management of the conservation areas where the presence of the Guayaquil macaw has been confirmed, incorporating new areas that are critical for conservation of the species, and providing connecting corridors between the areas;
- Reforestation with appropriate tree species in its habitat;
- Incentives and sustainable alternatives for communities and private property owners within its range; and
- Conservation of the Guayaquil macaw.

Despite the existence of this strategy, the great green macaw still faces significant threats in Ecuador (Horstman 2011, p. 12). There are likely fewer than 100 individuals of this subspecies remaining in Ecuador. Ecuador recognizes that threats exist to its natural heritage, not only to this species, but to all of its wildlife. In 2008, Ecuador approved Article 71 of its Constitution, which states, "Nature has a right to integrally respect its existence as well as the maintenance and regeneration of its vital cycles, structures, functions and evolutionary processes." Article 73 also mandates, "measures of precaution and restriction for all activities that could lead to the extinction of species, the destruction of ecosystems, or the permanent alteration of natural habitats."

Ecuador has made significant strides in conservation. Ecuador's Article 103 of Book IV on Biodiversity decreed that: "It is prohibited, on any day or time of the year, to hunt species, whether birds or mammals, that constitute wildlife and that are listed in Appendix 1 of the present Record that are qualified as threatened or endangered. Hunting is likewise prohibited in certain areas or zones while the bans are in effect" (Monge et al. 2009, p. 256; Unified Text of

the Secondary Legislation of the Ministry of the Environment). Despite the recent advances made in conservation efforts, Ecuador has gone through periods of devastating habitat loss and degradation, which affected the great green macaw's habitat such that it only remains in two fragmented and small areas. It is unclear how sustainable the remaining habitat is, particularly because this species has specialized feeding requirements and requires a large range to provide its nutritional needs.

The National Strategy for the In-Situ Conservation of the Guayaquil Macaw was revised in 2009. As a result, the first national census of great green macaw was conducted in Ecuador in late 2010 (Horstman 2011, pp. 16–17). The Cerro Blanco Protected Area has been managed by the Pro-Forest Foundation, an NGO, for approximately 20 years (Horstman 2011, unpaginated). Horstman indicated that, at the Cerro Blanco Reserve, the resident population of approximately 15 macaws travels widely outside of the 6,475-ha (16,000-ac) reserve (http://blogs.discovery.com/animal_news/2009/11/help-for-ecuadors-great-green-macaws.html, accessed October 28, 2011). Horstman, who has worked in this area since the early 1990s, indicated the need to establish a conservation corridor between Cerro Blanco and adjacent patches of suitable forest, and most are less than 40.5 ha (100 ac) in size. During the past 20 years, at least 2,000 ha (4,942 ac) have been reforested (Monge et al. 2009, p. 9). Although reforestation projects have occurred, encroachment is still occurring (Horstman 2011, p. 12). Despite conservation efforts and regulatory mechanisms in place, there is still limited funding available for conservation efforts. Encroachment and other forms of habitat degradation continue to occur within its habitat (see Factor A discussion, above). Therefore, we find that the regulatory mechanisms are inadequate to ameliorate the loss and degradation of great green

macaw habitat in Ecuador.

Honduras

The National Conservation and Forestry Institute (ICF) (formerly the Protected Areas and Wildlife Department, established in 1991) is responsible for regulating natural resources and management of protected areas. The National Protected Areas System includes 17 national parks created between 1980 and 2007. As of 2009, there were 79 protected areas (Triana and Arce 2012, p. 1). In 1991, the Protected Areas and Wildlife Department (which is now the National Conservation and Forestry Institute (ICF)) was designated to manage natural resources and protected areas (Devenish et al. 2009, p. 257; Decree no. 74-91, 1991). Prior to 1991, wildlife was managed by the Honduran Department of Wildlife and Ecology (RENARE).

Decree 98-2007, the Forest Law of Honduras, repealed Decree 163-93 of 1993, which contained the Law on Incentives for Forestation, Reforestation, and Forest Protection. The Forest Law sets forth the purposes of the law, and regulates the use of forestry areas, the rational and sustainable management of forestry resources, protected areas, and wildlife. The law contains definitions and created a series of administrative agencies charged with the implementation of forestry regulations, including the National Forestry Consultative Council. This law also formed the National Forestry Research System and the National Institute for Forestry Conservation and Development (211 provisions; pp. 1–17).

Before the 2007 Forest Law was approved, at least 38 laws governed the sector, creating a confusing policy framework. The situation is further complicated because, in many cases, forest tenure (ownership, tenancy, and other arrangements for the use of forests) is unclear. Although most forest is officially state-owned (FAO 2007), states have little practical authority over forest management, and individuals exercise de facto ownership. Corruption is a barrier to legal logging because it facilitates illegal operations and creates obstacles to legal ones (Pellegrini 2011, p. 18; Rodas et al. 2005, p. 53). Bribes are extorted from certified community forestry operations, and, reportedly, without bribes, transport of legal wood becomes impossible (Pellegrini 2011, p. 18; Rodas et al., 2005, p. 53).

The new 2007 Forest Law was supported by environmental groups, but its implementation was delayed. The law included the abolition of the Honduran Forest Development Corporation (COHDEFOR) (which received unanimous support), more resources for enforcement, and harsher penalties against those who commit forest-related crimes. Previously, the director of COHDEFOR and other political leaders were owners or employees of logging companies, an apparent conflict of interest (Pellegrini 2011, p. 20). Also at that time, the army was involved in enforcement. Out of the resources that were spent for the forestry sector, the military absorbed 70 percent without producing any evidence that enforcement had improved (Pellegrini 2011, p. 20).

Currently in Honduras, the great green macaw is believed to exist in eastern Honduras in suitable habitat distributed from Olancho to the Río Plátano Biological Reserve, the Tawahka Biological Reserve, and Patuca National Park (Monge et al. 2009, p. 39). Its range encompasses

both unprotected and protected areas; however, timber exploitation occurs even in areas designated as protected. This practice has created conflicts in protected areas such as the Río Plátano Biosphere Reserve, an area that is considered critical for its conservation (Lopez and Jiménez 2007, p. 26). Demand for mahogany, which has been one of the most extracted species in the area (Lopez and Jiménez 2007, p. 26), has also put pressure on this species' habitat. Selective logging creates openings in forest canopies and changes the ecosystem dynamics and composition of plant species. Income from logging is higher than that earned for crops and cattle, making logging far more lucrative for locals. However, after areas are logged, they become more accessible and are then often converted to uses such as crops and cattle grazing.

Indigenous communities have rights to use many protected areas. Article 107 of the Honduran Constitution protects the land rights of indigenous people. It is the duty of the government to create measures to protect the rights and interests of indigenous communities in the country, especially with respect to the land and forests where they are settled (Article 346). As an example of land use by Honduran indigenous communities, between 15 and 40 percent of the total value of consumption for two indigenous Tawahka communities was found to be derived directly from the forest (Godoy et al. 2002, p. 404). Struggle over land rights is a difficult issue for indigenous communities in Honduras. Logging and mining are some of the biggest threats not only to the great green macaw, but also to the indigenous communities. Indigenous cultures generally have a low impact on the forests (Stocks et al. 2007, pp. 1,502–1,503). Because indigenous communities want their lands protected for their traditional way of life, NGOs are working with these communities to protect reserves in Honduras, which should ultimately benefit the great green macaw.

In 1996, the Río Plátano Biosphere Reserve was placed on the “World Heritage Site in Danger” list, but it was removed from the list in 2007, due to a significant improvement in conservation efforts by NGOs. Several NGOs are working in this area including the Mosquitia Paquiza (MOPAWI) and the Río Plátano Biosphere Project (UNEP-WCMC 2011, p. 5). However, investigations in 2010 and 2011 indicate that there are still problems within the reserve (UNESCO 2011, pp. 1–3). UNESCO, as recently as 2011, conducted a survey in the Río Plátano Reserve and found illegal activity within the core zone (UNESCO 2011, pp. 1–3). Clearing of land for cattle grazing and illegal fishing and hunting along the river is ongoing. The area is protected by policy by the Department of Protected Areas and Wildlife, State Forestry Administration in Honduras. The reserve management plan, implemented in 2000, included zoning and specific plans for conservation issues. One of the goals of the reserve’s conservation plan is to integrate local inhabitants with their environment in part via sustainable agricultural practices. This practice has been found to be a good tool in forest conservation (Pellegrini 2011, pp. 3–8). The reserve plan established buffer zones, cultural zones, and nucleus zones. Indigenous communities living in the reserve and buffer zone are allowed to use the resources within the reserve. The integration of indigenous populations plays a large part in the success of the conservation plan, both inside the reserve and outside the reserve in the buffer and peripheral zones (Pellegrini 2011, p. 3; Stocks et al. 2007, pp. 1502–1503). This reserve also receives some funding from the World Wildlife Fund and other private organizations that assist in the management of the reserve. However, there are currently no park guards or any official entity actively patrolling or guarding the reserve to enforce restrictions.

There is a complex history concerning the balance of land rights of indigenous communities and preservation of habitat for species such as the great green macaw. In Honduras, there is a gap between forestry policy objectives and the state of forestry. The policy frameworks exist to manage timber extraction, but tools are not implemented (Pellegrini 2011, p. 1). COHDEFOR had been responsible for forestry development and enforcement of laws. The Honduran Government began to decentralize COHDEFOR beginning in 1985 (Butler 2012, unpaginated) due to its ineffectiveness. As of 2001, the management of Honduran forests was administered by the Administración Forestal del Estado (AFE, Government Forestry Administration), Corporación Hondureña de Desarrollo Forestal (COHEFOR Honduran Forestry Development Corporation) (Moreno and Marineros 2001, p. 2). Land use planning occurs at the national level; however, identifying the best use of areas has not been implemented (Pellegrini 2011, p. 17). In addition, estimates of illegal logging are approximately 80 percent of the total volume extracted for broadleaf and 50 percent for coniferous species (Richards et al. 2003, p. 1).

Honduras is making progress in managing its forested resources. In 2010, Honduras implemented Agreement number 011-2010 (Ecolex 2011), the Forestry Reinvestment Fund and Plantation Development, and its goal is to recover areas of degraded or denuded forests. In 2010, Honduras also put into place Decision No. 31/10, the General Regulation of Forestry Law, Protected Areas and Wildlife (Ecolex 2011). This covers the administration and management of forest resources, protected areas, and wildlife. Despite the progress made in Honduras with respect to laws and regulatory mechanisms that affect the great green macaw and other wildlife, the species continues to face habitat loss and degradation in Honduras.

Nicaragua

Nicaragua's General Environmental and Natural Resources Law No. 217, issued in 1996, is considered the legal framework that defines the standards and mechanisms in regard to the use, conservation, protection, and restoration of the environment and natural resources in a sustainable manner. It recognizes the sustainable development concept. By 2004, Nicaragua had enacted 10 environmental laws and was a member of regional and international environmental agreements (Moreno 2004, p. 9). As of 2004, Nicaragua was moving towards the consolidation of a National System of Protected Areas (SINAP) in order to preserve the country's biological wealth (Moreno 2004, p. 9). SINAP consists of National Protected Areas, Municipal Ecological Parks, and Private Wildlife Reserves of "ecological and social relevance at the local, national, and international level, defined in conformance with the law, and designated according to management categories that permit compliance with national policies and objectives of conservation" (McGinley 2009, p. 19; Protected Areas Regulations: Article 3). However, the overall protection and administration of SINAP is hindered by an inability to administer its financial and human resources (McGinley 2009, p. 20). Of the 72 national protected areas, only 23 had approved management plans in 2008, another 19 were in some phase of the approval process, and 30 protected areas had no management plan at all (McGinley 2009, p. 20). Despite protections in place, enforcement has been lacking in protected areas, and poverty continues to be a huge concern in Nicaragua (FAO 2011, pp. 1–2; McGinley et al. 2009, p. 16).

Three assessments of the effectiveness of Nicaragua's laws and regulations with respect to wildlife and forestry laws were recently conducted (Pellegrini 2011; McGinley et al. 2009;

Castellón et al. 2008). The first explored the relationship between forest management and poverty (Pellegrini 2011). The research published in 2009 evaluated Nicaragua's Tropical Forests and Biological Diversity (McGinley et al. 2009, entire). The other report evaluated the effectiveness of Nicaragua's wildlife trade policies (Castellón et al. 2008, entire). In Nicaragua, the organization responsible for regulation and control of the forestry sector is the National Forest Institute (INAFOR), which is under the Ministry of Agriculture, Livestock and Forestry (MAGFOR). The other relevant ministry is the Nicaraguan Ministry of Environment and National Resources (MARENA), which supports conservation awareness programs for this species. In early 2003, MARENA created the Municipal Environmental Unit in order to decentralize environmental functions. Although a good legal framework exists in Nicaragua to protect its natural resources, there are still on-the-ground problems that affect this species. For example, in the Indio-Maíz Biological Reserve, one of the strongholds for this species, each forest guard in the control posts along the border of the reserve is responsible for monitoring a stretch of 8 km (5 mi) of the border and an area of 70 km² (27 mi²) (Rocha 2012, pp. 3–6; Ravnborg et al. 2006, p. 6). There are communication and perception problems that are prevalent within the reserve that perpetuate the inability to adequately manage the resources within the reserve. These resources are used both legally and illegally by Costa Ricans who cross the San Juan River and the local communities who live in Nicaragua (Rocha 2012, pp. 3–6).

In 2008, the Government of Nicaragua published a report on the status of its wildlife laws and mechanisms (Castellón et al. 2008, entire). It reported the following findings (p. 9):

- Nicaragua's current laws are inadequate to protect and sustain domestic and international trade in CITES species. They are unfocused and lack provisions on habitat degradation and biological productivity.
- Nicaragua does not have a written wildlife trade policy or laws to underpin sustainable species management in domestic and international trade. The regulatory instruments pertaining to sustainable management of wildlife trade are relevant and coherent and provide a basis for the formulation of such a policy.
- The nonregulatory instruments for measuring the commercial sustainability of wildlife trade are rarely used. The most important of them are: monitoring, research, education, and information.
- Study of wildlife harvesting shows that the income from trade in harvested species goes principally to external actors, with little or no benefit to rural communities or populations.

The 2008 study also reported that the Government of Nicaragua was unable to find a single case in which the application of its laws led to actual fines or penalties for harvesting or trading banned species (McGinley 2009, p. 22). It found that nonregulatory instruments such as monitoring, research, education, and information are poorly used in the oversight of commercial wildlife trade in Nicaragua (McGinley 2009, p. 22). Despite these findings, a review undertaken by the CITES Secretariat found that the legislation of Nicaragua has been determined to be sufficient to properly implement the CITES Treaty (see discussion below). The country has made an effort to protect its resources and is attempting to address the management of its natural resources.

In addition, specific, targeted conservation measures are occurring. An NGO in Nicaragua, with the support of MARENA, is promoting conservation of this species. They have initiated a campaign to educate communities in part by posting messages on buses on three highly traveled public routes in Managua. For example, one message describes why buying endangered species as pets is not a good idea; rather, they should remain in the wild. Additionally, in 2003, Nicaragua and Costa Rica participated in the First Mesoamerican Congress for Protected Areas. Senior representatives of both countries discussed ways to explore the framework of connectivity between protected areas (Villate et al. 2008, p. 52). As a result, several active conservation measures for the great green macaw in Nicaragua are under way, such as the development of connected habitat corridors, and the great green macaw conservation workshop was held in 2008. In Nicaragua's Indio-Maíz Biological Reserve, training measures for monitoring the great green macaw have been implemented. For example, technicians associated with Fundacion del Rio have been trained in great green macaw research (Chassot et al. 2006, p. 86). The species' population is estimated to be only 871 individuals in Nicaragua and Costa Rica combined (Monge et al. 2010, p. 21), and pressures continue to occur to the species and its habitat. Despite regulatory mechanisms in place and the existence of many strategies in Nicaragua to combat threats to the species such as deforestation, habitat loss, and poaching for the wildlife trade, these activities continue.

The impoverished rely strongly on forest products (Pellegrini 2011, pp. 21–22). In an attempt to reduce poverty and at the same time conserve forested areas, analyses addressing poverty reduction were conducted prior to 2002. Strategies, described as Poverty Reduction

Strategy Papers (PRSPs), recommended approving a forestry law by 2002 (which actually was approved at the end of 2003) and addressing deforestation as a source of ecological vulnerability. As part of its poverty reduction strategy, Nicaragua developed a National Development Plan (Government of Nicaragua 2005 in Pellegrini 2011, pp. 21–22), the goal of which was to strengthen the whole forestry production chain. However, the plan was reported not to have been effectively implemented (Pellegrini 2011, p. 22). The main policy instruments that set the framework for forestry were the Forest Law and the logging ban. The Forest Law establishes the system of forest management (Pellegrini 2011, pp. 21–22). The law includes incentives for sustainable practices; however, Pellegrini noted that it is virtually impossible to take advantage of the law's provisions without support by external organizations such as NGOs (Pellegrini 2011, p. 22; TNC 2007, pp. 3–7).

Nicaragua is focusing efforts on the restoration and protection of forested areas, and its goal was to reduce the deforestation rate from 70,000 ha (172,974 ac) to 20,000 ha (49,421 ac) per year by 2010 (McGinley 2009, p. 28). Recently, the Associated Foresters of Nicaragua (FORESTAN), in cooperation with a local NGO, the Instituto de Investigaciones y Gestión Social (INGES), began an initiative to increase forest cover. Their goal is to incorporate conservation and production areas over 5,000 ha (12,355 ac), and more effectively use commercially valuable tree species while at the same time creating permanent jobs (INGES–FORESTAN 2005 in Sinreich 2009, p. 63). In 2006, a logging ban was put in place. The ban prohibited extraction of six species of wood and any logging operation in protected areas or within 15 km (9 mi) of all national borders, and it put the army in charge of enforcement (Government of Nicaragua 2006 in Pellegrini 2011, p. 23). However, deforestation rates may

have increased even after the ban's approval (Guzmán 2007, pp. 1–2). Although Nicaragua attempts to manage its natural resources, it has a large challenge due to the pressures for its forest resources in combination with extreme poverty (FAO 2011, p. 1; McGinley et al. 2009, p. 11). Despite these efforts, pressure on the great green macaw's habitat continues.

Panama

In Panama, the great green macaw's stronghold is believed to be in Darién National Park, which borders Colombia (Monge et al. 2009, p. 68; Angehr *in litt.* 1996 in Snyder et al. 2000, pp. 121–123; Ridgley 1982). The Darién region encompasses nearly 809,371 ha (2 million ac) of protected areas, including Darién National Park and Biosphere Reserve, Punta Patiño Natural Reserve, Brage Biological Corridor, and two reserves for indigenous communities (TNC 2011, p. 1). Panama's National System of Protected Areas (SINAP) is managed by the National Environmental Authority (ANAM) and consists of 66 areas, totaling 2.5 million ha (6.18 million ac) (Devenish et al. 2009b, pp. 1–2). Of these, 19 have management plans, and 36 have been through a process of strategic planning (ANAM 2006, unpaginated).

ANAM was established in 1998, through the General Environmental Law of Panama (Law 41). ANAM is the primary government institution for forest and biodiversity conservation and management. ANAM plans, coordinates, regulates, and promotes policies and actions to use, conserve, and develop renewable resources of the country. Its mission statement is to guarantee a healthy environment through the promotion of rational use of natural resources, the organization of environmental management, and the transformation of Panamanian culture to

improve the quality of life (Virviescas et al 1998, p. 2). Law 41 also provides the framework for SINAP. Environmental protection in Panama falls under the jurisdiction of three government agencies, the Institute for Renewable Natural Resources, the Ministry of Agricultural Development, and the Ministry of Health. There are 17 management categories of protected areas that were established through INRENARE's Resolution 09-94. A later law, the Forest Law of 2004, established protections for three types of forest, which covers 36 percent of the country.

There are political and economic pressures to develop many areas (Devenish et al 2009b, p. 291). Deforestation, in addition to the lack of management, and lease periods for these concessions of 2 to 5 years, have left only an estimated 250,000 to 350,000 ha (617,763 to 864,868 ac) of production forests in Panama (Gutierrez 2001a in Parker et al. 2004, p. I-10). Additionally, many protected areas in Panama lack adequate staff and resources to patrol the areas or enforce regulations (Devenish et al 2009b, p. 291). In 1986, Panama initiated a national forest strategy (Plan de Acción Forestal de Panama or PAFPAN) supported by FAO; however the plan reportedly did not directly tackle the causes of deforestation. Between 1980 and 1990, concessions for 77,800 ha (192,248 ac) of production forests were awarded to 23 companies, for periods ranging from 2 to 5 years (Parker et al. 2004, p. II-4). In 1994, a new forestry law was approved, which institutionalized forest management. Now, concessions exist only in the Darién Province (Parker et al. 2004, p. II-4). Between 1992 and 2000, the Darién Province was one of Panama's provinces that experienced the greatest declines (11.5 percent) in forest cover (Parker et al. 2004, p. 32). However, there are activities in place to combat these pressures. For example, a training program exists to increase capacity in issues such as planning, geographic

information systems, sustainable tourism, trail construction and management for park staff, community groups, and other stakeholders in the protected area system.

Darién National Park

Darién National Park extends along about 80 percent of the Panama–Colombia border and includes part of the Pacific coast. The area has been under protection since 1972, with the establishment of Alto Darién Protection Forest. It was declared a national park in 1980. The park is zoned as a strictly protected core zone of over 83,000 ha (205,097 ac). Another zone consists of 180,000 ha (444,789 ac) and contains indigenous Indian populations that have maintained their traditional way of life and culture. Approximately 8,000 ha (19,768 ac) is designated for tourism and environmental education, and the last zone is described as an “inspection zone” which is 40-km (25-mi) wide, and spans the Panama-Colombia border. The Darién forests are threatened from logging, agriculture expansion, burning, and hunting and gathering (TNC 2011, pp. 1–2; Monge et al. 2009, p. 68). Other threats to forest in the region include the development of projects such as dams and highways (Parker et al. 2004, pp. II-7–II-8).

Since 1986, the Asociación Nacional para la Conservación de la Naturaleza (ANCON) has been actively involved in conservation of the park in conjunction with INRENARE, the World Wildlife Fund, and other conservation entities. In 1995, a biodiversity conservation project was initiated. The project’s goal was to involve local communities in conservation and sustainable use activities, and was funded by the United Nations Environment Programme

(UNEP) and the Global Environment Facility. The Nature Conservancy (TNC) is also active in conservation efforts in this area through its Parks in Peril program (TNC 2011, pp. 1–2).

Panama has also initiated reforestation efforts. For example, beginning in the 1960s, Panama began to plant *Pinus caribaea* (pine species) in degraded areas of the Cordillera of the central region. Additionally, in 1992, a law was passed to provide incentives for the establishment of plantations; however, these were mainly exotic species (Parker et al 2004, p. III-6). Panama is now implementing reforestation and timber production projects that focus on native species. This initiative is known as the “Native Species Reforestation Project” (Proyecto de Reforestación con Especies Nativas; PRORENA) (Schmidt 2009, p. 10). Forestry managers have realized that, in some cases, native species are better adapted and perform better than introduced species. Since 2001, the joint Native Species Reforestation Project between the Smithsonian Tropical Research Institute and the Yale School of Forestry has conducted ongoing research on trees native to Panama. The almendro tree, which is vital to the great green macaw’s habitat, has been the subject of research projects in Panama because of its high commercial value (Schmidt 2009, p. 17). Despite efforts to reduce deforestation activities, management problems remain. A study conducted in 2004 suggested that the Forestry Department needs increased autonomy, funding, and staff, and a more appropriate mandate (Parker et al. 2004, pp. 10–11). The study suggested that strengthening the Parks and Wildlife Service through increased staffing and resources would enable them to protect and manage protected areas (Parker et al. 2004, pp. 10–11).

In summary, Panama has a suite of environmental laws in place, and conservation

measures are being implemented by the government in collaboration with some NGOs. However, there is very little information available about the great green macaw in Panama (Monge et al. 2009, p. 68), and the information indicates that this species continues to face pressures to its habitat. Despite Panama's participation in conservation initiatives and Panama's regulatory mechanisms in place, there are still significant pressures for resources in the great green macaw's habitat.

International Wildlife Trade (CITES)

The CITES Treaty requires Parties to have adequate legislation in place for its implementation. A complete discussion on CITES is found under Factor D for the military macaw. Within the recent past (since 2000), 261 live great green macaws were reported to have been imported by CITES reporting countries, and none of these live specimens were reported as wild origin (UNEP–WCMC CITES Trade Database, accessed December 8, 2011). Under CITES Resolution Conference 8.4 (Rev. CoP15), and related decisions of the Conference of the Parties, the National Legislation Project evaluates whether Parties have adequate domestic legislation to successfully implement the Treaty (CITES 2011a). In reviewing a country's national legislation, the CITES Secretariat evaluates factors such as whether or not a Party:

- Has domestic laws that prohibit trade contrary to the requirements of the Convention;
- Has penalty provisions in place for illegal trade, and has designated the responsible Scientific and Management Authorities; and
- Provides for seizure of specimens that are illegally traded or possessed.

The CITES Secretariat determined that the legislations of Colombia, Costa Rica, Honduras, Nicaragua, and Panama are sufficient to properly implement the Treaty (<http://www.cites.org>, SC58 Doc. 18 Annex 1, p. 1). These governments were determined to be in Category 1, which means they meet all the requirements to implement CITES. Ecuador was determined to be in Category 2, with a draft plan, but not enacted (<http://www.cites.org>, SC59 Document 11, Annex p. 1, accessed December 16, 2011). This means the CITES Secretariat determined that the legislation of Ecuador meets some, but not all, of the requirements for implementing CITES. Based on the limited amount of reported international trade for this species, particularly in wild-caught specimens, the range countries, including Ecuador, have effectively controlled legal international trade of this species. Therefore, we find CITES is an adequate regulatory mechanism.

Summary of Factor D

In the range countries for this species, we recognize that conservation activities are occurring, and each country has enacted laws with the intent of protecting its species and habitat. For example, in 2002, the San Juan–La Selva Biological Corridor, an area of 60,000 ha (148,263 ac), was implemented to protect the nesting places and migration flyway of the great green macaw in Costa Rica, as far as the Nicaragua border, where very little is known about the species. However, most of the suitable habitat is restricted to protected areas in clustered locations. Oliveira et al. (2007) found that forests in conservation units were four times better at protecting against deforestation than unprotected areas (Oliveira et al. 2007, p. 1,235). Despite

regulatory mechanisms established by this species' range countries and despite the species' existence in areas designated as protected, this species has experienced threats such that its populations are now so small that any pressure has a more significant effect. Parks, without management, are often insufficient to adequately protect the species.

The information available with respect to the species' population numbers is extremely limited in its range countries, and the populations of this species in these countries all likely range from a few individuals to a few hundred individuals (Botero-Delgadillo and Páez 2011, p. 91; Monge et al. 2010, p. 22; Monge et al. 2009, p. 256). The populations are all in relatively disconnected areas. Its suitable habitat has been severely constricted due to deforestation. In all of the range countries, there is clear evidence of threats to this species due to activities such as habitat destruction and degradation, and poaching, and there is decreased viability due to small population sizes, despite the laws and regulatory mechanisms in place. Given that the species' habitat continues to be fragmented and degraded, it is unlikely that any conservation measures are adequately mitigating the factors currently acting on the species.

Based on the best available information, despite protections in place by the respective governments, we find that the existing regulatory mechanisms are either inadequate or inadequately enforced to protect the species or to mitigate ongoing habitat loss and degradation, poaching, and severe population declines. Habitat conservation measures within these range countries do not appear to be sufficient to adequately mitigate future habitat losses. This is due to a suite of factors, such as high rates of poverty in the range of the great green macaw and subsequent pressures for resources, and conflicting management goals (such as economic

development and protection of its resources) of its range countries. Therefore, we find that the existing regulatory mechanisms are inadequate to mitigate the current threats to the continued existence of the great green macaw throughout its range.

E. Other natural or manmade factors affecting its continued existence

Small Population Size and Stochastic Events

There have been few quantitative studies of great green macaw populations (Botero-Delgadillo and Páez 2011, p. 91; Monge et al. 2010, p. 12; Monge et al. 2009.). In 2009, the combined estimate for Costa Rica and Nicaragua was 871 individuals (Monge et al. 2010, p. 21), and the estimate for Ecuador was fewer than 100 (Horstman 2011, p. 17). There are no current population estimates for Panama, Honduras, and Colombia, but the global population is believed to be fewer than 3,700 individuals (Monge et al. 2009, pp. 68, 79, 213). Small, declining populations can be especially vulnerable to environmental disturbances such as habitat loss (Harris and Pimm 2008, pp. 163–164; O’Grady 2004, pp. 513–514; Brooks et al. 1999, pp. 1,146–1,147). In Costa Rica, the great green macaw has been eliminated from approximately 90 percent of its former range, and one estimate indicated that there were only 275 birds remaining in 2010 (Chassot 2010 pers. comm. in Hardman 2011, p. 11). Isolated populations are more likely to decline than those that are not isolated (Davies et al. 2000, p. 1,456), as evidenced by the Ecuadorian population. Additionally, the great green macaw’s restricted range, combined with its small population size and low prospect for dispersal (Chosset et al. 2004, p. 32), makes the species particularly vulnerable to the threat of any adverse natural (e.g., genetic,

demographic, or stochastic) and manmade (e.g., habitat alteration and destruction) events that could destroy individuals and their habitats.

The government of Costa Rica, in cooperation with Zoo Ave Wildlife Conservation Park, located in Garita de Alajuela, has participated in a captive bird breeding program (Herrero 2006, pp. 2–3) since 1994. Some of the birds produced have been released in protected areas. However, captive breeding is a controversial issue, mainly due to the reintroduction of individuals. One of the concerns is that the reintroduced birds introduce infectious diseases (which may be in dormant phase for a period of time) into the wild (Brightsmith et al. 2006 in Herrero 2006, pp. 2–3).

There are multiple features of this species' biology and life history that affect its ability to respond to habitat loss and alteration, as well as to stochastic environmental events. Due to its current restricted distribution and habitat requirements, stochastic events could further isolate individuals. An example of a stochastic event impacting the species occurred in 2010, and the death of several nestlings was recorded (Chosset and Arias 2010, p. 15). One nestling fell out of a tree, and, in another case, a branch fell on a nestling while it was actually in the nest and it died (Chosset and Arias 2010, p. 15). Losses such as these can have a significant effect on the population. Additionally, limited available suitable habitat makes it difficult for the species to recolonize isolated habitat patches, which presently exist in a highly fragmented state. This, in combination with the species' nutritional needs, results in the species requiring large home ranges.

Border Conflict

One of the difficulties in the conservation of this species that may not be readily apparent is border conflict. For example, at the border of Nicaragua and Costa Rica, despite cooperation efforts; conflict continues (U.S. Department of State 2012, unpaginated; Berrios 2004, entire). The Nicaraguan-Costa Rican border is one of the most conflict-heavy frontiers in Central America (Lopez and Jimenez 2007, p. 21). Migration issues, navigation rights in border rivers, border delineation, and cultural differences all affect these countries' relations (Lopez and Jimenez 2007, p. 21). Additionally, this area has historically experienced exploitation of its natural resources. Since the beginning of last century, foreign companies have engaged in logging, rubber extraction, and mining (Lopez and Jimenez 2007, pp. 24–25). After these resources were depleted and these activities were no longer profitable, some companies left, leaving behind harmful environmental impacts (Lopez and Jimenez 2007, pp. 24–25). These activities have resulted in polluted rivers, high levels of sedimentation in coastal lagoons, and deforested areas (Lopez and Jimenez 2007, pp. 24–25). These activities all subsequently affect the habitat of the great green macaw.

Deforestation in Nicaragua has a complex history. After a civil war throughout the 1980s, land tenure policies inadvertently encouraged farming techniques that led to deforestation, soil erosion, and general land degradation (Sinreich 2009, p. 11). Later, during the 1990s, COHDEFOR opened up timber extraction opportunities to local community organizations, mainly cooperatives, to help mitigate the economic situation for local people. Licenses allowed the use of fallen wood and timber extraction for sale at local markets.

However, a study conducted between 1998 and 2000 found that local groups had extracted an enormous amount of timber and there was no monitoring (Colíndres and Rubí 2002). Although the government offered support to communities in its border regions during the period of 1994–1999, tensions continue to affect the Bosawas region of Nicaragua, one of the areas believed to contain a great green macaw population (Lopez and Jiménez 2007, p. 26). Land rights disputes continue to occur in Bosawas, and land use rights are often unclear. Although the Government of Nicaragua is attempting to manage these issues (Pellegrini 2011, p. 21), conflict and practices that degrade the great green macaw’s habitat persist both in the Bosawas Reserve and the Indio-Maíz Biological Reserve.

Climate Change

Our analysis under the ESA includes consideration of ongoing and projected changes in climate (see discussion under the military macaw). The 2008 workshop in Costa Rica addressed environmental disasters in the evaluation and assessment of the great green macaw, although climate change was not specifically addressed. Researchers describe environmental disasters as events that occur infrequently but that can drastically affect reproduction or survival. Monge et al. reported that in Costa Rica, the number of active nests in 2000 was well below the average of other years. The researchers linked this with the strong El Niño event that occurred during 1997–1998 (Monge et al. 2009, p. 149). The researchers stated that in the last 50 years there were two major El Niño events, and, therefore, one would expect that in 100 years there would be four events of this nature, which could subsequently reduce reproduction by 30 percent (Monge et al. 2009, p. 149). However, this correlation between the low number of active nests

and the El Niño event is not strongly supported, nor do we have supporting evidence that this is directly related to climate change. We are not aware of any information that indicates that climate change threatens the continued existence of the great green macaw.

Summary of Factor E

A species may be affected by more than one threat. Impacts typically operate synergistically, and are particularly evident when small populations of a species are decreasing. Initial effects of one threat factor can exacerbate the effects of other threat factors (Laurance and Useche 2009, p. 1,432; Gilpin and Soulé 1986, pp. 25–26). Further fragmentation of populations can decrease the fitness and reproductive potential of the species, which can exacerbate other threats. Lack of a sufficient number of individuals in a local area or a decline in their individual or collective fitness may cause a decline in the population size, even with suitable habitat patches. Within the preceding review of the five factors, we have identified multiple threats that have interrelated impacts on this species. Thus, the species' productivity may be reduced because of any of these threats, either singularly or in combination. These threats occur at a sufficient scale such that they are affecting the status of the species now and in the future.

This species' current range is highly restricted and severely fragmented. Each breeding pair requires a large home range to meet its nutritional requirements; it is a large macaw, and its sources of food are becoming scarcer and farther apart, which requires more energy consumption to locate. The susceptibility to extirpation of limited-range species can occur for a variety of reasons, such as when a species' remaining population is already too small or its distribution too

fragmented such that it may no longer be demographically or genetically viable. The species' small and declining population size, reproductive and life-history traits, and highly restricted and severely fragmented range together increase the species' vulnerability to any other stressors. Based on the above evaluation, we conclude that the effects of isolation and its small, declining population size, combined with the threats of continued fragmentation and isolation of suitable forest habitats, pose a threat to the great green macaw.

Finding and Status Determination for the Great Green Macaw

Although precise quantitative estimates are not available, the best available information suggests that populations of great green macaws have substantially declined, and this species likely persists at greatly reduced numbers relative to its historical abundance. The factors that threaten the survival of the great green macaw are: (A) Habitat destruction, fragmentation, and degradation; (B) Overutilization via poaching; (D) inadequacy of regulatory mechanisms to reduce the threats to the species; and (E) small population size and isolation of remaining populations.

The direct loss of habitat through widespread deforestation and conversion of primary forests to human settlement and agricultural uses has led to the fragmentation of habitat throughout the range of the great green macaw and isolation of the remaining populations. The species has been locally extirpated in many areas and has experienced a significant reduction of suitable habitat. The current suitable habitat in Costa Rica is now less than 10 percent of its original suitable habitat (Chosset et al 2004, p. 38). This species exists generally in small and

fragmented populations, and in many cases, the population is so small that intense monitoring and management of the population is under way. The San Juan–La Selva Biological Corridor was established to connect forest patches and join 20 protected areas (Chosset and Arias 2010, p. 5) specifically to preserve habitat for this species.

We have very little information about the species in many parts of its range (Botero-Delgado and Pérez 2011, p. 91; Monge et al. 2009, p. 68). In 2008, experts from this species' range countries attended a conference to evaluate the viability of its populations and its habitat (Monge et al. 2009, entire). In general, they concluded that populations are viable but they still face threats. The workshop also addressed goals for the conservation of the species; in some parts of its range, conservation efforts are intensive. Based on our review of the best available scientific and commercial information pertaining to the five factors, the threats to the species are generally consistent throughout its range. In many of the range countries, its populations are very small, and specific information about the status of the species is not available in all countries. However, habitat loss and degradation is prevalent throughout this species' range; its suitable habitat has severely contracted, and habitat loss is likely to continue into the future due to pressures for resources. Poaching is known to occur within many parts, if not all parts, of its range. Despite conservation awareness programs, poverty is prevalent within the range of the species, and the species is quite valuable commercially, so poaching continues to occur. We do not find that the effects of current threats acting on the species are being ameliorated by regulatory mechanisms. Therefore, we find that listing the great green macaw as endangered is warranted throughout its range, and we propose to list the great green macaw as endangered under the ESA.

Available Conservation Measures

Conservation measures provided to species listed as endangered or threatened under the ESA include recognition, requirements for Federal protection, and prohibitions against certain practices. Recognition through listing results in public awareness, and encourages and results in conservation actions by Federal and State governments, private agencies and interest groups, and individuals.

The ESA and its implementing regulations set forth a series of general prohibitions and exceptions that apply to all endangered and threatened wildlife. These prohibitions, at 50 CFR 17.21 and 17.31, in part, make it illegal for any person subject to the jurisdiction of the United States to “take” (includes harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or to attempt any of these) within the United States or upon the high seas; import or export; deliver, receive, carry, transport, or ship in interstate commerce in the course of commercial activity; or sell or offer for sale in interstate or foreign commerce any endangered wildlife species. It also is illegal to possess, sell, deliver, carry, transport, or ship any such wildlife that has been taken in violation of the ESA. Certain exceptions apply to agents of the Service and State conservation agencies.

Permits may be issued to carry out otherwise prohibited activities involving endangered and threatened wildlife species under certain circumstances. Regulations governing permits for endangered species are codified at 50 CFR 17.22. With regard to endangered wildlife, a permit

may be issued for the following purposes: For scientific purposes, to enhance the propagation or survival of the species, and for incidental take in connection with otherwise lawful activities. For threatened species, a permit may be issued for the same activities, as well as zoological exhibition, education, and special purposes consistent with the ESA.

National Environmental Policy Act (NEPA)

We have determined that environmental assessments and environmental impact statements, as defined under the authority of the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*), need not be prepared in connection with regulations adopted under section 4(a) of the ESA. We published a notice outlining our reasons for this determination in the **Federal Register** on October 25, 1983 (48 FR 49244).

References Cited

A complete list of all references cited in this proposed rule is available on the Internet at <http://www.regulations.gov> or upon request from the Branch of Foreign Species, Endangered Species Program, U.S. Fish and Wildlife Service (see **FOR FURTHER INFORMATION CONTACT**).

Authors

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List of Subjects in 50 CFR Part 17

Endangered and threatened species, Exports, Imports, Reporting and recordkeeping requirements, Transportation.

Regulation Promulgation

Accordingly, we amend part 17, subchapter B of chapter I, title 50 of the Code of Federal Regulations, as set forth below:

PART 17—[AMENDED]

1. The authority citation for part 17 continues to read as follows:

Authority: 16 U.S.C. 1361–1407; 1531–1544; 4201–4245; unless otherwise noted.

2. Amend § 17.11(h) by adding entries for “Macaw, great green” and “Macaw, military” in alphabetical order under BIRDS to the List of Endangered and Threatened Wildlife to read as follows:

§17.11 Endangered and threatened wildlife.

* * * * *

(h) * * *

Species		Historic range	Vertebrate population where endangered or threatened	Status	When listed	Critical habitat	Special rules
Common name	Scientific name						

BIRDS							

Macaw, great green	<i>Ara ambiguus</i>	Costa Rica, Honduras, Nicaragua, and Panama	Entire	E	797	NA	NA

Macaw, military	<i>Ara militaris</i>	Argentina, Bolivia, Colombia, Ecuador, Mexico, Peru, Venezuela	Entire	E	797	NA	NA

* * * * *

Dated: September 17, 2015.

Stephen Guertin

Director, U.S. Fish and Wildlife Service.

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