

## NOTES

NEAR COLONIZATION OF A DESERT ISLAND BY A TROPICAL BIRD:  
MILITARY MACAW (*ARA MILITARIS*) AT ISLA SAN PEDRO NOLASCO,  
SONORA, MEXICO

JUAN PABLO GALLO-REYNOSO,\* RICHARD STEPHEN FELGER, AND BENJAMIN THEODORE WILDER

*Centro de Investigación en Alimentación y Desarrollo A.C., Unidad Guaymas  
Carretera a Varadero Nacional km 6.6, Colonia Las Playitas, Guaymas, Sonora  
C.P. 85480, México (JPG)*

*University of Arizona Herbarium, P.O. Box 210036, Tucson, AZ 85721 (RSF)*

*University of California, Riverside, Department of Botany and Plant Sciences, 2150 Batchelor Hall, Riverside CA 92521 (BTW)*

*\*Correspondent: jpgallo@ciad.mx*

**ABSTRACT**—In 2000, military macaws (*Ara militaris*) arrived on Isla San Pedro Nolasco, a desert island near the coast of Sonora, Mexico. The last one was seen in 2009. This is the first report of this macaw on an island in the Gulf of California, Mexico.

**RESUMEN**—En el año 2000, algunos individuos de la guacamaya verde (*Ara militaris*) arribaron a la isla San Pedro Nolasco, una isla desierta cercana a la costa de Sonora, México. El último individuo fue visto en 2009. Este es el primer registro de la presencia de guacamayas verdes en una isla del Golfo de California, México.

The tropical military macaw (*Ara militaris*) is distributed from Sonora to southern Mexico. In northwestern Mexico, there are records from Río Fuerte (Sinaloa), Río Grande Santiago (Sinaloa to Nayarit), and various places in Sonora. This macaw historically has had fragmented populations across Mexico with records in Chiapas, Chihuahua, Colima, Durango, Guerrero, Jalisco, México, Michoacán, Morelos, Nayarit, Nuevo León, Querétaro, Oaxaca, San Luis Potosí, Sinaloa, Sonora, Tamaulipas, and Zacatecas, although there is no recent record in some of these states (Iñigo-Elías, 1999, 2000; Almazán-Nuñez and Nova-Muñoz, 2006). In Sonora, military macaws occur mainly in riparian habitats of the Río Bavispe-Yaqui, Río Mayo, and Río Cuchujaqui (a tributary of the Río Fuerte) and have been observed in these three watersheds during March–August. Russell and Monson (1998) reported ca. 43 observations, including four with confirmed reproduction in the area of the Río Mayo and Río Cuchujaqui in southeastern Sonora, but none of these was in coastal areas. We (one or more of the authors) recorded nine observations of military macaws through several years (September 1995, December 1997, February 2003, March 2005, and April 2007) in riparian areas of the Río Mayo and Río Cuchujaqui (Fig. 1). The military macaw in Sonora is at the northernmost limit of its geographical distribution, where it is an uncommon, year-round resident with an elevational distribution  $\leq 1,000$  m

(Villaseñor-Gómez et al., 2010). Ornelas-Rodríguez and Pérez-Villafaña (2000) considered that the Bavispe-Yaqui Basin was an important area for military macaws, and Valdéz-Casillas et al. (2000) noted them in the Alamos-Río Mayo area when they surveyed there in 1995–1996. In previous censuses of the avifauna of Isla San Pedro Nolasco, Sonora, Cervantes and Gallo-Reynoso (2000) did not report military macaws.

The military macaw is vulnerable at a global level (Collar et al., 1993) and is a protected species in Mexico (Secretaría de Medio Ambiente y Recursos Naturales, 2010). The species is associated with dry tropical-deciduous and tropical sub-deciduous forests, and also can be in pine-oak (*Pinus-Quercus*) forests at elevations above tropical-deciduous forests (Forshaw, 1989; Juniper and Parr, 1998; Iñigo-Elías 1999, 2000). In this paper, we report military macaws on Isla San Pedro Nolasco (27°58'N, 111°22'W), Sonora, Mexico. The only other records of these birds living on islands in Mexico are from Islas Blancas, only 100 m from the mainland on the Pacific Coast near Zihuatanejo, Guerrero (Goldman, 1951; Rowley 1984). The occurrence on Isla San Pedro Nolasco is the first record of the military macaw on an island >1 km from the mainland of Mexico.

Isla San Pedro Nolasco is a rugged and precipitous island in deep water ca. 30 km NW Guaymas, Sonora, and 14.6 km W Bahía San Pedro, the closest mainland (Fig. 1).

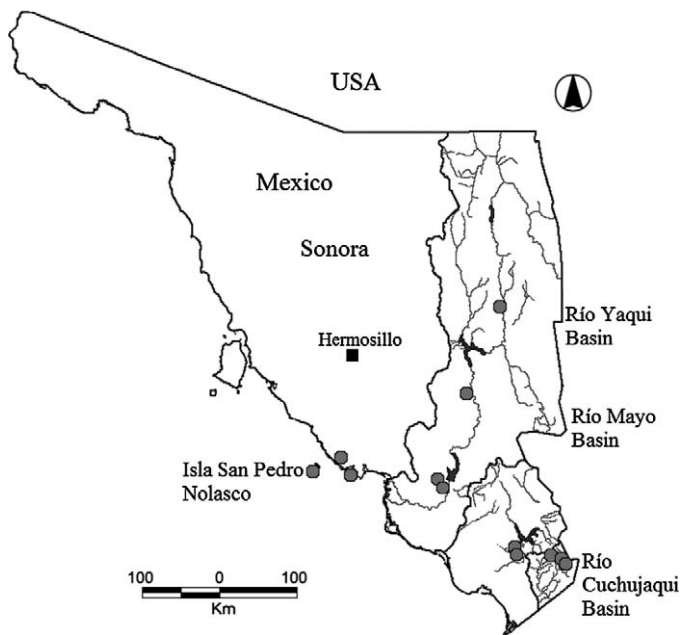


FIG. 1.—Records of the military macaw (*Ara militaris*) in three river basins, Isla San Pedro Nolasco, and two coastal sites in Sonora, Mexico.

The island consists of a narrow north-south-oriented mountain 3.5 km long and  $\leq 1.5$  km wide that constitutes ca. 3.5 km<sup>2</sup> of land. A prominent crest, reaching a peak of 315 m, runs along most of the island. On either side of the crest, the terrain quickly slants away into cliffs and steep slopes reaching to the sea. The island supports 58 species of vascular plants in relatively dense Sonoran Desert vegetation that is rich in succulents (Wilder et al., 2008; Felger et al., 2011). There are  $\geq 40$  species of birds, equally divided between marine and terrestrial, some of them are on the island year-round (e.g. pelicans, woodpeckers), while others are migratory (e.g. sparrows, cardinals). There is no permanent fresh water, except a tiny, highly alkaline seep called Agua Amarga.

On various occasions over several decades, including 11 February 2000, one or more of the authors visited Isla San Pedro Nolasco and there was no indication of military macaws or any other psittacine on the island. By May 2000, some fishermen and tourist guides informed us of two parrots on the island, which we first believed would be the white-fronted parrot (*Amazona albifrons*) that occurs in Sonoran desert scrub near Guaymas, often roosting in cardón cacti (*Pachycereus pringlei*). On 24 August 2000, we visited the island and heard the loud calls and observed two military macaws flying overhead on the eastern side of the island. We presume that these two individuals arrived on the island during February–May 2000. According to fishermen who observed the two macaws on the island, some observed them in February–March and others in April–May 2000. Finding military macaws on the island, far from their current distribution in the main watersheds of Sonora was surprising.

The strong El Niño season of 1997–1998 resulted in a dramatic drought and extraordinary conditions that produced large-scale, devastating fires that swept through the sierras of southern Mexico and the Sierra Madre Occidental of northwestern Mexico (Rodríguez-Trejo and Payne, 1998; Rodríguez-Trejo and Fulé, 2003). In the Sierra Madre Occidental, fires burned  $\geq 41,000$  ha of forested areas in Sonora, Sinaloa, and Chihuahua (Rodríguez-Trejo and Payne 1998). It is possible that environmental alterations following episodes of intense fires during January–April 1998, which affected the sierras from Chiapas to Sonora and Chihuahua, led to dispersal of military macaws outside of their usual range in search of food and suitable habitats.

In June and July 2001, we observed five military macaws flying together around the island as a group, and calling loudly. The three additional military macaws might have been new immigrants to the island, or reared on the island during the breeding season (March–August) in 2000, or were missed by us in 2000. During 2002–2003, four expeditions were made to the island. Five military macaws were observed in April 2002, none were seen on 10–12 September 2002, two were seen on 8 November 2002, and four were counted 2 days later. They were roosting at the top of a large, broad canyon (Arroyo de las Guacamayas) on the west-central side of the island.

Five individuals were observed on 14 and 15 April 2003 at Arroyo de las Guacamayas, and three were at the same place on 30 May. One individual, presumably from the island, was heard and then observed arriving on the mainland from over the sea to the northwest (direction of the island) on 16 December and roosting for several days on the cliffs facing Bahía Bacoichibampo in Guaymas, Sonora, just outside of the Ecofisiología Laboratory of the Centro de Investigación en Alimentación y Desarrollo A.C., then nearby at the Instituto Tecnológico de Estudios Superiores de Monterrey, Guaymas Campus, which overlooks Bahía de Bacoichibampo and toward Isla San Pedro Nolasco. After January 2004, no military macaw was on the mainland in the Guaymas area. Only two individuals were observed on the island on 19 May 2004 and also on 3 May and 8 June 2005. In 2006, no military macaw was present on 8 May, two were observed on 12 June, and only one was there on 14 September. A pair of military macaws was observed on 7 May and 11 September 2007.

By February 2008, only one military macaw remained on Isla San Pedro Nolasco. On 2–3 February, we conducted fieldwork along Cañón el Farito on the east side of the island, and, from the upper ridge, one military macaw was seen and heard circling the island. On 15–16 May 2008, at Arroyo de Mellink on the northwest side of the island (27°58.185'N, 111°23.110'W at the mouth of the canyon), we saw one military macaw. On 29 September 2008, we observed one individual at Arroyo de Mellink. On 30 May 2009, we saw no military macaw on

the island, but, on 11 July 2009, we heard and saw one individual. On 9 September 2009 and 11 November, fieldtrips were made to the island to ascertain damages to the flora and nesting birds resulting from tropical depression Jimena (2–3 September 2009), and no military macaw was heard or observed. On 13 May 2010, a census of birds conducted on Isla San Pedro Nolasco by one or more of the authors and associates rendered no observation of a military macaw, and we conclude that the military macaw no longer occurs on the island. The last military macaw was seen on the island on 11 July 2009.

On 30 May 2003, we observed three military macaws in the narrow, steep, and short canyon at Punta Los Nacapules (northwest end of the island, 27.983713°N, 111.390903°W in the lower part of the canyon). These military macaws were feeding on fruits of cliff figs (*Ficus petiolaris*) growing in shadows of large boulders. While the military macaw is a predator of seeds, the small seeds of figs and other plants can be swallowed and passed intact, having a predator of seeds acting as a disperser (Norconk et al., 1998). Cliff figs on the island are mostly shrubs and small trees  $\leq 4$  m in height. Cliff figs were on walls and bottoms of canyons growing on rocks, and they were most common in northern areas of the island, with rather large individuals in the canyon at Punta Los Nacapules (Felger et al., 2011) and above the rookery of California sea lions (*Zalophus californianus*) near El Farito. The cliff fig produces abundant fruits in times of plentiful rainfall (primarily in summer–autumn), which rapidly are consumed by numerous species and may serve as a keystone resource for animals on the island.

The military macaws probably subsisted largely on fruits of cliff figs and, perhaps, succulent fruits of several species of cacti that were available on the island at different times through the year. Fruits and shoots of various other plants could serve as food for military macaws, as reported for similar plants in Reserva de la Biosfera Tehuacán-Cuicatlán in Oaxaca and Puebla in southern Mexico (Salazar-Torres, 2001; Martínez-Domínguez and Bonilla-Ruz, 2008). Contreras-González et al. (2009) described diet of military macaws in a semiarid region of central Mexico; these birds ate fruits of several genera that also were on the island, such as *Bursera*.

The last military macaw was observed consistently in the company of a common raven (*Corvus corax*), and local fishermen (e.g., J. L. Ramírez, pers. comm.) observed that the two birds sometimes came to the mainland to an area called El Aguaje adjacent to Cerro Agua Caliente at San Carlos, Sonora. The fishermen also reported that this military macaw had been observed eating fruits of palms in that area (native palms in the canyons were *Brahea brandegeei*, *Sabal uresana*, and *Washingtonia robusta*; Felger, 1999; Felger et al., 2001). Isla San Pedro Nolasco is visible from El Aguaje on the mainland at a distance of 17 km, and the narrow channel probably would offer no barrier for military macaws. Bonilla-Ruz et al. (2007) reported the

average maximum flight distance for military macaws was ca. 20 km/day, allowing them access to a variety of potential foods.

Resiliency of military macaws to desert conditions in absence of fresh water is notable, although they are predominantly in non-desert riparian areas not too distant from desert vegetation in Sonora (Russell and Monson, 1998) and in some semiarid areas elsewhere (Salazar-Torres, 2001; Bonilla-Ruz et al., 2007). Despite the decade-long presence of the military macaw on Isla San Pedro Nolasco, its colonization of the island failed. The repeated presence of military macaws on this relatively isolated desert island far from its range in Sonora shows the dynamic nature of this tropical bird and the biota of the island. Occasional connections to the mainland by military macaws and other species and their potential role in dispersal of seeds should be considered in explaining current and future assemblages of flora on Isla San Pedro Nolasco.

We thank staff of Area de Protección de Flora y Fauna Islas del Golfo de California, Coordinación Sonora for logistical help, especially, F. Cota and J. Ventura who accompanied and assisted us on several trips to the island. Thanks also are extended to E. Mellink, G. Suárez, H. Cabrera, O. Rangel, J. Egido, and J. L. Ramírez for help with fieldwork. We thank the reviewers, E. Iñigo-Elias, C. Bonilla-Ruz, and J. Bednarz for helping to improve the manuscript.

#### LITERATURE CITED

- ALMAZÁN-NUÑEZ, R. C., AND O. NOVA-MUÑOZ. 2006. La guacamaya verde (*Ara militaris*) en la Sierra Madre del Sur, Guerrero, México. *Huitzil* 7:20–22.
- BONILLA-RUZ, C., G. REYES-MACEDO, AND R. GARCÍA. 2007. Observations of the military macaw (*Ara militaris*) in northern Oaxaca. *Wilson Journal of Ornithology* 119:729–732.
- CERVANTES, M., AND J. P. GALLO-REYNOSO. 2000. AICA 117, Isla San Pedro Nolasco. Page 45 *Áreas de importancia para la conservación de las aves en México* (M. C. Arizmendi and L. Márquez-Valdelamar, editors). La Sociedad para el Estudio y Conservación de las Aves en México A.C., México, Distrito Federal, México.
- COLLAR, N. J., D. C. WEGE, N. KRABBE, A. MADROÑO-NIETO, AND L. P. GONZAGA. 1993. Threatened birds of the Americas: the ICBP/IUCN Red Data Book, volume 2. Smithsonian Institution Press, Washington, D.C.
- CONTRERAS-GONZÁLEZ, A. M., F. A. RIVERA-ORTÍZ, C. SOBERANES-GONZÁLEZ, A. VALIENTE-BANUET, AND M. C. ARIZMENDI. 2009. Feeding ecology of military macaws (*Ara militaris*) in a semiarid region of central Mexico. *Wilson Journal of Ornithology* 121:384–391.
- FELGER, R. S. 1999. The flora of Cañón del Nacapule: a desert-bounded tropical canyon near Guaymas, Sonora, Mexico. *Proceedings of the San Diego Society of Natural History* 35:1–42.
- FELGER, R. S., M. B. JOHNSON, AND M. F. WILSON. 2001. The trees of Sonora, Mexico. Oxford University Press, New York.
- FELGER, R. S., B. T. WILDER, AND J. P. GALLO-REYNOSO. 2011. Floristic diversity and long-term vegetation dynamics of San Pedro

- Nolasco Island, Gulf of California, Mexico. Proceedings of the San Diego Society of Natural History 43:1–42.
- FORSHAW, J. M. 1989. Parrots of the world. Third edition. Lansdowne Press, Melbourne, Australia.
- GOLDMAN, E. A. 1951. Biological investigations in Mexico. Smithsonian Miscellaneous Collections 115:1–476.
- IÑIGO-ELÍAS, E. 1999. Las guacamayas verdes y esmeralda en México. Biodiversitas (México) 25:7–11.
- IÑIGO-ELÍAS, E. 2000. Guacamayas verde (*Ara militaris*). Pages 213–215 in Las aves de México en peligro de extinción (G. Ceballos and L. Márquez, editors). Fondo de Cultura Económica, México, Distrito Federal, México.
- JUNIPER, T., AND M. PARR. 1998. Parrots: a guide to parrots of the world. Yale University Press, London, United Kingdom.
- MARTÍNEZ-DOMÍNGUEZ, R., AND C. BONILLA-RUZ. 2008. Hábitos alimenticios de *Ara militaris* en la Reserva de la Biosfera Tehuacán-Cuicatlán, México. Mesoamericana 11:45–50.
- NORCONK, M. A., B. W. GRAFTON, AND N. L. CONKLIN-BRITAIN. 1998. Seed dispersal by Neotropical seed predators. American Journal of Primatology 45:103–126.
- ORNELAS-RODRÍGUEZ, J. F., AND M. PÉREZ-VILLAFANA. 2000. Áreas de Importancia para la Conservación de las Aves (AICA) 127, Cuenca del Río Yaqui. Page 223 in Áreas de importancia para la conservación de las aves en México (M. C. Arizmendi and L. Márquez-Valdelamar, editors). La Sociedad para el Estudio y Conservación de las Aves en México A.C., México, Distrito Federal, México.
- RODRÍGUEZ-TREJO, D. A., AND S. J. PAYNE. 1998. Mexican fires of 1998. International Forest Fires News 20:61–63.
- RODRÍGUEZ-TREJO, D. A., AND P. Z. FULÉ. 2003. Fire ecology of Mexican pines and a fire management proposal. International Journal of Wildland Fire 12:23–37.
- ROWLEY, J. S. 1984. Breeding records of land birds in Oaxaca, Mexico. Proceedings of the Western Foundation of Vertebrate Zoology 2:1–224.
- RUSSELL, S. M., AND G. MONSON. 1998. The birds of Sonora. University of Arizona Press, Tucson.
- SALAZAR-TORRES, J. C. 2001. Registro de guacamaya verde (*Ara militaris*) en los cañones del Río Sabino y Río Seco, Santa María Tecomavaca, Oaxaca, México. Huitzil 2:18–20.
- SECRETARÍA DE MEDIO AMBIENTE Y RECURSOS NATURALES. 2010. Norma Oficial Mexicana NOM-059-SEMARNAT-2010, Protección ambiental-especies nativas de México de flora y fauna silvestres-categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-lista de especies en riesgo. Jueves 30 de diciembre de 2010. Diario Oficial de la Federación, Ciudad de México, Distrito Federal, México.
- VALDÉZ-CASILLAS, C., E. ROJERO, M. PÉREZ-VILLAFANA, AND J. F. ORNELAS-RODRÍGUEZ. 2000. Áreas de Importancia para la Conservación de las Aves (AICA) 128, Álamos-Río Mayo. Page 250 in Áreas de importancia para la conservación de las aves en México (M. C. Arizmendi and L. Márquez-Valdelamar, editors). La Sociedad para el Estudio y Conservación de las Aves en México A.C. (CIPAMEX), México, Distrito Federal, México.
- VILLASEÑOR-GÓMEZ, J. F., O. HINOJOSA-HUERTA, E. GÓMEZ-LIMÓN, D. KRUEPER, AND A. D. FLESC. 2010. Avifauna. Pages 385–420 in Biodiversidad de Sonora (F. E. Molina Freaner and T. R. Van Devender, editors). Universidad Nacional Autónoma de México-Comisión Nacional para el Conocimiento y uso de la Biodiversidad, México, Distrito Federal, México.
- WILDER, B. T., R. S. FELGER, AND H. ROMERO-MORALES. 2008. Succulent plant diversity of the Sonoran islands, Gulf of California, Mexico. Haseltonia 14:127–160.

Submitted 1 December 2010. Accepted 17 August 2012.

Guest Associate Editor was James C. Bednarz.