**Supplementary Material**

Assessing spatial dispersion, abundance, and conservation perspectives of Military Macaw *Ara militaris* populations in Mexico

Tiberio C. Monterrubio-Rico, Juan F. Charre-Medellín, Yamel Rubio-Rocha, Carlos Bonilla-Ruz, Claudia Cinta-Magallón, Ramón Cancino-Murillo, Francisco Javier Sahagún-Sánchez, Alejandro Duran-Fernández, Jennifer S. Lowryand Jesús M. Corrales Saucedo

**Contents**

Table S1. States and municipalities surveyed.

Table S2. Characteristics of occupancy areas.

Table S3. Population abundance in occupancy areas and survey effort.

Table S1. States and municipalities surveyed.

|  |  |  |
| --- | --- | --- |
| **State** | **Municipalities with records before 1900** | **Survey status** |
| Sonora | Quiriego | No surveyed |
| Chihuahua | Ocampo | Surveyed, without detection |
| Sinaloa | Escuinapa | Surveyed, without detection |
| Nayarit | Amatlán de Cañas | Surveyed, without detection |
| Nayarit | Tuxpan | No surveyed |
| Colima | Manzanillo | Surveyed, without detection |
| Tamaulipas | Victoria | Surveyed, without detection |
|  | **Municipalities with records 1900-1999** |  |
| Sonora | Sahuaripa | No surveyed |
| Sonora | Navojoa | Surveyed, without detection |
| Chihuahua | Guachochi | No surveyed |
| Durango | Súchil | Surveyed, without detection |
| Tamaulipas | Xicoténcatl | Surveyed, without detection |
| Nuevo León | Monterrey | Surveyed, without detection |
| San Luis Potosí | Santa Catarina | Surveyed, without detection |
| Michoacán | Apatzingán | Surveyed, without detection |
| Michoacán | Aquila | Surveyed, without detection |
| Guerrero | Chilpancingo de los Bravo | Surveyed, without detection |
| Chiapas | Arriaga | Surveyed, without detection |
|  | **Municipalities with GBIF records 2000-2016** |  |
| Chihuahua | Batopilas | Unsurveyd |
| Durango | Pueblo Nuevo | Unsurveyd |
| Jalisco | Talpa de Allende | Surveyed, without detection |
| Jalisco | Mascota | Surveyed, without detection |
| Jalisco | Cuautitlán de García Barragán | Surveyed, without detection |
| Tamaulipas | Llera | Surveyed, without detection |
| Tamaulipas | Tula | Surveyed, without detection |
| Nuevo León | General Zaragoza | Surveyed, without detection |
| Nuevo León | Aramberri | Surveyed, without detection |
| San Luis Potosí | Aquismón | Surveyed, without detection |
| San Luis Potosí | Xilitla | Surveyed, without detection |
| Puebla | San José Miahuatlán | Unsurveyd |
| Puebla | Zapotitlán | Unsurveyd |
| Oaxaca | San Pedro Jaltepetongo | Surveyed, without detection |
| Oaxaca | Santa María Ixcatlán | Surveyed, without detection |
| Oaxaca | San Miguel Tequixtepec | Surveyed, without detection |
| Oaxaca | San Juan Bautista Cuicatlán | Surveyed, without detection |
| Guerrero | Técpan de Galeana | Surveyed, without detection |
| Guerrero | José Azueta | Surveyed, without detection |

Table S2. Characteristics of occupancy areas.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **State and Population Id** | **Locality (Municipality)**  | **Localities** | **Protected area** | **Forest availability in areas of occupancy** | **Nearest population in km (Id)**  | **Average precipitation in occupancy area** | **Forest type** |
| **Northern Pacific** |  |  |  |  |  |  |  |
| Sonora (1) | Los Algodones (Yéroca) | 1 | No | 732 | 91 (2 ) | 736 | Tropical dry |
| Chihuahua (2) | Otachique (Uruachi) | 1 | No | 656 | 72 (3) | 839 | Tropical dry |
| Sonora (3) | Santa Barbara- Huichichi (Álamos) | 15 | Yes | 3240 | 55 (4) | 735 | Tropical dry |
| Sinaloa -Chihuahua (4) | Baymena- Chinobampa (Choix)Urique (Urique) | 6 | No | 1851 | 55 (3) | 861 | Tropical dry |
| Durango (5) | Ciénega de la vaca (Guanaceví) | 7 | No | 1998 | 105 (7) | 749 | Pine-oak |
| Durango (6) | La Ciénega de los Otates (Tamazula) | 1 | No | 800 | 56 (7) | 749 | Pine-oak |
| Durango (7) | Santiago Papasquiaro (S. Papasquiaro) | 1 | No | 780 | 54 (6) | 1325 | Pine-oak |
| Sinaloa (8) | San José de las Bocas (Cosalá) | 12 | No | 1857 | 42 (9) | 1053 | Tropical dry-pine oak |
| Sinaloa (9) | Imala (Culiacán) San Javier (San Ignacio) | 3 | No | 1063 | 42 (8) | 1063 | Tropical dry-pine oak |
| Durango (10) | Guarisamey (San Dimas) | 2 | No | 916 | 59 (11) | 929 | Tropical dry-pine oak |
| Sinaloa (11) | El Cañón (San Ignacio, Rosario, Mazatlán,Concordia)  | 10 | No | 2017 | 59 (10) | 1063 | Tropical dry-pine oak |
| Durango (12) | Chachacuaxtle (Mezquital) | 1 | No | 501 | 64 (14) | 929 | Tropical dry-pine oak |
| Durango (13) | Salto de agua llovida (Durango) | 1 | No | 849 | 63 (14) | 1009 | Pine-oak |
| Durango (14) | Mesa de platanitos (Mezquital) | 1 | No | 540 | 63 (13) | 653 | Pine-oak |
| **Central Pacific** |  |  |  |  |  |  |  |
| Nayarit (15) | La Ciénega (Acaponeta) | 1 | No | 47 | 97 (16) | 1019 | Tropical dry |
| Nayarit (16) | El Mirador del Aguila-Aguamilpa (Tepic) | 5 | No | 661 | 75 (18) | 1528 | Tropical dry-subdeciduous |
| Nayarit (17) | La Yesca (La Yesca) San Juan Ixtlan (Compostela) | 6 | No | 757 | 88 (18) | 1063 | Tropical dry |
| Nayarit (18) | San Blas Sierra Vallejo (San Blas, Bahia de Banderas) | 8 | No | 1965 | 40 (19) | 1280 | Tropical dry-pine oak |
| Jalisco (18) | Bioto-Yelapa (Cabo Corrientes, P. Vallarta, S del oeste) | 10 | No | Shared with Nayarit |  | 1268 | subdeciduous-pine-oak |
| Jalisco (19) | Cajón de peñas (Tomatlán) | 5 | No | 273 | 40 (18) | 1291 | subdeciduous-pine-oak |
| Jalisco (20) | Las Higheritas (Casimiro Castillo) | 3 | No | 332 | 52 (21 | 1362 | tropical dry-pine oak |
| Jalisco (21) | Reserva Manantlán (Autlán) | 3 | Yes | 122 | 52 (23) | 997 | tropical dry-pine oak |
| Michoacán (22) | Chorros del Varal (Los Reyes) | 4 | Yes | 178 | 82 (23) | 988 | tropical dry-subdeciduous |
| Michoacán (23) | Huatzirán-Poturo (La Huacana, Arteaga, Churumuco) | 46 | Yes | 4528 | 83 (22) | 642 | tropical dry |
| Guerrero (23) | R. Cucharatepec (U. I. Montes de Oca, Coahuayutla) | 16 | No | Shared with Michoacán |  | 732 | tropical dry |
| **Upper Balsas Basin** |  |  |  |  |  |  |  |
| Guerrero (24) | La Higuera (Petatlán) El Durazno (Coyuca de Catalán) | 3 | No | 866 | 89 (23) | 1368 | tropical dry-subdeciduous |
| Guerrero (28) | Papalutla (Copalillo) Cañon Chinchuetlán (Olinalá) | 2 | No | 63 | 103 (26) | 801 | tropical dry |
| Estado de México (25) | Parque Nanchititla (Luvianos) | 1 | Yes | 84 | 63 (27) | 900 | tropical dry-pine oak |
| Morelos (26) | Cuentepec, Tetlama (Temixco) | 1 | No | 15 | 53 (28) | 920 | tropical dry |
| Puebla (27) | Santa Cruz Achichipilco (Teotlalco) | 1 | No | 178 | 53 (27) | 829 | tropical dry |
| Oaxaca (29) | Cañon Sabino (S. J. Bautista, C. Papalo, S.M. Tecomavaca, Tepelmeme ) | 8 | Yes | 1299 | 152 (30) | 864 | tropical dry |
| Oaxaca (30) | Santo Domingo Narro (S.J. Juquila Mixes) | 1 | No | 258 | 152 (29) | 1884 | tropical dry |
| **Gulf of Mexico** |  |  |  |  |  |  |  |
| Tamaulipas (31) | Jaumave (Jaumave, Gómez Farías) | 8 | Partially protected | 1855 | 58 (32) | 607 | tropical dry-pine oak |
| San Luis Potosí (32) | Minas Viejas (El Naranjo) | 5 | No | 1032 | 31 (34) | 1263 | tropical dry-subdeciduous |
| San Luis Potosí (33) | Abra Tanchipa- El Ahuaje (Ciudad Valles) | 5 | Partially protected | 607 | 41 (32) | 1261 | tropical dry-subdeciduous |
| San Luis Potosí (34) | San Nicolás de los Montes (Tamasopo) | 2 | No | 687 | 31 (32) | 1010 | tropical dry-subdeciduous |
| Querétaro (35) | S. M. Cocos (Pinal de Amoles, Arroyo Seco) | 3 | Yes | 963 | 68 (34) | 690 | tropical dry-pine oak |

Table S3. Population abundance in occupancy areas and survey effort.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| State | Source of data | Id map | Population name (municipality reference) | Estimation Minimum | Estimation Maximum | Average abundance per locality | Mean flock size (std) | Macaws/hour | Last year surveyed | No. Counts | Aparent density /100 km2 |
| Sonora | Surveys | 1 | Los Algodones (Yéroca) | 2 | 4 | 3 | 1.0 (1.6) | 0.25 | 2010 | 10 | 0.4 |
| Chihuahua | Literature | 2 | Otachique (Uruachi) | 50 | 75 |  | Literature |  |  | Literature | 9.7 |
| Sonora | Surveys | 3 | Santa Barbara- Huichichi (Álamos) | 22 | 37 | 2.8 | 1.3(3.6) | 0.33 | 2007, 2012-2013 | 42 | 1.2 |
| Sinaloa | Surveys | 4 | Baymena- Chinobampa (Choix) | 26 | 47 | 16.1 | 2.9 (6.4 ) | 0.73 | 2010 | 28 | 2.0 |
| Durango | Surveys | 5 | Las Mangas-Ciénega de la vaca (Guanaceví) | 4 | 12 | 3 | 1.2 (1.6 ) | 0.3 | 2010 | 10 | 0.6 |
| Durango | Surveys | 6 | La Ciénega de los Otates (Tamazula) | 2 | 4 | 3 | 1.3 (1.6) | 0.33 | 2010 | 10 | 0.4 |
| Durango | Surveys | 7 | Santiago Papasquiaro (Santiago Papasquiaro) | 2 | 4 | 3 | 1.3 (1.5) | 0.32 | 2009 | 10 | 0.4 |
| Sinaloa | Surveys | 8 | San José de las Bocas (Cosalá) | 126 | 301 | 19 | 6.3 (13.3) | 1.5 | 2006-2015 | 311 | 9.2 |
| Sinaloa | Surveys | 9 | Laguna de Canachi-San Javier (Culiacán-San Ignacio) | 71 | 95 | 29.8 | 5.8 (14.7) | 1.4 | 2010 | 32 | 1.4 |
| Durango | Surveys | 10 | Guarisamey (San Dimas) | 22 | 34 | 12.5 | 3.9 (6.5) | 1.01 | 2010 | 14 | 2.5 |
| Sinaloa | Surveys | 11 | El Rosario-Prado-Mesillas (Concordia) | 250 | 445 | 72.7 | 23 (48.6) | 5.5 | 2015 | 43 | 5.9 |
| Durango | Surveys | 12 | Chachacuaxtle (Mezquital) | 12 | 16 | 4.5 | 2.3 (3.1) | 1.1 | 2011 | 8 | 2.2 |
| Durango | Literature | 13 | Durango (Durango) | 60 | 60 |  | Literature |  | 2012 | Literature | 6.6 |
| Durango | Surveys | 14 | Platanitos (Mezquital) | 2 | 4 | 3 | 1.3 (1.6) | 0.5 | 2011 | 10 | 0.4 |
| Nayarit | Surveys | 15 | La Ciénega (Acaponeta) | 2 | 6 | 3 | 1.7 ( 2.1 ) | 0.42 | 2009 | 7 | 0.6 |
| Nayarit | Surveys and Literature | 16 | El Mirador del Aguila (Tepic) | 48 | 66 | 20.6 | 4.7 (20.6 ) | 0.9 | 2007, 2012 | 18 | 3.0 |
| Jalisco | Surveys | 17 | Hostotipaquillo- La Yesca (La Yesca)  | 14 | 38 | 7.5 | 2 (3.2) | 0.5 | 2012-2013 | 12 | 2.8 |
| Jalisco | Surveys | 18 | Yelapa- Bioto (Cabo Corrientes) | 215 | 616 | 46.1 | 6.8 (9.0) | 11.5 | 2012-2015 | 80 | 12.7 |
| Jalisco | Surveys and Literature | 19 | Cajón de Peñas (Tomatlán) | 66 | 132 | 15.5 | 3.7 (3.3) | 3.1 | 2010-2015 | 22 | 17.7 |
| Jalisco | Surveys | 20 | Las Higueritas (Casimiro Castillo) | 14 | 30 | 22 | 4.6 (7.8 ) | 0.6 | 2012 | 22 | 3.4 |
| Jalisco | Surveys | 21 | Manantlán | 20 | 32 | 16 | 5.2 (10.5) | 0.5 | 2015 | 13 | 3.4 |
| Michoacán | Surveys and Literature | 22 | Chorros del Varal (Los Reyes) | 4 | 7 | 4 | 1.5 (2.1) | 0.08 | 2015 | 20 | 1.5 |
| Michoacán-Guerrero | Surveys | 23 | Puturo (Churumuco)- Cucharatepec (La Unión) | 56 | 242 | 4.7 | 3.9 (5.1) | 0.25 | 2015 | 60 | 1.5 |
| Guerrero | Literature | 24 | La Higuera (Petatlán) | 17 | 20 |  | Literature |  |  |  | 1.2 |
| Estado de México | Literature | 25 | Nanchititla, Luvianos | 2 | 4 |  | Literature |  |  |  | 0.4 |
| Morelos | Literature | 26 | Cuentepec, Tetlama (Temixco) | 6 | 20 |  | Literature |  |  |  | 2.0 |
| Puebla | Literature | 27 | Santa Cruz Achichipilco (Teotlalco) | 32 | 32 |  | Literature |  |  |  | 3.6 |
| Guerrero | Literature | 28 | Papalutla (Copalillo) Chinchuehuetlán (Olinalá) | 30 | 56 |  | Literature |  |  |  | 5.5 |
| Oaxaca | Literature | 29 | Cañon del Sabino (San Juan Bautista Cuicatlán) | 98 | 100 |  | Literature |  |  |  | 5.3 |
| Oaxaca | Literature | 30 | Santo Domingo Narro (San Juan Juquila Mixes) | 38 | 38 |  | Literature |  |  |  | 4.0 |
| Tamaulipas | Surveys | 31 | La Gloria (Gómez Farias)- (Jaumave) | 130 | 473 | 59.1 | 6.9 (11.4) | 1.7 | 2014-2015 | 25 | 12.1 |
| San Luis Potosí | Surveys | 32 | El Sabinito, Minas Viejas (El Naranjo) | 12 | 36 | 7.6 | 4.75 (5.0) | 0.3 | 2014 | 10 | 2.2 |
| San Luis Potosí | Surveys | 33 | Abra Tanchipa- El Ahuaje (Ciudad Valles) | 49 | 74 | 10.8 | 4.9 (5.9) | 0.29 | 2012-2015 | 62 | 7.9 |
| San Luis Potosí | Surveys | 34 | San Nicolás de los Montes (Tamasopo) | 4 | 16 | 4 | 3.3 (5.1) | 0.4 | 2014 | 10 | 0.4 |
| Querétaro | Surveys | 35 | Queretaro; Santa Maria Cocos (Arroyo Seco), Santa Agueda (Pinal de Amoles), San Luis Potosí; San Diego (Santa Catarina) | 55 | 87 | 43.5 | 20.4 (22.7 ) | 0.9 | 2014 | 24 | 6.2 |