# Population Analysis & Breeding and Transfer Plan

# Blue-billed Curassow (*Crax alberti*) AZA Species Survival Plan® Signature Program


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PMC Population Management Center

LINCOLN PARK ZOO.

ASSOCIATION OF ZOOS & AQUARIUMS

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# Acknowledgments

The Blue-billed Curassow SSP planning meeting was held at the San Diego Zoo and via online conferencing on 09 December 2024 and was attended by the following:

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Cover photo courtesy of Joel Sartore

This plan was prepared and distributed with the assistance of Planning Coordinator, PMCTrack Coordinator, and Program Assistant at the AZA Population Management Center.
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# Description of Population Status

**Introduction:** The blue-billed curassow is a large-sized curassow endemic to the tropical forests of Colombia. In the wild, blue-billed curassows have been listed as 'critically endangered' since 1994 as populations have declined mainly due to habitat loss and habitat degradation (IUCN Red List last assessed 2016). The main purpose of the Blue-billed Curassow SSP is to establish and maintain a genetically robust assurance population and to support the Latin American Association of Zoos and Aquariums (ALPZA) and European Association of Zoos and Aquaria (EAZA) breeding programs.

The current Blue-billed Curassow SSP population consists of 70 birds distributed among 21 AZA facilities (Table 1). Under AZA's current sustainability designations, this Animal Program qualifies as a Signature SSP. The Galliformes Taxon Advisory Group in their 2024 Regional Collection Plan (RCP), has designated this population with a commitment population trend ($CPT_{2029}$) of increasing. A target population size ($TPS_{2027}$) of 75 was developed with the Coordinator and Population Advisor to set population goals for this plan. An Advised Population Size (APS) of 120 birds with occasional imports of founders (two every 15 years) was developed with the Coordinator and Population Advisor to set long-term genetic viability goals of meeting 90% gene diversity for the next 100 years.

**Analytical Assumptions and Exclusions:** The pedigree of this population is 65.8% known 65.8% certain) before assumptions and exclusions (for clarification on known vs. certain, see Appendix F). Ten birds have been excluded from the potentially breeding population due to medical reasons or for exiting the SSP (Appendix B). Assumptions previously developed for six birds were also applied in this plan along with one new assumption developed for this plan. Following assumptions and exclusions, the pedigree is 100% known (98.3% certain). The potentially breeding population consists of 69 animals (Table 1).

**Demography:** Studbook records indicate blue-billed curassow first appeared in AZA facilities in 1919 when two wild-caught birds entered Philadelphia Zoo, however, this species was not consistently held until 1965. Few imports or exports have been recorded historically, and although breeding in the private sector occurred as early as the 1960s, the first hatch at an AZA facility was not recorded until 1970 at the Houston Zoo. Breeding across AZA facilities became more consistent after 1985, allowing the SSP population to continuously grow at an average annual rate of 9.7% since that time (average λ 1985-2023 = 1.097; Figure 1). This growth can be attributed to successful breeding, as the population relies little on imports with only four birds imported since 2010. The SSP population reached a historic number of holding facilities and birds in recent years with a peak of 74 birds in 2022-2023 and 20 holder since 2023; both numbers continue to remain stable. As of 2020, no more wild-caught birds remain in the population.

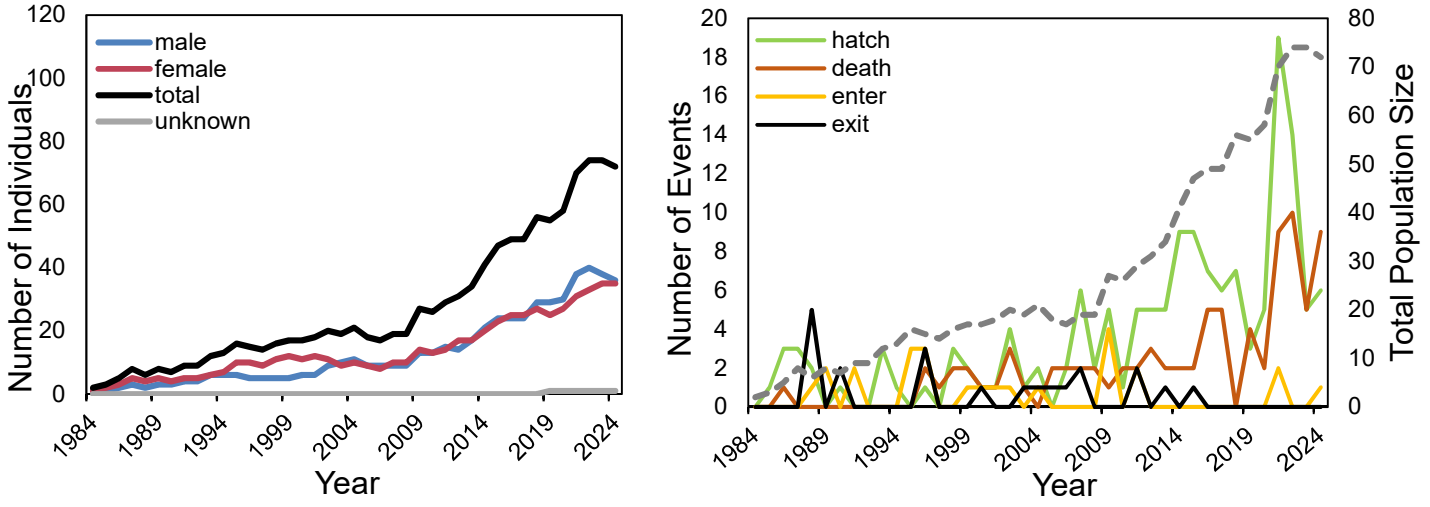


**Figure 1:** Census of Blue-billed Curassow SSP from 1984 to 2024 by sex (left) and census event type (right).

Significant numbers of blue-billed curassows have been held in captivity for a short period of time relative to their potential lifespan, and demographic data for this population may not yet accurately reflect biological parameters. Studbook data suggest that blue-billed curassows can live into their early 30s; the oldest recorded male lived to 33 years of age (SB# 6) and the oldest recorded female lived to 34 years of age (SB# 9). It is important to note, however, SB# 6 was wild-caught and both birds have age estimates of one year. Current life tables used for demographic analyses indicate first-year mortality is 29% for males and 24% females (Appendix D). Both sexes are reproductive by the time they are two to three years of age. Females start laying eggs around age 2 to 3, however, they appear to start sitting on eggs around 8-9 years of age. Though it is unclear from life tables whether this species experiences reproductive senescence due to the insufficient dataset, it is thought that females approach reproductive senescence in their mid-20s, and males can reproduce throughout most of their lives. At this time, the oldest male on record to breed was 24 years of age at the time of conception (SB# 6) and the oldest female to produce offspring was 22 years of age at the time of hatch (SB# 28). It is important to note SB# 6 is wild-caught with an age estimate of one year. As the population ages and more individuals fill older age classes, demographic data quality will improve and values in life tables may change. Females typically produce one to two eggs per clutch and can lay as many as four clutches per year if eggs are collected for artificial incubation.

The age structure illustrates the number of males and females in each age class (Figure 2). Based on its current age structure and growth rate, if the population continues on its current trajectory, this population has the potential to increase over time (Table 1). The age structure of the blue-billed curassow population is generally robust, with birds present in most age classes (Figure 2). The variable number of individuals across age classes is due to fluctuating rates of reproduction across years; between 2019 and 2023, the annual number of hatches ranged from 3 to 19 hatches in any given year. The higher number of individuals in age class 2-3 is due to particularly high rates of reproduction in 2021 and 2022 and the sparsity of birds over age class 18 is reflective of low rates of reproduction prior to 2007. If more consistent rates of reproduction can be achieved, a more stable age structure will be supported. The sex ratio of the population is exactly even. This is improved from the last plan which exhibited a slightly higher male bias likely due to hand-raised males that can exhibit aggression towards paired hens (1.2 males per female; 2022 BTP). Because this species is bred in monogamous pairs, a skew in sex ratio can limit reproduction.

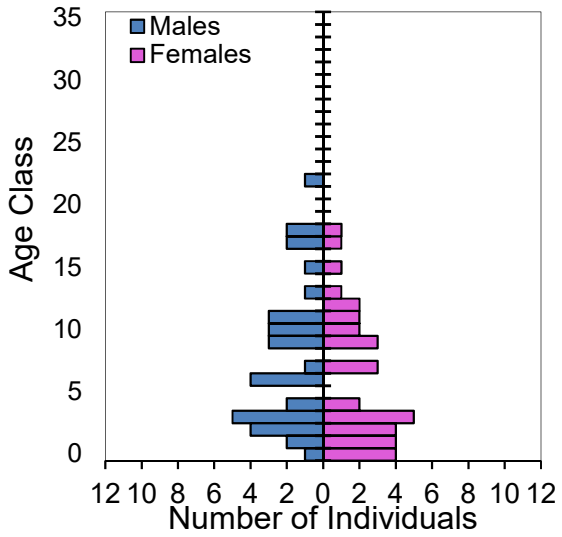


**Figure 2:** Age distribution of the total population for the Blue-billed Curassow SSP.

**Table 1:** Demographic status of the Blue-billed Curassow SSP population according to studbook data.

| **Demography Summary** | | |
|---|---|---|
| Current size of SSP population (N) – Total (Males.Females.Unknown Sex) | 70 (35.35.0) | |
| Number of individuals excluded from genetic analyses | 10 (7.3.0) | |
| Population size following exclusions | 60 (28.32.0) | |
| Target population size (Kt) derived in planning meeting | 75 | |
| Mean generation time (T, years) | 9.2 | |
| Population growth rates (λ; lambda)*: Life Table / 5-year / Projected | 1.084 / 1.057 / *0.067<>1.085<>1.101 | |
| Percentage (%) of living population produced ex situ | 100 | |
| Number of participating facilities | 20 | |
| **Survival/Mortality** | **Males** | **Females** |
| Observed first year mortality rate ($Q_x$) | 0.29 | 0.24 |
| Median life expectancy (MLE), excluding first year mortalities (years) ** | -- | -- |
| Observed maximum longevity (years): SB# 6 & 9 have estimated ages +/- 6 mo | 33 (SB# 6) | 34 (SB# 9) |
| **Reproduction** | | |
| Observed reproductive age range | 1.8–24 | 1.9–22 |
| Incubation time (days) | 30 - 31 | |
| Median clutch size hatched | 1 (1-2) | |

* Life table (AZA; 1985-2024); 5-year from studbook census; Projected from PMx stochastic 20-year projections

**Data was not of sufficient robustness to analyze. Calculated from Descriptive Survival Analysis Report in PopLink. See table in Appendix C for AZA Survival Statistics Library link.

**Genetics:** Genetic values are calculated after incorporating pedigree assumptions and removing excluded individuals. Analysis of the studbook indicates that this SSP is descended from 16 founders with no potential founders remaining (Figure 3, Table 2). The gene diversity of the population is 85.38%. Based on current founder representations, gene diversity is equivalent to that found in approximately three founders. The mean kinship in the population is 0.1462. Full-siblings have a kinships of 0.25 and half-siblings have a kinship of 0.125, which means that the average relationship across the population is just above that of second-order relatives. Population management theory suggests genetic management should strive to maintain thresholds for tolerance of gene diversity loss. The standard goal is 90% gene diversity retention for 100 years. Decreases in gene diversity below 90% of that in the founding population have been associated with increasingly compromised reproduction by, among other factors, lower hatch weights, smaller clutch sizes, and greater chick mortality in some species.

The best genetic management strategy to maximize a population's long-term gene diversity retention is typically managed breeding targeted at equalizing founder representations, by breeding animals with low and well-matched mean kinships. Founder representations in the blue-billed curassow population are currently skewed (Figure 3); more equal representations would retain more gene diversity. However, seven of the under-represented founders (SB# 151, 152, 153, 154, 155, 252, 253) trace to three living descendants SB# 195, 196, and 254 in Colombia (CALI) with little likelihood of exchange of birds with North America in the near future. Therefore, the high potential gene diversity (93.46%) may be a slightly inflated representation of the current population's ability to improve gene diversity. Though much of the population descends from over-represented founders SB# 4, 5, 18 and 69, there are still opportunities to breed living descendants of the remaining under-represented lineages to strive for higher gene diversity in the population through careful management. This mean kinship-based breeding strategy has resulted in improved gene diversity over time since the population's inception. This year, over-represented birds were selected for export to support the EEP population, which also improved gene diversity for the SSP population.

**Table 2:** Genetic status of the Blue-billed Curassow SSP population.

| Genetics Summary* | | | | | |
|---|---|---|---|---|---|
| | 2015** | 2019** | 2022** | 2025** | Potential |
| Founders | 9 | 9 | 14 | 16 | 0 |
| Founder genome equivalents (FGE) | 2.53 | 2.60 | 2.97 | 3.42 | 7.65 |
| Gene diversity (GD %) | 80.26 | 80.75 | 83.15 | 85.38 | 93.46 |
| Population mean kinship (MK) | 0.1974 | 0.1925 | 0.1685 | 0.1462 | -- |
| Mean inbreeding (F) | 0.1058 | 0.1145 | 01156 | 0.0979 | -- |
| Effective population size relative to population size ($N_e$/N) | 0.47‡ | 0.43‡ | 0.43‡ | 0.4643‡ | -- |
| Percentage of pedigree known before / after assumptions and exclusions (%) | 75.7 / 100 | 74.8 / 100 | 69.6 / 100 | 65.8 / 100 | -- |
| Percentage pedigree certain after assumptions and exclusions (%) | -- | 100 | 98.6 | 98.3 | -- |

*Genetic statistics may not be comparable across years due to changes in software and parameters used for projections from year to year.
**Pedigree assumptions were created for this population and may over- or under-estimate genetic statistics shown in this table.
‡Excludes founders.

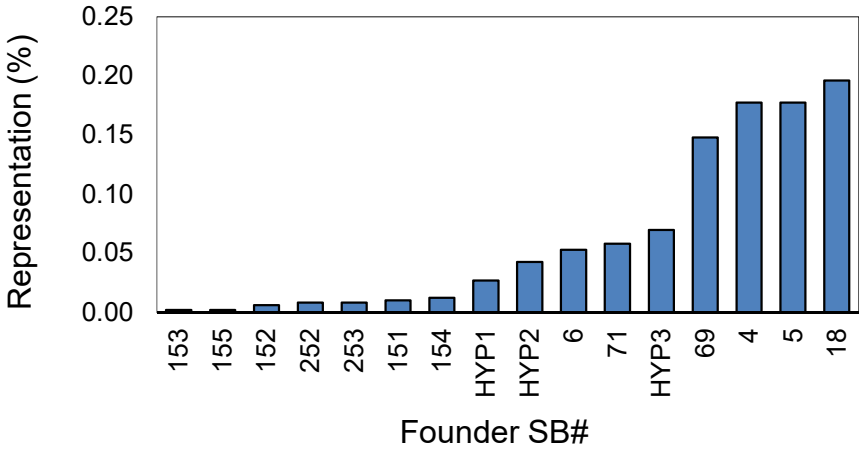


**Figure 3**: Founder representation distribution of the analytical Blue-billed Curassow SSP population.

Based on current population parameters, gene diversity is projected to decline to 73% over the next 100 years if the current population grows to the recommended target size of 75 (Table 3, Scenario a). Adjustments to the population parameters used for genetic projections suggest that no one particular parameter is inordinately driving projected gene diversity loss. The population's Ne/N ratio and target size are already quite reasonable. This leaves generation length and starting gene diversity as parameters that could be manipulated to improve projections. However, increasing the generation time to 12 years resulted in a small improvement (gene diversity retention in 100 years is projected to

be 76%), and increasing the starting gene diversity to 90% only improved gene diversity retention in 100 years to 77%. This suggests additional imports of unrelated birds will ultimately be necessary to support long-term gene diversity maintenance. An advised population target size (APS) of 120 birds and two new founders would need to be acquired every 15 years (and successfully breed every 5 years) to obtain 90% founding gene diversity for 100 years (T = 9.2 years; λ = 1.057; Ne/N = 0.4643; starting GD = 0.8538).

**Table 3:** Long term gene diversity scenarios from PMx. Scenarios a-b are standard minimum projections run for every report and reflect projections based on current parameters*~.

| **Scenario Descriptions** | Lambda | Ne/N | Max Allowable Population Size | Years to Reach Genetic Goal | GD Maintained (%) |
|---|---|---|---|---|---|
| a. Maintain 90% GD for 100 years | 1.057 | 0.4643 | TPS from meeting (75) | N/A | 72.8 |
| b. Maintain 10% GD loss (74.49%) for 100 years | 1.057 | 0.4643 | TPS from meeting (75) | 78 | 72.8 |
| c. Reach the Advised Population Size (APS) including importations of 2 founders every 15 years | 1.057 | 0.4643 | 120 | 100 | 90 |

*Starting population (N) accounting for exclusions = 60; Generation time (T) = 9.2; current GD = 0.8538.

**Recommendation Outcomes**: The website PMCTrack calculates the outcomes for SSP recommendations by comparing breeding and transfer recommendations to hatches and transfers recorded in the studbook (Figure 4). Use of PMCTrack surveys is now required as of 2023 for SSP Program management. Outcomes are calculated using the most recent recommendation from either the SSP's Breeding and Transfer Plan or interim recommendations as of 2022. There are many reasons that recommendations might not be fulfilled and these reasons can be captured using PMCTrack Outcomes Surveys. Note that starting in 2023, the fulfillment rates of any plan may include attempted fulfillment. Facilities can communicate how they are making progress with their recommendations when they complete the Outcomes Surveys, and this is reflected as attempted fulfillment (patched pattern in outcomes graphs below).

Of the Breeding and Transfer Plan and interim recommendations proposed since 2022, 69% of the breeding recommendations were fulfilled/attempted, and 93% of transfer recommendations were fulfilled/attempted. SSP participants are always encouraged to attempt to fulfill recommendations and communicate successes and challenges to the SSP Coordinator.

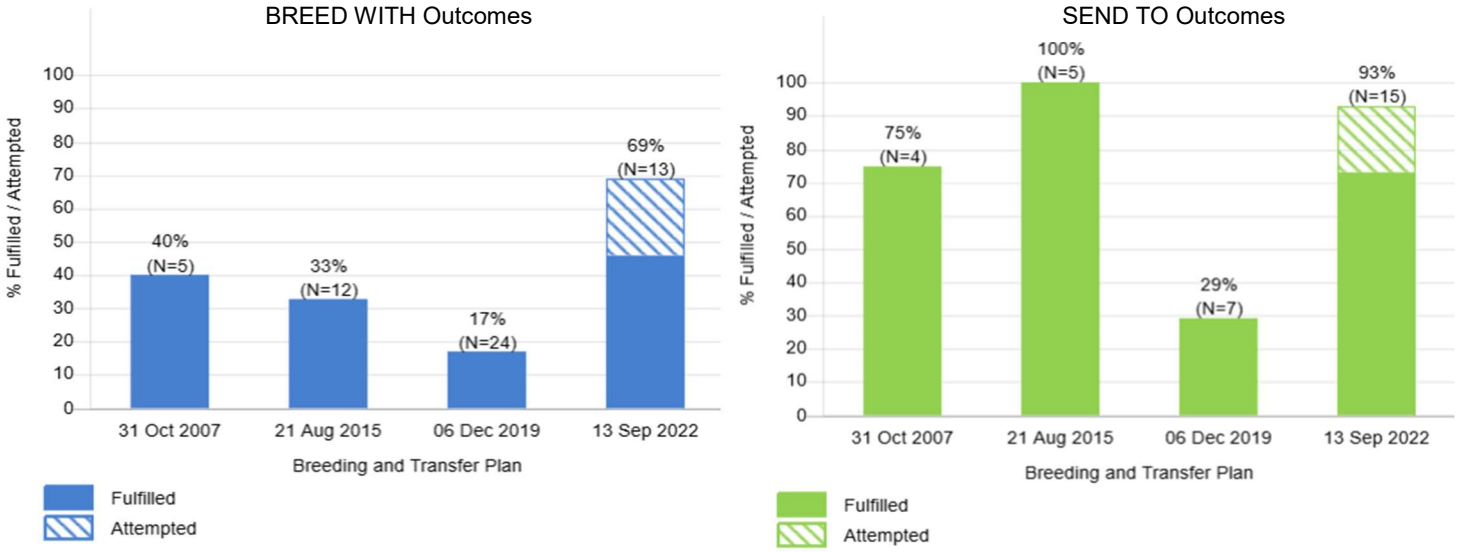


**Figure 4:** Recommendation outcomes by breeding (left) and transfer (right) for the past Blue-billed Curassow SSP Breeding and Transfer Plans. *N* represents the number of recommendations scored for each recommendation type that was issued in the plan or during the interim, and the number represents the percent of recommendations fulfilled and attempted. Please visit PMCTrack.org or contact pmctrack@lpzoo.org for more information or with any questions.

# Management Strategies

This is a 3-year plan (2025-2027). Interim recommendations will continue to be made as needed until another full set of recommendations is produced. Recommendations contained in this plan supersede all previous recommendations.

Gene diversity in the analytical population is 85.38%, which is well below the 90% threshold commonly thought to represent genetic vigor. Gene diversity is projected to decline to ~73% over the next 100 years. Given that the parameters used for genetic projections are generally quite reasonable, it is unlikely long-term gene diversity retention can be notably improved through management alone and additional imports of unrelated birds ultimately will be necessary to support long-term gene diversity maintenance. New sources for potential founders from collections outside the SSP should be investigated.

At this time, the number of breeding recommendations is intended to slowly grow the population towards a target size of 75 birds. Given that the population is generally demographically robust, and not all females require breeding recommendations, particular priority is being placed on breeding birds with low mean kinships (representative of under-represented founders) to support long-term gene diversity retention across the population. As with most AZA-managed programs, breeding recommendations also aim to limit inbreeding and minimize differences between sire and dam kinships.

The Blue-billed Curassow SSP will pursue the scenario of growing to 75 target size for this Breeding and Transfer Plan (Table 4, scenario b). The population has been averaging 9.6 hatches per year over the last five years (2019-2023), indicating that recent reproduction is more than sufficient to confidently grow the population, and that careful management may be needed to avoid growing the population too quickly. However, if the export of nine birds to the EEP occurs within the next three years, more hatches will be needed to reach the target size (Table 4, scenario c).

**Table 4:** Reproduction plan and history for the Blue-billed Curassow SSP population.

| **Reproductive Goals**** | | | | |
|---|---|---|---|---|
| | **Growth Rate (λ)** | **Year to Reach Goal** | **Number of Offspring Needed per Year** | **To Reach Target Population Size Of** |
| a. Maintain current population size | 1.00 | 2027 | 4 | 70 |
| **b. Grow size to the recommended target population size ($TPS_{2027}$) in 3 years** | **1.023** | **2027** | **5-6** | **75** |
| c. Grow size to the recommended target population size ($TPS_{2027}$) in 3 years accounting for the 9 birds slated for export to the EEP | 1.071 | 2027 | 9 | 75 |
| **Reproductive Goals Summary from the Last BTP (2022)** | | | | |
| Number of females recommended to breed | | | 13 | |
| Number of hatches since publication date of last report (9/13/22) | | | 11 | |
| **Average Number of Events in the SSP Population per Year over the Last Five Years*** | | | | |
| Average number of hatches per year | | | 9.8 | |
| Average number of deaths per year | | | 7.0 | |
| Average number of imports per year | | | 0.6 | |
| Average number of exports per year | | | 0 | |

*Changes to numbers of imports or exports between reports may be due to changes in accreditation through time. These numbers pertain to the AZA Population at the time of analysis/publication.

**Summary Recommendations:**

1. **The SSP recommends 9 females to breed at 8 facilities.** The number of breeding pairs recommended is intended to slowly grow the population towards 75 birds in the next three years. This will require 16 hatches total in the next three years (or 5-6 hatches per year). However, if the export of nine birds to the EEP occurs within the next three years, more hatches will be needed to reach the target size (27 hatches total or 9 hatches per year).
    - Five of the nine females have previously produced offspring.
    - Facilities should contact the SSP Coordinator after a successful clutch before attempting to breed a second clutch.
    - Facilities should attempt parent-rearing first. Please contact the SSP Coordinator if this is not a possibility.

2. **The SSP recommends 18 transfers to establish new pairs and meet facility requests.**
    - Five of the eighteen transfers are intended to place more birds slated for export to the EEP at PINOLA temporarily (a total of nine birds slated for export).
    - Five of the eighteen transfers are intended to establish new breeding pairs.

3. Please consult with the AZA Reproductive Management Center (See Appendix I) for questions related to limiting or promoting fertility as well as reproductive health. Direct inquiries to contraception@stlzoo.org.

4. **Blue-billed Curassow Rearing Information.** This species is long-lived and it is strongly recommended that when rearing chicks of this species that great care is taken not to produce imprinted animals. Appropriate rearing is the first step for lifelong welfare and allows for these long-lived birds to live a content life. Imprinted males have limited housing and breeding success for this species.
    - **Parent-rearing**: Institutions capable of parent-rearing are strongly recommended to do so. Parent-rearing will need to be closely monitored, especially for individuals with aggressive tendencies or other behavioral issues. Aggressive males may need to be removed from their enclosures to minimize risk to the hens and/or chicks.
    - **Hand-rearing**: *C. alberti* have been successfully hand-reared in the past, but it is only recommended if no other viable option is available. In the past, heightened aggression towards other individuals, species, or keepers has been exhibited in hand-raised *C. alberti* males. For institutions that need to hand-rear birds, it is recommended that birds are hand raised in pairs, or that they be raised with a chicken-chick companion. For management practices, it is recommended that eggs be blood-sexed as females if hand-raising is to occur, unless otherwise requested by the SSP coordinator.
    - **Foster-rearing**: Several institutions have had success utilizing domestic chicken hens as foster-parents for *C. alberti* (as well as other Galliformes). Broody chicken hens are capable of incubating curassow eggs and rearing curassow chicks. Partial artificial incubation may be required on a case-by-case basis and eggs will need additional hand-turning by animal care staff. Foster-rearing is a preferred alternative to hand-rearing and helps to minimize imprinting on human keepers. Institutions capable of foster-rearing chicks are encouraged to do so if parent-raising is not an option**. For more information on foster-rearing, contact the SSP coordinator, studbook keeper, or Galliformes TAG chair.**

# Explanation of Recommendations Using MateR$_x$

**Recommendations Using MateR$_x$:** MateR$_x$ is analytical software developed jointly by the Lincoln Park Zoo and Smithsonian's National Zoo and Conservation Biology Institute. The primary output is a matrix of genetic ratings (Mate Suitability Indices = MSI) for possible breeding pairs.

Each MSI represents the genetic consequences for the population if a given pair was to produce offspring. There are seven values for MSIs varying in degree of genetic benefit or detriment to the genetic health of the population.

These MSI values are defined as:

| *MSI Value* | *Genetic consequences* | *Demographic consequences* |
|---|---|---|
| **1** | very beneficial | ok to breed |
| **2** | moderately beneficial | ok to breed |
| **3** | slightly beneficial | ok to breed |
| **3.5** | See explanation below for numerical scoring of 3.5 | |
| **4** | slightly detrimental/beneficial | may be necessary to breed to maintain or increase population size |
| **5** | moderately detrimental | may be necessary to breed in declining populations |
| **6** | very detrimental | not to be bred without a consultation with a population biologist |
| **—** | extremely detrimental | not to be bred without a consultation with a population biologist |

**MateR$_x$ Settings for Potential Founders:** In the Pairwise tab (MateR$_x$) or in Genetic Details>Settings, there is now an option to have the MSI score for pairs involving potential founders be a maximum of 3.5. This is so that pairs that do involve potential founders are recognized as being genetically valuable since they often have high MSI because of the difference in the *mk* of the potential founder and its pairing. There is now a setting in the Genetics Settings tab that allows the user to impose this modification or not. The default setting is set to impose this modification.

**Reminder –** the MateRx is a genetic only tool that does not incorporate demographic data or needs of the population.

**If MateRx setting have been modified by the population biologist, the interpretation of the MSI values may differ. Your population biologists may provide additional MateR$_x$ instructions, as MateR$_x$ values do not integrate a population's demographic goals or needs.**

MateR$_x$ integrates four genetic factors to produce the Mate Suitability Index:

1. The expected change in **genetic diversity** (increase, decrease) that would result if an offspring of a pair is added to the population
2. The **relative rareness or commonness** of the parent's genome (i.e., the difference between the male and female mean kinships)
3. The **inbreeding** coefficient of offspring that would be produced by a pair
4. The proportion, if any, of the dam and sire's pedigree that is of **unknown origin**.

# Breeding and Transfer Recommendations by Facility

**AUDUB SSC**
**Freeport-McMoRan Audubon Species Survival Center**
New Orleans, LA

**Facility Note:** Please receive valuable F149 to breed with valuable M126; F149 produced two chicks with her current mate in 2023 and M126 has yet to produce offspring.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 64 | 16B014 | M | 15 | HOLD | AUDUB SSC | DO NOT BREED | | |
| 126 | 22B044 | M | 11 | HOLD | AUDUB SSC | BREED WITH | 149 | |
| 149 | 15124 | F | 7 | RECEIVE FROM | COLUMBIA | BREED WITH | 126 | |
| 172 | 19B002 | F | 7 | SEND TO | COLUMBIA | DO NOT BREED | | |
| 203 | 22B020 | M | 2 | SEND TO | DALLAS WA | SEE MATERX | | |
| 204 | 22B028 | M | 2 | SEND TO | DALLAS WA | SEE MATERX | | |
| 206 | 22B027 | F | 2 | SEND TO | PINOLA | DO NOT BREED | | excluded – slated for EEP |

**BIODOME**
**Biodome de Montreal**
Montreal, Quebec, Canada

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 180 | 5742 | M | 6 | HOLD | BIODOME | DO NOT BREED | | |

**CALI**
**Fundación Zoologica de Cali**
Cali, Valle del Cauca, Colombia

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 195 | A21034 | M | 4 | HOLD | CALI | BREED WITH | 254 | |
| 196 | A21035 | F | 4 | HOLD | CALI | DO NOT BREED | | |
| 254 | A24017 | F | 1 | HOLD | CALI | BREED WITH | 195 | |

**CHICAGOBR**
**Brookfield Zoo**
Brookfield, IL

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 114 | 6718 | M | 11 | HOLD | CHICAGOBR | DO NOT BREED | | |
| 139 | 10018 | F | 9 | HOLD | CHICAGOBR | DO NOT BREED | | |

**COLUMBIA**
**Riverbanks Zoo and Garden**
Columbia, SC

**Facility Note:** Please swap females with AUDUB SSC so valuable F172 can be placed in a breeding situation with an equally valuable male.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 149 | 15124 | F | 7 | SEND TO | AUDUB SSC | BREED WITH | 126 | |
| 172 | 19B002 | F | 7 | RECEIVE FROM | AUDUB SSC | DO NOT BREED | | |
| 186 | 15077 | M | 6 | HOLD | COLUMBIA | DO NOT BREED | | |
| 241 | 16626 | F | 1 | SEND TO | PINOLA | DO NOT BREED | | excluded – slated for EEP |
| 242 | 16627 | M | 1 | SEND TO | PINOLA | DO NOT BREED | | excluded – slated for EEP |

**DALLAS WA**
**Dallas World Aquarium**
Dallas, TX

**Facility Note:** Please breed at your discretion considering institutional capacity to hold offspring. Pairs with a Mate Suitability Index (MSI) score of "1", "2", or "3" may breed up to institutional capacity. Pairings with MateRx values of 5, 6, or "-" are not recommended and should be discouraged by managers. MateRx pairings of 4 are recommended if better pairings are unable to meet demographic goals.

While pairing should be based on MSI scores, the following males and females are the most genetically valuable in your flock and should be prioritized for breeding to meet institutional capacity.
Priority males: M132, M174, M219
Priority females: F65, F127, F175

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 44 | 9A226 | M | 22 | HOLD | DALLAS WA | SEE MATERX | | |
| 65 | 9A107 | F | 18 | HOLD | DALLAS WA | SEE MATERX | | |
| 77 | 12A046 | M | 13 | HOLD | DALLAS WA | SEE MATERX | | |
| 127 | 16A010 | F | 10 | HOLD | DALLAS WA | SEE MATERX | | |
| 132 | 16A009 | M | 10 | HOLD | DALLAS WA | SEE MATERX | | |
| 174 | 15H113 | M | 9 | HOLD | DALLAS WA | SEE MATERX | | |
| 175 | 15H238 | F | 9 | HOLD | DALLAS WA | SEE MATERX | | |
| 203 | 22B020 | M | 2 | RECEIVE FROM | AUDUB SSC | SEE MATERX | | |
| 204 | 22B028 | M | 2 | RECEIVE FROM | AUDUB SSC | SEE MATERX | | |
| 213 | 21H023 | F | 3 | HOLD | DALLAS WA | SEE MATERX | | |
| 214 | 21H028 | F | 3 | HOLD | DALLAS WA | SEE MATERX | | |
| 216 | 21H033 | F | 3 | HOLD | DALLAS WA | SEE MATERX | | |
| 219 | 21H055 | M | 3 | HOLD | DALLAS WA | SEE MATERX | | |
| 222 | 21H074 | M | 3 | HOLD | DALLAS WA | SEE MATERX | | |
| 224 | 22H042 | F | 2 | HOLD | DALLAS WA | SEE MATERX | | |
| 247 | 24H047 | F | 0 | HOLD | DALLAS WA | SEE MATERX | | |

**DALLAS WA continued…**

| SB# | Females > | 65 | 127 | 175 | 213 | 214 | 216 | 224 | 247 |
|---|---|---|---|---|---|---|---|---|---|
| Males V | Location | DALLAS WA | DALLAS WA | DALLAS WA | DALLAS WA | DALLAS WA | DALLAS WA | DALLAS WA | DALLAS WA |
| 44 | DALLAS WA | 6 | 4 | - | - | - | - | - | - |
| 77 | DALLAS WA | 6 | 4 | 4 | 4 | 4 | - | 4 | 4 |
| 132 | DALLAS WA | 4 | - | 2 | 4 | - | 4 | 4 | - |
| 174 | DALLAS WA | - | 2 | - | - | 4 | - | - | 4 |
| 203 | AUDUB SSC | 6 | 4 | 4 | 4 | 4 | - | 4 | 4 |
| 204 | AUDUB SSC | 6 | 4 | 4 | 4 | 4 | - | 4 | 4 |
| 219 | DALLAS WA | 4 | - | 4 | - | 4 | 4 | - | 4 |
| 222 | DALLAS WA | 6 | 4 | - | 4 | 4 | - | 4 | 4 |
| 64 | AUDUB SSC | 6 | 4 | 6 | 4 | 4 | - | 4 | 4 |
| 126 | AUDUB SSC | - | 2 | - | 4 | 4 | - | 4 | 4 |
| 203 | AUDUB SSC | 6 | 4 | 4 | 4 | 4 | - | 4 | 4 |
| 204 | AUDUB SSC | 6 | 4 | 4 | 4 | 4 | - | 4 | 4 |

**DRAPER**
**The Loveland Living Planet Aquarium**
Draper, UT

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 228 | 217460 | F | 2 | HOLD | DRAPER | DO NOT BREED | | |
| 240 | 217479 | F | 2 | HOLD | DRAPER | DO NOT BREED | | |

**HOUSTON**
**Houston Zoo**
Houston, TX

**Facility Note:** M73 is highly genetically valuable. Pair M73 x F67 was established in 2016; together they have produced ten chicks between 2017 and 2024.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 67 | 26317 | F | 13 | HOLD | HOUSTON | BREED WITH | 73 | |
| 73 | 25792 | M | 17 | HOLD | HOUSTON | BREED WITH | 67 | |
| 244 | 36110 | F | 1 | SEND TO | NY BRONX | BREED WITH | 229 | |
| 249 | 36785 | F | 0 | SEND TO | SEDGWICK | DO NOT BREED | | |
| 250 | 36786 | F | 0 | SEND TO | SEDGWICK | DO NOT BREED | | |

**LOSANGELE**
**Los Angeles Zoo & Botanical Gardens**
Los Angeles, CA

**Facility Note:** This young and genetically valuable pair is newly established in 2024. Please parent-rear any offspring produced or contact the SSP Coordinator for foster placement.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 205 | 2250060 | M | 2 | HOLD | LOSANGELE | BREED WITH | 245 | |
| 245 | 36331 | F | 1 | HOLD | LOSANGELE | BREED WITH | 205 | |

**METROZOO**
**Zoo Miami**
Miami, FL

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 48 | B80024 | M | 18 | HOLD | METROZOO | DO NOT BREED | | |
| 54 | B90076 | F | 17 | HOLD | METROZOO | DO NOT BREED | | |

**NATAVPGH**
**National Aviary in Pittsburgh**
Pittsburgh, PA

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 129 | 9272 | M | 10 | HOLD | NATAVPGH | DO NOT BREED | | |
| 197 | 6938 | F | 4 | HOLD | NATAVPGH | DO NOT BREED | | |

**NY BRONX**
**Bronx Zoo**
Bronx, NY

**Facility Note:** The SSP will gain this facility as a result of these transfers. This will be a new pairing of young and genetically valuable birds. Please parent-rear any offspring produced or contact the SSP Coordinator for foster placement.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 229 | A2218 | M | 2 | RECEIVE FROM | YULEE | BREED WITH | 244 | |
| 244 | 36110 | F | 1 | RECEIVE FROM | HOUSTON | BREED WITH | 229 | |

**NZP-WASH**
**Smithsonian National Zoo**
Washington, D.C.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 49 | 216940 | M | 18 | HOLD | NZP-WASH | DO NOT BREED | | excluded - medical |
| 128 | 994155 | F | 10 | HOLD | NZP-WASH | DO NOT BREED | | |

**PHOENIX**
**Phoenix Zoo**
Phoenix, AZ

**Facility Note:** Pair M138 x F140 was established in 2016; they have yet to produce offspring. The SSP would like to consider repairing after attempting to breed this pair for two more seasons. Please parent-rear any offspring produced or contact the SSP Coordinator for foster placement.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 138 | 13123 | M | 9 | HOLD | PHOENIX | BREED WITH | 140 | |
| 140 | 13150 | F | 9 | HOLD | PHOENIX | BREED WITH | 138 | |

**PINOLA**
**Pinola Conservancy**
Shreveport, LA

**Facility Note:** The SSP thanks you for receiving these birds for eventual export to the EEP.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 141 | 15273 | M | 9 | RECEIVE FROM | SEDGWICK | DO NOT BREED | | excluded – slated for EEP |
| 179 | BCCU2401 | M | 6 | SEND TO | TBD | SEE NOTES | | excluded – slated for EEP |
| 198 | BCCU2403 | M | 3 | SEND TO | TBD | SEE NOTES | | excluded – slated for EEP |
| 199 | 2353001 | M | 3 | RECEIVE FROM | YULEE | DO NOT BREED | | excluded – slated for EEP |
| 200 | BCCU2404 | F | 3 | SEND TO | TBD | SEE NOTES | | excluded – slated for EEP |
| 206 | BCCU2402 | F | 2 | SEND TO | TBD | SEE NOTES | | excluded – slated for EEP |
| 241 | 16626 | F | 1 | RECEIVE FROM | COLUMBIA | DO NOT BREED | | excluded – slated for EEP |
| 242 | 16627 | M | 1 | RECEIVE FROM | COLUMBIA | DO NOT BREED | | excluded – slated for EEP |
| 243 | 2350134 | M | 1 | RECEIVE FROM | YULEE | DO NOT BREED | | excluded – slated for EEP |

**SD-WAP**
**San Diego Zoo Safari Park**
Escondido, CA

**Facility Note:** Please receive M248 to socially pair with M251 since both individuals are foster-raised. Once socialized, the SSP would like to recommend M248 breed with F202 due to her genetic value. Please update the SSP Coordinator on the progress of this new, young pair.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 134 | 815009 | M | 10 | HOLD | SD-WAP | DO NOT BREED | | |
| 202 | 34379 | F | 3 | HOLD | SD-WAP | DO NOT BREED | | |
| 248 | 21450143 | M | 0 | SEND TO | SD-WAP | DO NOT BREED | | social pairing with 251 |
| 251 | 4007172 | F | 0 | HOLD | SD-WAP | DO NOT BREED | | social pairing with 248 |

**SEATTLE**
**Woodland Park Zoo**
Seattle, WA

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 113 | 207601 | F | 11 | HOLD | SEATTLE | DO NOT BREED | | |
| 190 | 207533 | M | 4 | HOLD | SEATTLE | DO NOT BREED | | |

**SEDGWICK**
**Sedgwick County Zoo**
Wichita, KS

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 141 | 15273 | M | 9 | SEND TO | PINOLA | DO NOT BREED | | excluded – slated for EEP |
| 249 | 36785 | F | 0 | RECEIVE FROM | HOUSTON | DO NOT BREED | | |
| 250 | 36786 | F | 0 | RECEIVE FROM | HOUSTON | DO NOT BREED | | |

**ST AUGUST**
**St. Augustine Alligator Farm**
St. Augustine, FL

**Facility Note:** Please contact the SSP if your facility is interested in receiving chicks for foster-raising.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 51 | A1932 | M | 17 | HOLD | ST AUGUST | DO NOT BREED | | |
| 59 | A1707 | F | 15 | HOLD | ST AUGUST | DO NOT BREED | | |

**TRACY AV**
**Tracy Aviary**
Salt Lake City, UT

**Facility Note:** Pair M176xF148 was established in 2020 and produced one chick together in 2023.

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 148 | 31721 | F | 7 | HOLD | TRACY AV | BREED WITH | 176 | |
| 176 | 33721 | M | 7 | HOLD | TRACY AV | BREED WITH | 148 | |

**WINNIPEG**
**Assiniboine Park Zoo**
Winnipeg, Manitoba, Canada

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 181 | 5743 | M | 6 | HOLD | WINNIPEG | DO NOT BREED | | |

**YULEE**
**White Oak Conservation Center**
Yulee, FL

| ID | Local ID | Sex | Age | Disposition | Location | Breeding | With | Notes |
|---|---|---|---|---|---|---|---|---|
| 108 | 145307 | F | 12 | HOLD | YULEE | BREED WITH | 125 | |
| 109 | 135301 | F | 12 | HOLD | YULEE | DO NOT BREED | | |
| 124 | 215303 | F | 11 | HOLD | YULEE | BREED WITH | 217 | |
| 125 | 215302 | M | 11 | HOLD | YULEE | BREED WITH | 108 | |
| 199 | 2353001 | M | 3 | SEND TO | PINOLA | DO NOT BREED | | excluded – slated for EEP |
| 217 | 2353004 | M | 3 | HOLD | YULEE | BREED WITH | 124 | |
| 229 | A2218 | M | 2 | SEND TO | NY BRONX | BREED WITH | 244 | |
| 243 | 2350134 | M | 1 | SEND TO | PINOLA | DO NOT BREED | | excluded – slated for EEP |
| 248 | 2450143 | M | 0 | SEND TO | SD-WAP | DO NOT BREED | | |

# Appendices

## A. Analytical Assumptions

**HYPOTHETICAL INDIVIDUALS**

| Studbook ID | Sire | Dam | Notes |
|---|---|---|---|
| HYP1 | WILD | WILD | Hypothetical sire of SB# 61 at ESTUDILLO. |
| HYP2 | WILD | WILD | Hypothetical sire of SB# 65 at ESTUDILLO. |
| HYP3 | WILD | WILD | Hypothetical dam of SB# 61 & 65 used to relate these birds from ESTUDILLO at the half-sibling level. |

**ANALYTICAL DATA FOR TRUE INDIVIDUALS**

| Studbook ID | Field | True | Overlay | Notes |
|---|---|---|---|---|
| 61 | Sire | UNK5 | HYP1 | SB# 61 and 65 are both from ESTUDILLO and are thought to be related. An assumption was created to make them half-siblings and unrelated to the rest of the AZA population. |
| | Dam | UNK6 | HYP3 | |
| 65 | Sire | UNK | HYP2 | |
| | Dam | UNK | HYP3 | |
| 69 | Sire | UNK | WILD | SB# 69 is likely from the wild and unrelated to the rest of the AZA population. |
| | Dam | UNK | WILD | |
| 71 | Sire | UNK | WILD | SB# 73 most likely represents a unique lineage. |
| | Dam | UNK | WILD | |
| 73 | Dam | MULT1 | 69 | SB# 69 is the most likely dam for SB# 73. |
| 194 | Sire | UNK | MULT2 | SB#194 hatched in CARTAG AV on 3/29/14 (c. 2/26/14), a search for birds >3 yr of age living at the facility +/- 1 mo of the conception date shows males 152 (and 151 went LTF in 2012) and females 153, 154, 155. MULT2 and MULT3 were used to capture these potential sires and dams. |
| | Dam | UNK | MULT3 | |
| 252 | Sire | UNK | WILD | SB# 252 is from a private facility in Colombia and likely unrelated to the rest of the AZA population. |
| | Dam | UNK | WILD | |

# B. Animals Excluded from Genetic Analysis

| ID | Sex | Age | Location | Reason for Exclusion |
|---|---|---|---|---|
| 49 | M | 18 | NZP-WASH | medical |
| 141 | M | 9 | SEDGWICK | Slated for eventual transfer to the EEP, contact SSP Coordinator for more info |
| 179 | M | 6 | PINOLA | |
| 198 | M | 3 | PINOLA | |
| 199 | M | 3 | YULEE | |
| 200 | F | 3 | PINOLA | |
| 206 | F | 2 | PINOLA | |
| 241 | F | 1 | COLUMBIA | |
| 242 | M | 1 | COLUMBIA | |
| 243 | M | 1 | YULEE | |

# C. Summary of Data Exports

| | |
|---|---|
| **Studbook Software and version #** | ZIMS for Studbooks 3.0 |
| **Overlay Name** | 2023_Overlay_AZA_EAZA |
| **MateR$_x$ Settings (F Break Pt & MK Diff Method)** | F Breakpoint: UseAverageMK<br>Genetic Value Type: Mean Kinship<br>MK Diff Method: AbsoluteDiffs<br>F Breakpoint: UseAverageMK<br>For Unknown Sexes: ExcludeUnknowns<br>MSI Method: Tulsa<br>F: Breakpoint = 0.1462, No Way Point = 0.1700<br>GV Diff: Breakpoint = 0.069937, No Way Point = 1.00 |
| **Descriptive Survival Statistics Report** | Data were not of sufficient robustness to analyze. |

**PMx Project:** CurassowBB_XXAZA_121024
**Created:** 2024-12-10 by PMx version 1.7.0.20210811
**File:** C:\PMxProjects\CurassowBB_XXAZA_121024.pmxproj

**Primary data file**
Data File Name: zims.zims
Common Name: Blue-billed curassow
Scientific Name: Crax alberti
Data Source: ZIMS for Studbooks
Studbook Name: Curassow, Blue-Billed (Crax alberti) SSP
Exported On: 2024-12-10
Software version: ZIMS for Studbooks 3.0
Current Through: 2024-12-10
Compiled By: Christopher Holmes, Christian Andres Olaciregui Pineda
Scope: WAZA
Dates: 1985-01-01 to 2024-12-10
Association: AZA / Association of Zoos & Aquariums (AZA)
Other Filters: Status = Living
User: Asako Chaille

**Moves data file**
Data File Name: genetic.csv
Dates: 1985-01-01 to 2024-12-10
Association: AZA / Association of Zoos & Aquariums (AZA)
Other Filters: Status = None
Data File Name: demographic.csv
Scope: WAZA
Dates: 1985-01-01 to 2024-12-10
Association: AZA / Association of Zoos & Aquariums (AZA)
Other Filters: Status = None

**Demographic input files**
Census1 file: Exchcens.txt

**PMx modifications:** Births throughout the year was set to seasonal. M30, M177 and U185 were removed from demographic and genetic analyses due to recent death not yet recorded in the studbook at time of data export.

**Comment period changes:** M179, M198, F200, F206 transferred from AUDUB SSC to PINOLA during the comment period.

# D. Life Tables

Px = survival; Qx = mortality; Lx = cumulative survivorship; Mx = fecundity;
At Risk (Qx and Mx) = number of animals corresponding values are estimated from.

Qx at for males age class 31 was set to 1.00 due to the oldest male still living at time of data export (SB# 30).

**MALES**

| Age | Px | Qx | Risk Qx | Lx | Mx | Risk Mx |
|---|---|---|---|---|---|---|
| **0** | 0.715 | 0.285 | 53.312 | 1.000 | 0.000 | 53.312 |
| **1** | 0.939 | 0.061 | 48.045 | 0.715 | 0.022 | 48.045 |
| **2** | 1.000 | 0.000 | 40.747 | 0.671 | 0.024 | 40.747 |
| **3** | 0.975 | 0.025 | 36.051 | 0.671 | 0.096 | 36.051 |
| **4** | 0.941 | 0.059 | 31.963 | 0.654 | 0.268 | 31.963 |
| **5** | 1.000 | 0.000 | 30.179 | 0.616 | 0.133 | 30.179 |
| **6** | 0.967 | 0.033 | 27.534 | 0.616 | 0.224 | 27.534 |
| **7** | 1.000 | 0.000 | 23.285 | 0.595 | 0.325 | 23.285 |
| **8** | 1.000 | 0.000 | 22.096 | 0.595 | 0.271 | 22.096 |
| **9** | 0.957 | 0.043 | 20.710 | 0.595 | 0.101 | 20.710 |
| **10** | 0.947 | 0.053 | 16.890 | 0.569 | 0.338 | 16.890 |
| **11** | 0.923 | 0.077 | 14.148 | 0.539 | 0.150 | 14.148 |
| **12** | 1.000 | 0.000 | 12.000 | 0.498 | 0.667 | 12.000 |
| **13** | 1.000 | 0.000 | 11.611 | 0.498 | 0.258 | 11.611 |
| **14** | 1.000 | 0.000 | 11.000 | 0.498 | 0.227 | 11.000 |
| **15** | 1.000 | 0.000 | 10.447 | 0.498 | 0.191 | 10.447 |
| **16** | 1.000 | 0.000 | 10.000 | 0.498 | 0.200 | 10.000 |
| **17** | 1.000 | 0.000 | 9.118 | 0.498 | 0.288 | 9.118 |
| **18** | 0.833 | 0.167 | 6.277 | 0.498 | 0.100 | 6.277 |
| **19** | 1.000 | 0.000 | 5.000 | 0.415 | 0.200 | 5.000 |
| **20** | 1.000 | 0.000 | 5.000 | 0.415 | 0.600 | 5.000 |
| **21** | 1.000 | 0.000 | 5.000 | 0.415 | 0.200 | 5.000 |
| **22** | 0.800 | 0.200 | 3.540 | 0.415 | 0.458 | 3.540 |
| **23** | 0.750 | 0.250 | 3.877 | 0.332 | 0.000 | 3.877 |
| **24** | 1.000 | 0.000 | 3.000 | 0.249 | 0.167 | 3.000 |
| **25** | 1.000 | 0.000 | 3.000 | 0.249 | 0.000 | 3.000 |
| **26** | 1.000 | 0.000 | 3.000 | 0.249 | 0.000 | 3.000 |
| **27** | 1.000 | 0.000 | 3.000 | 0.249 | 0.000 | 3.000 |
| **28** | 1.000 | 0.000 | 3.000 | 0.249 | 0.000 | 3.000 |
| **29** | 0.667 | 0.333 | 2.085 | 0.249 | 0.000 | 2.085 |
| **30** | 1.000 | 0.000 | 1.647 | 0.166 | 0.000 | 1.647 |
| **31** | 1.000 | 1.000 | 0.307 | 0.166 | 0.000 | 0.307 |

r = 0.081, λ = 1.084, Ro = 2.250, T = 10.0, N@20 = 195

**FEMALES**

| Age | Px | Qx | Risk Qx | Lx | Mx | Risk Mx |
|---|---|---|---|---|---|---|
| **0** | 0.761 | 0.239 | 58.268 | 1.000 | 0.000 | 58.268 |
| **1** | 0.946 | 0.054 | 50.086 | 0.761 | 0.034 | 50.087 |
| **2** | 0.976 | 0.024 | 42.974 | 0.720 | 0.063 | 42.976 |
| **3** | 0.973 | 0.027 | 38.955 | 0.702 | 0.159 | 38.958 |
| **4** | 1.000 | 0.000 | 34.105 | 0.683 | 0.237 | 34.109 |
| **5** | 0.938 | 0.063 | 31.919 | 0.683 | 0.277 | 31.926 |
| **6** | 0.932 | 0.068 | 28.173 | 0.640 | 0.254 | 28.177 |
| **7** | 0.930 | 0.070 | 25.860 | 0.597 | 0.218 | 25.864 |
| **8** | 0.875 | 0.125 | 22.233 | 0.555 | 0.141 | 22.235 |
| **9** | 0.944 | 0.056 | 20.058 | 0.486 | 0.181 | 20.062 |
| **10** | 0.941 | 0.059 | 15.751 | 0.459 | 0.064 | 15.752 |
| **11** | 1.000 | 0.000 | 14.219 | 0.432 | 0.315 | 14.223 |
| **12** | 0.917 | 0.083 | 12.874 | 0.432 | 0.120 | 12.879 |
| **13** | 0.909 | 0.091 | 9.899 | 0.396 | 0.610 | 9.908 |
| **14** | 1.000 | 0.000 | 9.000 | 0.360 | 0.342 | 9.008 |
| **15** | 1.000 | 0.000 | 8.523 | 0.360 | 0.249 | 8.526 |
| **16** | 1.000 | 0.000 | 8.989 | 0.360 | 0.171 | 8.995 |
| **17** | 1.000 | 0.000 | 8.488 | 0.360 | 0.256 | 8.491 |
| **18** | 0.875 | 0.125 | 7.548 | 0.360 | 0.220 | 7.553 |
| **19** | 0.857 | 0.143 | 6.208 | 0.315 | 0.342 | 6.217 |
| **20** | 1.000 | 0.000 | 6.000 | 0.270 | 0.085 | 6.000 |
| **21** | 1.000 | 0.000 | 6.000 | 0.270 | 0.256 | 6.006 |
| **22** | 1.000 | 0.000 | 6.000 | 0.270 | 0.171 | 6.003 |
| **23** | 1.000 | 0.000 | 6.000 | 0.270 | 0.000 | 6.000 |
| **24** | 1.000 | 0.000 | 6.000 | 0.270 | 0.000 | 6.000 |
| **25** | 0.833 | 0.167 | 5.877 | 0.270 | 0.000 | 5.877 |
| **26** | 0.800 | 0.200 | 4.167 | 0.225 | 0.000 | 4.167 |
| **27** | 0.750 | 0.250 | 3.200 | 0.180 | 0.000 | 3.200 |
| **28** | 0.667 | 0.333 | 2.940 | 0.135 | 0.000 | 2.940 |
| **29** | 1.000 | 0.000 | 2.000 | 0.090 | 0.000 | 2.000 |
| **30** | 1.000 | 0.000 | 2.000 | 0.090 | 0.000 | 2.000 |
| **31** | 0.500 | 0.500 | 1.071 | 0.090 | 0.000 | 1.071 |
| **32** | 1.000 | 0.000 | 1.000 | 0.045 | 0.000 | 1.000 |
| **33** | 1.000 | 0.000 | 1.000 | 0.045 | 0.000 | 1.000 |
| **34** | 0.000 | 1.000 | 0.000 | 0.045 | 0.000 | 0.000 |

r = 0.081, λ = 1.084, Ro = 1.955, T = 8.3, N@20 = 195

# E. Ordered Mean Kinship List

*These lists are current to 24 January 2025 and values are subject to change with any hatch, death, import, export, inclusion, exclusion, or changes in pedigree or pedigree assumptions. Unknown sexed animals appear on both the male and female side of the mean kinship list and are designated by adding a "U" behind their ages.*

Population Mean Kinship = 0.1462
(As indicated by a black line below)

**Males**

| SB ID | MK | Known | Age | Location |
|---|---|---|---|---|
| 195 | 0.0141 | 100 | 4 | CALI |
| 73 | 0.0807 | 100 | 17 | HOUSTON |
| 125 | 0.1251 | 100 | 11 | YULEE |
| 126 | 0.1288 | 100 | 11 | AUDUB SSC |
| 132 | 0.1293 | 100 | 10 | DALLAS WA |
| 205 | 0.1293 | 100 | 2 | LOSANGELE |
| 229 | 0.1293 | 100 | 2 | YULEE |
| 217 | 0.1352 | 100 | 3 | YULEE |
| 174 | 0.1376 | 100 | 9 | DALLAS WA |
| 219 | 0.1381 | 100 | 3 | DALLAS WA |
| 176 | 0.1402 | 100 | 7 | TRACY AV |
| 248 | 0.1578 | 100 | 0 | YULEE |
| 222 | 0.1644 | 100 | 3 | DALLAS WA |
| 138 | 0.1843 | 100 | 9 | PHOENIX |
| 51 | 0.1847 | 100 | 17 | ST AUGUST |
| 129 | 0.1849 | 100 | 10 | NATAVPGH |
| 64 | 0.1863 | 100 | 15 | AUDUB SSC |
| 190 | 0.1868 | 100 | 4 | SEATTLE |
| 48 | 0.1873 | 100 | 18 | METROZOO |
| 204 | 0.1878 | 100 | 2 | AUDUB SSC |
| 77 | 0.1886 | 100 | 13 | DALLAS WA |
| 203 | 0.1888 | 100 | 2 | AUDUB SSC |
| 114 | 0.1923 | 100 | 11 | CHICAGOBR |
| 186 | 0.1923 | 100 | 6 | COLUMBIA |
| 134 | 0.1926 | 100 | 10 | SD-WAP |
| 180 | 0.1941 | 100 | 6 | BIODOME |
| 181 | 0.1941 | 100 | 6 | WINNIPEG |
| 44 | 0.2005 | 100 | 22 | DALLAS WA |

**Females**

| SB ID | MK | Known | Age | Location |
|---|---|---|---|---|
| 254 | 0.0083 | 100 | 1 | CALI |
| 196 | 0.0141 | 100 | 4 | CALI |
| 65 | 0.0495 | 100 | 18 | DALLAS WA |
| 149 | 0.1119 | 100 | 7 | COLUMBIA |
| 244 | 0.1119 | 100 | 1 | HOUSTON |
| 249 | 0.1119 | 100 | 0 | HOUSTON |
| 250 | 0.1119 | 100 | 0 | HOUSTON |
| 148 | 0.114 | 100 | 7 | TRACY AV |
| 202 | 0.114 | 100 | 3 | SD-WAP |
| 140 | 0.121 | 100 | 9 | PHOENIX |
| 108 | 0.1231 | 100 | 12 | YULEE |
| 124 | 0.1252 | 100 | 11 | YULEE |
| 127 | 0.1304 | 100 | 10 | DALLAS WA |
| 245 | 0.1312 | 100 | 1 | LOSANGELE |
| 175 | 0.1327 | 100 | 9 | DALLAS WA |
| 67 | 0.1348 | 100 | 13 | HOUSTON |
| 197 | 0.1352 | 100 | 4 | NATAVPGH |
| 214 | 0.1352 | 100 | 3 | DALLAS WA |
| 247 | 0.1352 | 100 | 0 | DALLAS WA |
| 213 | 0.1381 | 100 | 3 | DALLAS WA |
| 224 | 0.1381 | 100 | 2 | DALLAS WA |
| 109 | 0.1568 | 100 | 12 | YULEE |
| 251 | 0.1569 | 100 | 0 | SD-WAP |
| 216 | 0.1644 | 100 | 3 | DALLAS WA |
| 139 | 0.1803 | 100 | 9 | CHICAGOBR |
| 172 | 0.1821 | 100 | 7 | AUDUB SSC |
| 128 | 0.1831 | 100 | 10 | NZP-WASH |
| 54 | 0.1876 | 100 | 17 | METROZOO |
| 228 | 0.1922 | 100 | 2 | DRAPER |
| 240 | 0.1922 | 100 | 2 | DRAPER |
| 59 | 0.1941 | 100 | 15 | ST AUGUST |
| 113 | 0.1966 | 100 | 11 | SEATTLE |

# F. Definitions

## Demographic Terms (as of July 2024)

**Age Distribution –** A visual representation of the numbers or percentages of individuals in various age and sex classes.

**Lambda (λ) or Population Growth Rate –** The proportional change in population size from one year to the next. A lambda of 1.11 means an 11% per year increase; a lambda of 0.97 means a 3% decline in size per year. The three lambdas highlighted in this BTP are: 1) Life Table, from the PMx life tables, the change in the population based on the demographic regional and date window exported from the studbook, the life table lambda is the rate at which the population would be expected to grow (in the future) given the birth and death rates reported in the life tables and assuming a stable age distribution (does NOT factor in imports or exports); 2) 5-year, from the studbook census, the 5-year lambda is calculated from observed changes in population size over the last 5 years and includes births, deaths, imports and exports; and 3) Projected, from the PMx stochastic 20-year projections (includes confidence intervals), models how the population is predicted to grow or decline over the next 20 years given the birth and death rates from the life tables and the age structure of the current population.

**Lx, Age-Specific Survivorship –** The probability that a new individual (e.g., age 0) is alive at the *beginning* of age *x*. Alternatively, the proportion of individuals which survive from birth to the beginning of a specific age class.

**Mean Generation Time (T)** – The average time elapsing from reproduction in one generation to the time the next generation reproduces. Also, the average age at which a female (or male) produces offspring. It is not the age of first reproduction. Males and females often have different generation times.

**Median Life Expectancy (MLE) –** The 'typical' age at which an average animal is expected to live; 50% will die before the median life expectancy and 50% die after. The MLE reported in Breeding and Transfer Plans (BTPs) and Survival Stats Reports, does exclude individuals that did not survive to their first birthday. The MLE obtained from population management software (PM2000, PMx, ZooRisk) or from life tables in BTPs (e.g., where Lx = 0.5) will be lower because they include those individuals that did not survive to their first birthday in order to project the correct number of births needed. A Survival Statistics Library is maintained for most AZA Animal Programs on the AZA website: https://www.aza.org/species-survival-statistics.

**Maximum Longevity –** The maximum age at which we have observed a species to live. If the oldest observed animal is currently living, we do not yet know the maximum longevity.

**Mx, Fecundity –** The average number of same-sexed offspring born to animals in that age class. Because studbooks typically have relatively small sample sizes, studbook software calculates Mx as 1/2 the average number of offspring born to animals in that age class. This provides a somewhat less "noisy" estimate of Mx, though it does not allow for unusual sex ratios. The fecundity rates provide information on the age of first, last, and maximum reproduction.

**Px, Age-Specific Survival –** The probability that an individual of age *x* survives an age class; is conditional on an individual being alive at the beginning of the age class. Alternatively, the proportion of individuals that survive from the beginning of one age class to the next.

**Qx, Mortality –** The probability that an individual of age *x* dies during an age class (Qx = 1-Px). Alternatively, the proportion of individuals that die during an age class. It is calculated from the number of animals that die during an age class divided by the number of animals that were alive at the beginning of the age class (i.e., "at risk").

**Risk (Qx or Mx) –** The number of individuals that have lived during an age class. The number "at risk" is used to calculate Mx and Qx by dividing the number of births and deaths that occurred during an age class by the number of animals at risk of dying and reproducing during that age class.

## Genetic Terms

**Effective Population Size ($N_e$) –** The size of a randomly mating population of constant size with equal sex ratio and a Poisson distribution of family sizes that would (a) result in the same mean rate of inbreeding as that observed in the population, or (b) would result in the same rate of random change in allele frequencies (genetic drift) as observed in the population. These two definitions are identical only if the population is demographically stable (because the rate of inbreeding depends on the distribution of alleles in the parental generation, whereas the rate of allele frequency drift is measured in the current generation). More specifically, PMx software use the definition as the size of the current population that has produced offspring, assuming that there are current breeders, that these current breeders have a Poisson distribution of family sizes, that none of the current breeders are now post-reproductive, and none of the not-yet-breeding adults will breed.

**Founder –** An individual obtained from a source population (often the wild) that has no known relationship to any individuals in the derived population (except for its own descendants).

**Founder Genome Equivalents (FGE) –** The number of wild-caught individuals (founders) that represent the same amount of gene diversity as does the population under study. The gene diversity of a population is 1 - 1 / (2 * FGE).

**Founder Representation –** The proportion of the alleles in the living, descendant population that are derived from that founder.

**Gene Diversity (GD) –** The probability that two alleles randomly sampled from the same genetic locus across a population are not identical by descent. Gene diversity is calculated relative to a population's founders, which are assumed to be unrelated and not inbred, and is the proportional diversity retained by the current, descendant population.

**Inbreeding Coefficient (F) –** The probability that the two alleles present at an individual's genetic locus are identical by descent (i.e., both alleles originated from an ancestor common to both the individual's parents).

**Mean Kinship (MK) –** The mean (or average) kinship coefficient between an animal and all animals (including itself) in the living, zoo/aquarium population. An individual's mean kinship is a measure of how well its alleles are represented within a population. Animals with low mean kinships have few relatives, are from under-represented founder lineages, and have transmitted few of their alleles to the next generation; these individuals should be prioritized for breeding to slow a population's gene diversity loss.

**Percent Known –** The percentage of an animal's genome that is traceable to known founders. Thus, if an animal has an UNK sire, its % Known = 50. If it has an UNK grandparent, its % Known = 75.

**Percent Certain –** The percentage of the living individuals' pedigree that can be completely identified as *certain:* (exact identity of both parents is known) and traceable back to known founders. Individuals that are 100% *certain* do not have any MULTs or UNKs in their pedigree. *Certainty* represents a higher degree of knowledge than *Known* and therefore is always less than or equal to *Known.*

## Management Terms

**Signature Species Survival Plan® (Signature SSP) Program –** A Signature SSP Program is a population that is considered to be sustainable using robust measures of viability and sustainability defined by the AZA Animal Population Management Committee. A Signature SSP meets all of the requirements to become an SSP, and scores at least two positives and does not score any negatives in the SSP Assessment process.

**Provisional Species Survival Plan® (Provisional SSP) Program –** A Provisional SSP Program is a population that is a priority for AZA members but does not currently meet the definitions of viability and sustainability defined by the AZA Animal Population Management Committee. A Provisional SSP Program meets all of the requirements to become an SSP and does not score a negative in more than two categories in the SSP Assessment process.

**Sustainability Partners –** AZA Animal Population Management (APM) Committee approved wildlife facilities that regularly exchange animals with AZA-accredited facilities and certified related facilities, typically as part of the Species Survival Plan® (SSP) Program Breeding and Transfer Plan or other SSP Program management process.

For more information on Program definitions – visit the AZA Resources Documents Page. https://www.aza.org/resource-documents

**Animal Program Engagement –** AZA policy stating that all AZA accredited are committed to managing robust animal populations in zoos and aquariums to assure that animals are available to meet individual program goals and fulfill our collective mission. Successful population management relies on highly collaborative, communicative, and engaged relationships among AZA members and Animal Programs (i.e., Taxon Advisory Groups (TAGs), Species Survival Plans® (SSPs), and AZA Studbooks). Therefore, all AZA member facilities must fully engage with and participate in each SSP that pertains to an animal that the facility own or is part of their collection. Further, each Animal Program Leader (i.e., TAG Chair, SSP Coordinator, and Studbook Keeper) must fully engage with each facility that is part of their Animal Program. Animal Program engagement is defined and explained in the Facility Handbook on Animal Program Engagement and with the SSP and TAG Handbooks (See Appendix G for link to additional AZA Policies pertinent to population management).

**Target Population Size ($TPS_{DATE}$):** A short-term target number of animals that is realistic yet aspirational, to be reached by the program by a specified target date. Factors considered when setting TPS may include program goals, the CPS/CPT, logistical constraints, the trajectory and performance of the population, species biology/life history, and/or, where relevant, a desire to move the population size closer to the APS. The TPS should always be reported with a target date (e.g. $TPS_{2029}$).

**Commitment Population Size ($CPS_{DATE}$) or Trend ($CPT_{DATE}$):** A number ***OR*** trend in number of animals **projected to be** in a program by a specified short-term date, based solely on realistic participant commitment to holding the species. CPS/CPT should always be reported with a target date (e.g., $CPS_{2029}$). CPS is a **number** that represents the size the population would be on that date if all realistic commitment to hold the taxon were filled and requests for acquisition/disposition completed. The unit for CPS may be "individuals" or an alternative unit appropriate to the taxon (e.g., "tanks"). Alternatively, CPT is the **direction** that the population is projected to shift, based on realistic commitment (growing, declining, remaining stable). CPS/CPT do **not** include biological/husbandry limitations, which are accounted for when setting TPS. TAGs are responsible for identifying the CPS or CPT and these values should be found in a Regional Collection Plan.

**Advised Population Size (APS):** a scientifically derived size that, if the population reaches that size and maintains appropriate demographic and genetic characteristics, would result in a high likelihood of the population being robust, viable, healthy, and biologically sound.

# G. AZA Animal Population Management (APM) Committee Disclaimers

as of July 2024

*All Species Survival Plans® are **subject to AZA Animal Program Engagement and Sustainability Partner Policies and Accreditation Standards**. All participants, including APM Committee-approved Sustainability Partners, are expected to agree and abide by AZA's Code of Professional Ethics, Policy on Animal Program Engagement, Policy on Responsible Population Management, and Accreditation Standards related to animal care and welfare.*

Please refer to the definition appendix above for more on how Programs are defined. Lastly, all Board-approved policies mentioned above regarding Animal Program Engagement and population management can be found on the AZA website linked below:

https://www.aza.org/board-approved-policies-and-position-statements?locale=en

# H. Directory of Institutional Representatives

Exported from PMCTrack as of 30 January 2025

| Mnemonic | Facility Name | Institutional Representative | Email |
|---|---|---|---|
| AKRON | Akron Zoological Park | Shane Good | S.Good@akronzoo.org |
| AUDUB SSC | Freeport-McMoRan Audubon Species Survival Center | Richard Dunn | rdunn@audubоninstitute.org |
| BIODOME | Montreal Biodôme | Emiko Wong | emiko.wong@montreal.ca |
| CALI | Zoologico de Cali | Carlos Andrés Galvis | carlos.galvis@fzc.com.co |
| CHICAGOBR | Brookfield Zoo Chicago | Justin Hickman | cody.hickman@czs.org |
| COLUMBIA | Riverbanks Zoo & Garden | Nichole Hartman | nhartman@riverbanks.org |
| DALLAS WA | The Dallas World Aquarium | Carolina Arruda | carolina@dwazoo.com |
| DISNEY AK | Disney's Animal Kingdom | Kristin Cibotti | kristin.cibotti@disney.com |
| DRAPER | Loveland Living Planet Aquarium | Rebecca Westover | rebecca.w@livingplanetaquarium.org |
| HOUSTON | Houston Zoo, Inc. | Brent Nelson | Bnelson@houstonzoo.org |
| LOSANGELE | Los Angeles Zoo and Botanical Gardens | Rose Legato | rose.legato@lacity.org |
| METROZOO | Zoo Miami | Russell Martin | Russell.Martin@miamidade.gov |
| NASHV ZOO | Nashville Zoo, Inc. | Joe DeGraauw | jdegraauw@nashvillezoo.org |
| NATAVPGH | National Aviary | Kurt Hundgen | Kurt.Hundgen@aviary.org |
| NY BRONX | Bronx Zoo | Kevin Hils | khils@wcs.org |
| NZP-CRC | Smithsonian's Conservation Biology Institute | Sara Hallager | hallagers@si.edu |
| NZP-WASH | Smithsonian National Zoological Park | Sara Hallager | hallagers@si.edu |
| PHOENIX | Phoenix Zoo | Kyle Waites | kwaites@phoenixzoo.org |
| PINOLA | Pinola Conservancy | Jacob Kraemer | jkraemer@pinola.net |
| SACRAMNTO | Sacramento Zoo | Matthew McKim | MMcKim@saczoo.org |
| SD-WAP | San Diego Zoo Safari Park | Andrew Stehly | astehly@sdzwa.org |
| SEATTLE | Woodland Park Zoo | Robyn Russnogle | robyn.russnogle@zoo.org |
| SEDGWICK | Sedgwick County Zoo | Anne Heitman | Anne.Heitman@scz.org |
| ST AUGUST | St. Augustine Alligator Farm | Gennifer Anderson | ganderson@alligatorfarm.com |
| ST LOUIS | Saint Louis Zoo | Anne Tieber | tieber@stlzoo.org |
| TRACY AV | Tracy Aviary | Kate Lyngle - Cowand | katel@tracyaviary.org |
| WINNIPEG | Assiniboine Park Zoo | Shane Pratt | SPratt@assiniboinepark.ca |
| YULEE | White Oak Conservation Center | Andrew Schumann | Aschumann@white-oak.org |

**Additional Advisors**

| Mnemonic | Facility Name | Institutional Representative | Email |
|---|---|---|---|
| ANTWERP | Antwerp Zoo | Jan Dams – EAZA Galliformes TAG Chair | jan.dams@kmda.org |
| BARRANQUL | Barranquilla Zoo | Christian Olaciregui – ALPZA Advisor | c.olaciregui@zoobaq.org |
| SANDIEGOZ | San Diego Zoo | Chris Holmes – SSP Coordinator | cholmes@sdzwa.org |

# I. Contraception and Reproductive Health

Reproductive management is essential to meeting genetic and demographic goals and supporting long-term sustainability of populations in human care. The AZA Reproductive Management Center (RMC) can provide services related to contraception, and a variety of other reproductive challenges. If contraception is elected for animals designated as "DO NOT BREED", please visit the RMC Website at http://stlzoo.org/contraception and consult the SSP coordinator and the RMC at contraception@stlzoo.org for advice.

When contraception is used, please contribute these contraception data to the AZA RMC Contraception Database at www.zoocontraceptiondata.org. The AZA RMC Contraception Database contains thousands of records that are analyzed to continually update contraception recommendations on efficacy, dosing, frequency of administration, and reversibility for a wide variety of animals. The RMC relies heavily on institutions to share information about their animals by contributing contraception data for their animals to our contraception database. The data collected include animal information (e.g. taxonomy, age, weight), contraceptive products used, doses, frequency and number of treatments used, implant removals, contraception outcomes (e.g. birth control failures, reversals, etc.), as well as behavioral and physical changes observed during use.

In addition, the Reproductive Health Surveillance Program (RHSP) conducts comprehensive pathologic examinations on reproductive tracts to detect deleterious effects associated with contraception or other reproductive management practices. The results of these analyses are shared with the RMC and provide important information about contraceptives that is incorporated in the Contraception Recommendations. If an animal of any taxa (male or female; contracepted or non-contracepted) dies or is permanently sterilized, please submit the reproductive tract tissues to the RHSP. There are several options for tissue submission. For the most up-to-date tissue submission instructions, please visit the RHSP webpage on the RMC's website at http://stlzoo.org/rhsp.