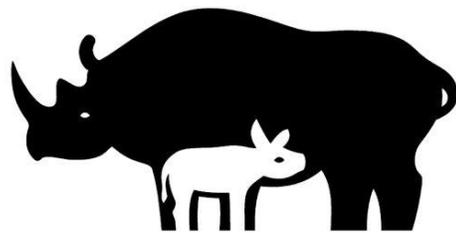


Mixed- Species Opportunities for Red- Crowned and Similar Crane Species

July 1, 2022



**ASSOCIATION
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Species Survival Plan®

Taylor Keddie
Red- Crowned Crane SSP Coordinator
Fresno Chaffee Zoo
tkeddie@fresnochaffeezoo.org

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Cover Photo Courtesy of Seoul Zoo PR Team

Background: This document is the result of a program goal for the AZA (Association of Zoos and Aquariums) Red- Crowned Crane Species Survival Plan (SSP) as indicated in the 2021 Gruiformes, Eurypygiformes, Cariamiformes & Otidiformes Taxon Advisory Group Regional Collection Plan (Taylor, 2021). This document is a resource compiling the successes and failures for species housed with Red-Crowned Cranes and other crane species of similar size and temperament.

Scope of Document: All of the 15 extant crane species are held in managed care globally (Species360, 2022). In developing this document and to be in line with the program goal, it was determined that the following crane species would be surveyed and included: Black- Necked, Eurasian, Hooded, Red-Crowned, Sarus, Siberian, Wattled, and White- Naped. Some amount of data was acquired for each of these species, excluding Black- Necked Cranes.

The following crane species were not surveyed for this document: Black- Crowned, Blue, Brolga, Demoiselle, Grey- Crowned, Sandhill, and Whooping. Blue, Black- Crowned, Demoiselle, and Grey-Crowned cranes are gregarious species that are temperamentally dissimilar to Red- Crowned Cranes, as well as being of smaller body size. Additionally, these species are commonly maintained in mixed-species exhibits throughout zoological institutions. Brolga were excluded due to a relatively small number of birds being in managed care, with only two facilities outside of Oceania currently holding the species. Sandhill cranes were excluded due to being temperamentally dissimilar to the focus species. Additionally, Whooping Cranes were not included due to most birds belonging to a federal release program, with holding facilities currently being discouraged from mixing the cranes with other animal species.

Data Collection: Information on specific zoo exhibits was obtained via a SurveyMonkey digital survey that was distributed to crane holders through program leaders for the selected species. The zoological associations surveyed included the Association of Zoos & Aquariums (AZA), the European Association of Zoos and Aquaria (EAZA), and the Japanese Association of Zoos and Aquariums (JAZA). When applicable, surveys were also sent to crane studbook keepers for the World Association of Zoos and Aquariums (WAZA). Additionally, information was obtained from the 2017 AZA Ungulate TAGs Mixed-Species Manual (AZA Ungulate TAGs, 2017).

Data gathered from this project was summarized and broken down into four categories: exhibit description, management notes, challenges & accommodations, and whether the species mix was able to be housed year-round. Please see Appendix I for a list of all questions from the mixed- species survey. The question as to whether year- round housing was possible is due to the highly seasonal reproductive cycle of cranes, which can lead to increased aggression at certain times of year. Note that this question does not consider the need to separate birds seasonally due to weather or if species mixes were not attempted for a full year.

Please note that information on mixed- species exhibits obtained from the AZA Ungulate TAGs Mixed-Species Manual may not be entirely complete, as this document focuses primarily on the ungulates present in mixed- species situations, rather than management of birds housed with them. The ungulate manual breaks exhibit size into categories, rather than exact size (i.e., 10,000-20,000 ft²).

Applications of Mixed- Species Crane Management: Management of cranes in mixed- species situations can present multiple benefits, including:

- Increased guest engagement and education by demonstrating natural species interactions.
- Social enrichment opportunities for cranes and the species they are housed with.
- Enhanced ability to focus on breeding for cranes paired in single species habitats while adding space for non- breeding or juvenile birds.

- Temporary crane housing.
- Added flexibility for crane population managers to meet their program goals by adding additional spaces for birds awaiting placement.

Potential drawbacks of mixed- species crane management include:

- Increased risk of death or injury to cranes or the species they are housed with.
- Decreased opportunity to manage animals individually.
- Potential impediments to breeding cranes or the species they are housed with.
- Limitations for public walk-through exhibits; this is dependent on the species and individual temperaments of the birds involved.

It should be noted that this document does not endorse any particular mixed- species opportunity, rather it is a summary of what zoological facilities have attempted. The decision to attempt a mixed- species crane exhibit should be a collaboration between facility animal managers and the population manager to ensure that the needs of the birds, the facility, and the population can be met. Responding facilities can be contacted for additional information; please reach out to the author for contact information.

While many of the crane species included in this document have successfully bred in mixed- species exhibits, it should be considered that bonded, breeding cranes can present challenges when mixed with other species, including increased territoriality and aggression during the breeding season. In some cases, single or juvenile cranes may be more successful with other species due to the decreased potential of seasonal aggression. In all cases, it is recommended that holding space be set aside to meet the breeding needs of the cranes and the species they are housed with, as well as backup housing for species mixes that are unsuccessful.

Eurasian Crane (*Grus grus*)

ARTIS Amsterdam Royal Zoo	Amsterdam, Noord- Holland, Netherlands	
<u>Species Mix:</u> 1.1 Eurasian Crane (<i>Grus grus</i>) 19.12 Eurasian Spoonbill (<i>Platalea leucorodia</i>) 22.15 Pied Avocets (<i>Recurvirostra avosetta</i>) 5.4 Redshank (<i>Tringa totanus</i>) 2.2 Red- Breasted Goose (<i>Branta ruficollis</i>) 1.1 European Roller (<i>Coracias garrulus</i>) 1.3 Little Egret (<i>Egretta garzetta</i>) 0.2 Lesser Kestrel (<i>Falco naumanni</i>) 1.0 Eurasian Oystercatcher (<i>Haematopus ostralegus</i>) 1.0 Scaly- Sided Merganser (<i>Mergus squamatus</i>) 1.1 Northern Shoveler (<i>Spatula clypeata</i>)	Exhibit Description	This is an 11,625 ft ² mesh enclosed outdoor aviary. There is an additional 968 ft ² indoor, heated holding space. The outer edge of the outdoor aviary is a 6.5 ft wide pond.
	Management Notes	There were no problems introducing any of the species to one another. The cranes are the dominant species in this exhibit and being housed with other birds does not affect their ability to breed. The cranes do disturb the other bird species, particularly during breeding season. They are not overly reactive to the other birds but have caused regular disturbances.
	Challenges & Accommodations	This facility has had to pull and hand rear wader species, as all nests disappear, or eggs are broken. Facility noted that they would recommend housing bird species with the cranes that are not recommended to breed or are acceptable to hand rear.
	Able to House Year- Round?	Yes
Assiniboine Park Zoo	Winnipeg, Manitoba, Canada	
<u>Species Mix:</u> 1.1 Eurasian Crane (<i>Grus grus</i>) 1.3 White Stork (<i>Ciconia ciconia</i>) 1.18 Reindeer (<i>Rangifer tarandus</i>)	Exhibit Description	This exhibit was a large, open top yard. Cut outs in planting strips were created for birds to nest and get away from the reindeer. Holding facilities were well ventilated barns for winter and inclement weather use.
	Management Notes	Cranes were various ages, all juvenile to adult. This was a seasonal species mix, only due to inclement winter weather. Reindeer periodically raised calves in this exhibit. This species mix ended when the exhibit was repurposed.

	Challenges & Accommodations	Reindeer can be aggressive to the bird species at times. Additional birds can create stress and disrupt nesting birds. Nests have been destroyed in territorial disputes. Facility believes this species mix affected the ability of the cranes to breed. In hindsight, it is thought that more hotwire and treed planting strips could have benefitted breeding.
	Able to House Year- Round?	No

Assiniboine Park Zoo		Winnipeg, Manitoba, Canada
<u>Species Mix:</u> 0.1 Eurasian Crane (<i>Grus grus</i>) 7.3 Demoiselle Crane (<i>Anthropoides virgo</i>)	Exhibit Description	This exhibit was a large, open top yard.
	Management Notes	The Eurasian Crane was raised with the Demoiselle Cranes. The Demoiselle Crane group was split into breeding pairs over time.
	Challenges & Accommodations	Additional birds can create stress and disrupt nesting birds. Nests have been destroyed in territorial disputes.
	Able to House Year- Round?	Yes

Bronx Zoo		Bronx, New York, USA
<u>Species Mix:</u> 1.1 Eurasian Crane (<i>Grus grus</i>) 2.0 Lesser Kudu (<i>Tragelaphus imberbis</i>) 1.20 Thomson's Gazelle (<i>Eudorcas thomsonii</i>) 0.2 Ostrich (<i>Struthio camelus</i>)	Exhibit Description	This exhibit was between 1-3 acres.
	Management Notes	This is a historical exhibit that was reported in the AZA Ungulate TAG Mixed-Species Manual. No additional management information was given.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Unknown

Hirakawa Zoological Park		Kagoshima City, Kagoshima Prefecture, Japan
<u>Species Mix:</u> Eurasian Crane (<i>Grus grus</i>) Hooded Crane (<i>Grus monacha</i>)	Exhibit Description	This is a covered, steel mesh aviary that is 20,343 ft ² . Enclosure height ranges from 6.5 ft to 39 ft. The public can walk through this aviary.
	Management Notes	It is unknown if this species mix affects crane breeding, as cranes are not bred in this space.

Scarlet Ibis (<i>Eudocimus ruber</i>) Mandarin Duck (<i>Aix galericulata</i>) Little Egret (<i>Egretta garzetta</i>) Purple Swampphen (<i>Porphyrio porphyrio</i>) Blue- Crowned Pigeon (<i>Goura cristata</i>) Hartlaub's Turaco (<i>Tauraco hartlaubi</i>) Lesser Flamingo (<i>Phoeniconaias minor</i>) Greater Flamingo (<i>Phoenicopterus roseus</i>) Great Cormorant (<i>Phalacrocorax carbo</i>) Trumpeter (<i>Psophia sp</i>) Spot-Billed Duck (<i>Anas poecilorhyncha</i>) Night Heron (sp unknown)	Challenges & Accommodations	Facility reports that they would not attempt to use larger crane species in this aviary to ensure guest safety.
	Able to House Year- Round?	Yes

Mesker Park Zoo		Evansville, Indiana, USA	
<u>Species Mix:</u>	Exhibit Description	This yard was between 1-3 acres.	
1.1 Eurasian Crane (<i>Grus grus</i>)	Management Notes	This is a historical exhibit that was reported in the AZA Ungulate TAG Mixed-Species Manual. No additional management information was given.	
1.4 Axis Deer (<i>Axis Axis</i>)	Challenges & Accommodations	The male nilgai was dangerous to keepers and some other animals and was dehorned.	
1.2 Nilgai (<i>Boselaphus tragocamelus</i>)	Able to House Year- Round?	Unknown	
1.1 Reeves's Muntjac (<i>Muntiacus reevesi</i>)			

Oakland Zoo		Oakland, California, USA	
<u>Species Mix:</u>	Exhibit Description	This exhibit was between 1/2 and 1 acre.	
Eurasian Crane (<i>Grus grus</i>)	Management Notes	All species got along well.	
Addra Gazelle (<i>Nanger dama</i>)	Challenges & Accommodations	None reported.	
Kudu (<i>Tragelaphus sp.</i>)	Able to House Year- Round?	Unknown	
Ostrich (<i>Struthio camelus</i>)			
Grey- Crowned Crane (<i>Balearica</i>)			

<i>regulorum</i> Griffon Vulture (<i>Gyps fulvus</i>) Helmeted Guineafowl (<i>Numida meleagris</i>) Lappet- faced Vulture (<i>Torgos tracheliotos</i>) Sarus Crane (<i>Grus antigone</i>)		
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Hooded Crane (*Grus monacha*)

Franklin Park Zoo	Boston, Massachusetts, USA	
<u>Species Mix:</u> 1.1 Hooded Crane (<i>Grus monacha</i>) 3.2 Scaly- Sided Merganser (<i>Mergus squamatus</i>) 3.1 Red- Breasted Merganser (<i>Mergus serrator</i>) 4.1 Hooded Merganser (<i>Lophodytes cucullatus</i>) 2.3 Red- Breasted Goose (<i>Branta ruficollis</i>) 1.1 Azure- Winged Magpie (<i>Cyanopica cyanus</i>) 2.0 Golden Pheasant (<i>Chrysolophus pictus</i>) 2.0 Lady Amherst's Pheasant (<i>Chrysolophus amherstiae</i>) 3.1 Baikal Teal (<i>Sibirionetta formosa</i>) 1.1 Barrow's Goldeneye (<i>Bucephala islandica</i>) 2.1 Bufflehead (<i>Bucephala albeola</i>) 1.3 Canvasback (<i>Aythya valisineria</i>) 3.2 Northern Shoveler (<i>Spatula</i>)	Exhibit Description	This is a 2,600 ft ² covered, outdoor aviary with a pond. Mesh size was specified in design so that native birds are unable to enter the habitat. The public can walk through this space.
	Management Notes	All species are cold tolerant and are exhibited outdoors year-round. The cranes have not shown breeding behavior yet and are not recommended to breed at this time. Species that are bred in this habitat are pulled as eggs for artificial incubation and returned when they are the appropriate size.
	Challenges & Accommodations	No major challenges introducing species to one another. A Hooded Crane died when she appeared to slip into the pond from ice along the side and drowned. The cranes are currently secured when the water freezes over, and facility has further addressed this hazard by adding water agitators and a pond heater. The heater is currently non- operational due to supply issues, but it is believed that it will prevent ice form forming in the pond.
	Able to House Year- Round?	Yes

<i>clypeata</i> 1.0 Rosybill (<i>Netta peposaca</i>)		
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Hirakawa Zoological Park

Kagoshima City, Kagoshima Prefecture, Japan

<u>Species Mix:</u> Hooded Crane (<i>Grus monacha</i>) Eurasian Crane (<i>Grus grus</i>) Scarlet Ibis (<i>Eudocimus ruber</i>) Mandarin Duck (<i>Aix galericulata</i>) Little Egret (<i>Egretta garzetta</i>) Purple Swamphen (<i>Porphyrio porphyrio</i>) Blue- Crowned Pigeon (<i>Goura cristata</i>) Hartlaub's Turaco (<i>Tauraco hartlaubi</i>) Lesser Flamingo (<i>Phoeniconaias minor</i>) Greater Flamingo (<i>Phoenicopterus roseus</i>) Great Cormorant (<i>Phalacrocorax carbo</i>) Trumpeter (<i>Psophia sp</i>) Spot-Billed Duck (<i>Anas poecilorhyncha</i>) Night Heron (sp unknown)	Exhibit Description	This is a covered, steel mesh aviary that is 20,343 ft ² . Enclosure height ranges from 6.5 ft to 39 ft. The public is able to walk through this aviary.
	Management Notes	It is unknown if this species mix affects crane breeding, as cranes are not bred in this space.
	Challenges & Accommodations	Facility reports that they would not attempt to use larger crane species in this aviary to ensure guest safety.
	Able to House Year- Round?	Yes

Lee Richardson Zoo

Garden City, Kansas, USA

<u>Species Mix:</u> 1.1 Hooded Crane (<i>Grus monacha</i>) 2.4 Chinese Goral (<i>Naemorhedus griseus</i>)	Exhibit Description	This yard was between 5,000-10,000 ft ² .
	Management Notes	There have been two pairs of crane in this exhibit. The original pair would nest on exhibit. The goral have bred in this exhibit.
	Challenges & Accommodations	Exclusion feeders are used to prevent goral from eating the crane diet.

		The cranes utilize puddles and wet areas while goral do not. Facility has to keep a balance of wet areas that work for both species.
	Able to House Year- Round?	Yes
Memphis Zoological Garden & Aquarium		
Memphis, Tennessee, USA		
<u>Species Mix:</u>	Exhibit Description	This exhibit was a 1/4 acre open top yard.
1.1 Hooded Crane (<i>Grus monacha</i>)	Management Notes	Cranes were able to successfully nest in this exhibit; eggs were infertile, however.
1.0 Hog Deer (<i>Axis porcinus</i>)	Challenges & Accommodations	None Reported.
	Able to House Year- Round?	Yes
Saint Louis Zoological Park		
Saint Louis, Missouri, USA		
<u>Species Mix:</u>	Exhibit Description	This exhibit was between 1/2 and 1 acre.
1.0 Hooded Crane (<i>Grus monacha</i>)	Management Notes	The Banteng and crane were together for one year. Male banteng was left with the group year-round and females were pulled for calving.
1.3 Banteng (<i>Bos javanicus</i>)	Challenges & Accommodations	Exclusion feeder was provided for the crane.
	Able to House Year- Round?	Yes
Saint Louis Zoological Park		
Saint Louis, Missouri, USA		
<u>Species Mix:</u>	Exhibit Description	This exhibit was between 10,000 and 20,000 ft ² .
1.0 Hooded Crane (<i>Grus monacha</i>)	Management Notes	All animals were adults when introduced and goral were immediately aggressive to crane.
1.1 Chinese Goral (<i>Naemorhedus griseus</i>)	Challenges & Accommodations	This exhibit was unsuccessful due to aggression from the goral to the crane.
	Able to House Year- Round?	No
Woodland Park Zoo		
Seattle, Washington		
<u>Species Mix:</u>	Exhibit Description	This is a large, open top yard with a pond.
1.1 Hooded Crane (<i>Grus monacha</i>)	Management Notes	The current pair of Hooded Cranes are young and non- breeding. There is little interaction between them and the geese.
Swan Geese (<i>Anser cygnoid</i>)	Challenges & Accommodations	None Reported.

Bar- Headed Geese (<i>Anser indicus</i>) Barnacle Geese (<i>Branta leucopsis</i>)	Able to House Year- Round?	Yes
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Red- Crowned Crane (*Grus japonensis*)

ARTIS Amsterdam Royal Zoo	Amsterdam, Noord- Holland, Netherlands	
<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) 0.2 Snowy Owl (<i>Bubo scandiacus</i>)	Exhibit Description	This is an enclosed, 5,381 ft ² outdoor aviary with two ponds measuring 32 ft ² and 43ft ² . Max depth of the ponds is approximately 19 in. Within this exhibit there is a 16 ft tall ruin of an old brick building which the birds can walk around or land on.
	Management Notes	The cranes and owls do well being housed together.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes
Birmingham Zoo	Birmingham, Alabama, USA	
<u>Species Mix:</u> 1.0 Red- Crowned Crane (<i>Grus japonensis</i>) 1.1 Black- Crowned Crane (<i>Balearica pavonina</i>) 1.0 Blue Crane (<i>Anthropoides paradiseus</i>) 1.0 White Stork (<i>Ciconia ciconia</i>) 1.1 Kori Bustard (<i>Ardeotis kori</i>) 1.0 Blue Duiker (<i>Philantomba monticola</i>)	Exhibit Description	This exhibit is an approximately 30 ft x60 ft open top yard that can be divided for breeding or aggression. Fence height varies from 7 ft- 9 ft. There is a holding area for the duiker that the birds are excluded from. A back yard fit with a creep is available to the female Kori Bustard that the male cannot access.
	Management Notes	Introductions consisted of putting birds together and observing. Birds were sometimes separated into runs overnight until staff were comfortable with the dynamic. The Black- Crowned Cranes were juveniles that were moved out of the yard due to jumping out of the exhibit, even with wing trimming. This exhibit is mainly used to house single male cranes awaiting mates.
	Challenges & Accommodations	The White Stork proved difficult to manage in a mixed- species setup and will be moved out. Facility advises not using this species in this mix.

		<p>The Kori Bustard female is older with a younger mate, necessitating a creep area for her to get away from him. The White Stork has figured out how to squat and access this creep.</p> <p>When the male Blue Crane had a mate and began nesting, they needed to be separated into one area of the exhibit. Female Blue Crane presented with a laceration under her wing while nesting and died from that injury. Following this the male began jumping out of the exhibit multiple times, even with heavily clipped wings and was temporarily moved to a covered area. Upon reintroduction to this space, the bird has remained in the exhibit and has become a companion to the male Red- Crowned Crane.</p> <p>This exhibit works well with the current animals, but the facility believes it may not work if cranes had mates.</p>
	Able to House Year- Round?	Yes

Blackpool Zoo

**Blackpool, Lancashire,
United Kingdom**

<p><u>Species Mix:</u></p> <p>Red- Crowned Crane (<i>Grus japonensis</i>) Sitatunga (<i>Tragelaphus spekii</i>)</p>	Exhibit Description	This is a paddock style exhibit with a field shelter. The sitatunga can use this shelter but have alternative holding space.
	Management Notes	Both species have bred in this exhibit. The cranes hatched a clutch in 2020 but neither chick survived. One chick disappeared after 6 days and the other died at 22 days (necropsy identified aspergillosis).
	Challenges & Accommodations	Some aggression was noted in ZIMS when the crane pair was introduced to the exhibit, but this was many years ago.
	Able to House Year- Round?	Yes

Bronx Zoo

Bronx, New York, USA

<p><u>Species Mix:</u></p> <p>1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Bar- Headed Geese (<i>Anser indicus</i>)</p>	Exhibit Description	This exhibit is a large, 90 ft x 90 ft tree covered wetland with a pond. Visitor viewing is in the front of the exhibit only.
	Management Notes	This species mix was started in the fall through the winter without problems. As crane breeding season approached, the male became very aggressive towards the geese. The geese had to be removed from the exhibit. There were 8 Bar- Headed Geese in this group.
	Challenges & Accommodations	Facility notes that it was not optimal to move birds in and out depending on the season.

	Able to House Year- Round?	No
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**Capron Park Zoo Attleboro, Massachusetts,
USA**

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) 1.1 Muntjac (<i>Muntiacus sp</i>)	Exhibit Description	This is an open top, 1,500 ft ² yard with a 141 ft ² holding.
	Management Notes	Muntjac were allowed to access the exhibit before being introduced to the cranes. Facility had to increase number of hiding spaces for the Muntjac during crane breeding season. This mix did not affect the ability of the cranes to breed. This species mix ended when it was determined that there was not enough space for both species.
	Challenges & Accommodations	Facility reports that the size of this exhibit was challenging. They recommend a significantly larger space to provide more room for animals to get away from each other.
	Able to House Year- Round?	Yes

Cleveland Metroparks Zoo Cleveland, Ohio, USA

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Tufted Deer (<i>Elaphodus cephalophus</i>) Bar- Headed Goose (<i>Anser indicus</i>) North American Waterfowl (various)	Exhibit Description	Exhibit is a 1/4 acre, open top yard with mature trees. The holding space is a 12 ft x 12 ft hoofstock style barn stall.
	Management Notes	Introduction process consisted of allowing new species to explore the yard independently before sharing space. Visual howdy was sometimes provided. This mix does not affect the ability of birds to breed.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Columbus Zoo and Aquarium Powell, Ohio, USA

<u>Species Mix:</u> Red- Crowned Crane (<i>Grus japonensis</i>) Siberian Musk Deer (<i>Moschus moschiferus</i>)	Exhibit Description	
	Management Notes	
	Challenges & Accommodations	Unsuccessful exhibit. Musk deer were aggressive to the cranes, which required their removal from the space.
	Able to House Year- Round?	No

Columbus Zoo and Aquarium Powell, Ohio, USA

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Tufted Deer (<i>Elaphodus cephalophus</i>)	Exhibit Description	This exhibit is a 1/2 acre open top yard. A shelter is available for the Tufted Deer. A tall exclusion feeder with holes is provided for the cranes.
	Management Notes	<p>This mix has been ongoing for several years and cranes were always in pairs.</p> <p>During crane breeding season, it is not uncommon for the cranes to aggress on the deer, which sometimes requires their temporary removal.</p> <p>Recently, cranes began aggressing on deer outside of their breeding season. The deer would respond by plucking feathers from the cranes. Once deer breeding started last year, the deer began aggressing on the cranes and a bird was injured; the species were split following this.</p>
	Challenges & Accommodations	<p>The crane feeder had to be modified when the deer learned to stand on their back legs to reach it.</p> <p>This facility believes that the success of this species mix is dependent on individual temperaments. There are plans to try this mix again in the future due to a long history of success in the past.</p>
	Able to House Year- Round?	Sometimes

Detroit Zoological Society

Royal Oak, Michigan, USA

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Hooded Vulture (<i>Necrosyrtes monachus</i>)	Exhibit Description	This historical exhibit was a large yard with a man- made wallow for wading and eating. There was a pool large enough for all species to use.
	Management Notes	Species introductions were gradual.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Detroit Zoological Society

Royal Oak, Michigan, USA

<u>Species Mix:</u> 1.0 Red- Crowned Crane (<i>Grus japonensis</i>) 1.1 White Stork (<i>Ciconia ciconia</i>) Greater Rhea (<i>Rhea americana</i>) 2.2 Cinereous Vulture (<i>Aegypius</i>)	Exhibit Description	This current exhibit is a large yard with a man- made wallow for wading and eating. There is a pool large enough for all species to use.
	Management Notes	<p>Introductions were gradual and one species at a time.</p> <p>The single, Red-Crowned Crane is geriatric.</p> <p>There are 4 Greater Rhea in this exhibit.</p>

<i>monachus</i>) 1.0 Ruppell's Griffon Vulture (<i>Gyps rueppelli</i>)		The Cinereous Vulture currently breed in this exhibit.
	Challenges & Accommodations	Cinereous Vulture pairs must have enough space to separate themselves during breeding. Facility reports that they would not have Red- Crowned Cranes in this mix if there was a breeding pair.
	Able to House Year- Round?	Yes

Kansas City Zoo

Kansas City, Missouri, USA

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Black Swan (<i>Cygnus atratus</i>) Black- Necked Swan (<i>Cygnus melancoryphus</i>) Mandarin Duck (<i>Aix galericulata</i>) Shelduck (Various Species) Vulturine Guineafowl (<i>Acryllium vulturinum</i>)	Exhibit Description	This is a large, open top exhibit with a large body of water and three islands. There is no holding space.
	Management Notes	This mix has worked well with no issues. The cranes were housed with the guinea fowl in a separate area in the past.
	Challenges & Accommodations	Multiple feeding stations are offered to reduce competition.
	Able to House Year- Round?	Yes

Memphis Zoological Garden & Aquarium

Memphis, Tennessee, USA

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Pere David's Deer (<i>Elaphurus davidianus</i>)	Exhibit Description	This open top exhibit was between 1/4 and 1/2 acre.
	Management Notes	Initial introductions consisted of dividing the yard with hog panels for a slow howdy. Breeding management had to change due to a male deer becoming aggressive to cranes when he was in rut. The male deer threw cranes into the air at one point. Following this, cranes were removed from exhibit when both they and the deer were breeding. At one point several young deer were present in the exhibit with White- Naped Cranes and ran over a bird; this resulted in bone fractures and the crane did not survive.

		This exhibit mix was stopped when a new male deer was brought in and managers believed he was too risky to be in with cranes.
	Challenges & Accommodations	It was challenging to keep the deer out of the crane's diet, and variable feeding methods were tried. Facility advises to be ready to separate cranes and deer during peak breeding season. It is believed that an exhibit design that included a creep for the cranes to avoid the deer would have been more successful. Facility believes that juvenile or non- breeding cranes may work better in this species mix.
	Able to House Year- Round?	Yes

Oglebay's Good Children's Zoo **Wheeling, West Virginia, USA**

<u>Species Mix:</u> 0.1 Red- Crowned Crane (<i>Grus japonensis</i>) 2.0 Chinese Goral (<i>Naemorhedus griseus</i>) 1.1 Red Panda (<i>Ailurus fulgens fulgens</i>)	Exhibit Description	This exhibit was a 30 ft x 40 ft open top yard in a forested area. Bridges, logs, and shelves connected the trees so that the pandas could choose to remain off the ground.
	Management Notes	The crane and goral were introduced to each other first before bringing in the pandas. The goral and cranes respected each other's space and would move away if one species was too close. The pandas initially were curious about the crane and would approach; the crane would vocalize which would cause the pandas to stay back. After a few days, the pandas no longer showed interest in the crane. The pandas were the only species brought off exhibit overnight. This mix ended after 4- months due to the Red- Crowned Crane pacing the fence line to get to a nearby male Sandhill Crane. Both crane species were introduced to each other successfully in a different space.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	N/A

Palm Beach Zoo at Dreher Park		West Palm Beach, Florida, USA	
<u>Species Mix:</u> 1.0 Red- Crowned Crane (<i>Grus japonensis</i>) 1.4 Aldabra Tortoise (<i>Geochelone gigantea</i>)	Exhibit Description	This was a large yard with deer fencing. Tortoises had a barn within the enclosure. Bollards were used to create an area the crane could use to get away from tortoises.	
	Management Notes	The crane was fed his diet in the area inaccessible to the tortoises. Tortoises were secured in their barn overnight when temperatures are low. This was a temporary holding space for a juvenile crane once he needed to be separated from his parents before being shipped out.	
	Challenges & Accommodations	None reported.	
	Able to House Year- Round?	Yes	
Rotterdam Zoo		Rotterdam, Zuid- Holland, Netherlands	
<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Falcated Duck (<i>Mareca falcata</i>) Mandarin Duck (<i>Aix galericulata</i>)	Exhibit Description	This exhibit was a 4,305 ft ² open top yard. Yard space is 40% land and 60% water with mature trees and aquatic reeds. Exhibit is surrounded by bushes.	
	Management Notes	Facility reports that this species mix works well. The cranes breed in the open and the ducks find shelter in natural cover or in next boxes. This mix was stopped due to change in collection and a national ban on pinioning.	
	Challenges & Accommodations	None reported.	
	Able to House Year- Round?	Yes	
Seoul Zoo		Gwacheon, Gyeonggi, South Korea	
<u>Species Mix:</u> 11.17 Red- Crowned Crane (<i>Grus japonensis</i>) 2.0 White- Naped Crane (<i>Grus vipio</i>)	Exhibit Description	This large waterfowl aviary is a 98,834 ft ² (2.27 acre) covered exhibit that is approximately 100 ft tall. There are several large, manmade ponds as well as mature trees, shrubs, and grassy areas. There is an attached off exhibit holding area for breeding and isolating birds. The	

1.0 Demoiselle Crane (<i>Anthropoides virgo</i>) 3.3 Eastern White Pelican (<i>Pelecanus onocrotalus</i>) 0.2 Canada Goose (<i>Branta canadensis</i>) 2.0 Whooper Swan (<i>Cygnus cygnus</i>) 2.9 Black Swan (<i>Cygnus atratus</i>) 3.1 Mute Swan (<i>Cygnus olor</i>) 1.0 Bean Goose (<i>Anser fabalis</i>) 0.3 Swan Goose (<i>Anser cygnoid</i>)		holding space has four, 196 ft ² yards and 16 indoor pens; eight are 125 ft ² and eight are 140 ft ² . This exhibit was previously a public walk through but due to avian influenza, the public can no longer enter the bird's space.
	Management Notes	The cranes are free flighted in this aviary. Each species tends to have their own territories. The species get along well, but during breeding season the cranes can become territorial and attack other species. It has proven difficult to breed cranes in the main exhibit, as eggs have been broken by other birds. When breeding is required, breeding pairs are separated into the attached holding area to nest and raise chicks. The cranes usually do not have problems breeding in a different space. Birds are fed near the holding area so that they are habituated to the space. When it is necessary to isolate individuals, keepers wait for them to move off exhibit and close them in.
	Challenges & Accommodations	Birds can become aggressive during the breeding season and have challenges breeding on exhibit. If breeding is required, parent birds are moved off exhibit.
	Able to House Year- Round?	Yes

Sunset Zoo

Manhattan, Kansas, USA

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) 1.0 Tufted Deer (<i>Elaphodus cephalophus</i>)	Exhibit Description	Approximately 200 ft x 250 ft open top yard with 8 ft fencing.
	Management Notes	Exhibit works well and does not affect the crane's ability to breed.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Terra Natura Benidorm

Benidorm, Alicante, Spain

<u>Species Mix:</u> 0.0.1 Red- Crowned Crane (<i>Grus japonensis</i>)	Exhibit Description	This exhibit was a 20,236 ft ² , open top yard with rockwork, trees, and structures to provide visual barriers from the rhinos.
	Management Notes	The introduction process consisted of the cranes being allowed to explore the yard alone before gradually introducing the rhinos into the space. The rhinos

0.0.2 Sarus Crane (<i>Antigone antigone</i>) Greater One- Horned Rhino (<i>Rhinoceros unicornis</i>) Eastern White Pelican (<i>Pelecanus onocrotalus</i>) Great Cormorant (<i>Phalacrocorax carbo</i>)		<p>were initially curious about the cranes, but they soon stopped showing interest. Facility reports that the cranes were calm around the rhinos.</p> <p>Cranes did not breed in this space due to the amount of time they were housed in this species mix. Facility believes breeding may have been possible if an exclusion area was provided for the birds.</p> <p>The pelicans and cormorants were intended to stay in a pool that was inaccessible to the rhinos but chose to use the rhino pool without any problems.</p> <p>The cranes are no longer present in this species mix due to natural attrition.</p>
	Challenges & Accommodations	When rhinos become excited, the cranes must be able to get out of their way quickly.
	Able to House Year- Round?	Yes

Terra Natura Benidorm

Benidorm, Alicante, Spain

<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) Pink- Backed Pelican (<i>Pelecanus rufescens</i>) South African Black Duck (<i>Anas sparsa</i>) Muscovy Duck (<i>Cairina moschata</i>) Mallard (<i>Anas platyrhynchos</i>)	Exhibit Description	This current exhibit is approximately 8,611 ft ² with two small pools, some trees and bushes, but otherwise an open area.
	Management Notes	Cranes and pelicans are secured in a shelter overnight.
	Challenges & Accommodations	Facility reports that it was challenging to habituate the cranes and pelicans to entering a shelter for overnight housing.
	Able to House Year- Round?	Yes

Zoo Augsburg

Augsburg, Bavaria, Germany

<u>Species Mix:</u> Red- Crowned Crane (<i>Grus japonensis</i>) 1.1 Coscoroba Swan (<i>Coscoroba coscoroba</i>) 1.1 Ne-ne Goose (<i>Branta sandvicensis</i>)	Exhibit Description	This open top exhibit is approximately 3,229 ft ² .
	Management Notes	<p>The swans and geese were introduced to the exhibit after the cranes were established in the space.</p> <p>The Ne-ne geese have bred in this exhibit.</p>
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Zoo Dresden GmbH		Dresden, Sachsen, Germany	
<u>Species Mix:</u> 1.1 Red- Crowned Crane (<i>Grus japonensis</i>) 3.2 Golden Takin (<i>Budorcas taxicolor bedfordi</i>)	Exhibit Description	Exhibit is a 16,145 ft ² open top yard with the capability to separate animals into a 861 ft ² space.	
	Management Notes	Introduction was a smooth process. Age of Takin ranges from 1-11 years.	
	Challenges & Accommodations	None reported.	
	Able to House Year- Round?	Yes	

Zoo Koki		Santo Domingo-Caudilla, Toledo, Spain	
<u>Species Mix:</u> Red- Crowned Crane (<i>Grus japonensis</i>) Common Ring- Necked Pheasant (<i>Phasianus colchicus pallasi</i>) Mandarin Duck (<i>Aix galericulata</i>) Pied Imperial Pigeon (<i>Ducula bicolor</i>)	Exhibit Description	This exhibit is a 3229 ft ² meadow like, uncovered yard. Interior holding space is 322 ft ² . This yard includes theming elements, such as bridges and small ponds.	
	Management Notes	Facility wing trims cranes to prevent egress.	
	Challenges & Accommodations	Theming elements allow species to avoid each other. This facility was created in 2021 and no challenges have occurred so far.	
	Able to House Year- Round?	Yes	

Sarus Crane (*Antigone antigone*)

Assiniboine Park Zoo		Winnipeg, Manitoba, Canada	
<u>Species Mix:</u> 0.1 Sarus Crane (<i>Antigone antigone</i>) 1.3 Guanaco (<i>Lama guanicoe</i>)	Exhibit Description	This exhibit was a large, open top yard. Cut outs in planting strips were created for birds to get away from the guanacos.	
	Management Notes	This was a seasonal species mix due to inclement winter weather. Holding facilities were well ventilated barns for winter and inclement weather use. This species mix ended when the exhibit was repurposed.	
	Challenges & Accommodations	Facility reports that more hotwire and treed planting strips for the crane would have been beneficial.	

	Able to House Year- Round?	No
Blank Park Zoo		
Des Moines, Iowa, USA		
<u>Species Mix:</u> 1.1 Sarus Crane (<i>Antigone antigone</i>) 4.1 Bactrian Camel (<i>Camelus bactrianus</i>)	Exhibit Description	Approximately 2- acre open air exhibit containing a pond. The pond is separated by a strand of hotwire that allows the cranes to walk under but excludes the camels.
	Management Notes	The cranes can breed in this space due to excluded area from camels.
	Challenges & Accommodations	Keepers cannot enter this mixed- species exhibit in an emergency when they camels are out. Camels sometimes block cranes from entering their holding area.
	Able to House Year- Round?	Yes
Disney's Animal Kingdom		
Lake Buena Vista, Florida, USA		
<u>Species Mix:</u> 1.1 Sarus Crane (<i>Grus antigone</i>) 0.3 Asiatic Water Buffalo (<i>Bubalus bubalis</i>) 5.8 Blackbuck (<i>Antilope cervicapra</i>) 1.2 Eld's Deer (<i>Rucervus eldii</i>) 5.5 Bar-headed Goose (<i>Anser indicus</i>) 1.2 Javan Green Peafowl (<i>Pavo muticus</i>) 1.1 Ruddy Shelduck (<i>Tadorna ferruginea</i>)	Exhibit Description	This exhibit is between 1 and 3- acres.
	Management Notes	1.1 Banteng were present in this exhibit before the Asiatic Water Buffalo. This exhibit was reported in the AZA Ungulate TAG Mixed- Species Manual. No additional management information for the cranes were noted.
	Challenges & Accommodations	The male Eld's deer can be aggressive to other animals when in rut.
	Able to House Year- Round?	Unknown
Los Angeles Zoo & Botanical Gardens		
Los Angeles, California, USA		
<u>Species Mix:</u> 0.0.1 Sarus Crane (<i>Grus antigone</i>) 1.1 North Sulawesi Babirusa (<i>Babyrousa celebensis</i>)	Exhibit Description	This exhibit was between 5,000 and 10,000 ft ² .
	Management Notes	All animals were adults at time of introductions.
	Challenges & Accommodations	This exhibit was unsuccessful due to the babirusa attacking and severely injuring the crane.
	Able to House Year- Round?	No

Los Angeles Zoo & Botanical Gardens		Los Angeles, California, USA
<u>Species Mix:</u> 0.1 Sarus Crane (<i>Grus antigone</i>) 0.1 Chinese Water Deer (<i>Hydropotes inermis inermis</i>)	Exhibit Description	This exhibit was less than 5,000 ft ² . The yard was separated using bamboo poles.
	Management Notes	The crane would sometimes chase the deer onto one side of the yard but would cohabitate as well.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Unknown
Mesker Park Zoo		Evansville, Indiana, USA
<u>Species Mix:</u> 1.1 Sarus Crane (<i>Grus antigone</i>) Bactrian Camel (<i>Camelus bactrianus</i>) Indian Muntjac (<i>Muntiacus muntjak</i>)	Exhibit Description	This exhibit was between 1 and 3 acres.
	Management Notes	The crane pair was in this mix for approximately 5- years.
	Challenges & Accommodations	No challenges reported with the cranes in this species mix.
	Able to House Year- Round?	Unknown
Oakland Zoo		Oakland, California, USA
<u>Species Mix:</u> Sarus Crane (<i>Grus antigone</i>) Eurasian Crane (<i>Grus grus</i>) Addra Gazelle (<i>Nanger dama</i>) Kudu (<i>Tragelaphus sp.</i>) Ostrich (<i>Struthio camelus</i>) Grey- Crowned Crane (<i>Balearica regulorum</i>) Griffon Vulture (<i>Gyps fulvus</i>) Helmeted Guineafowl (<i>Numida meleagris</i>) Lappet- faced Vulture (<i>Torgos tracheliotos</i>)	Exhibit Description	This exhibit was between 1/2 and 1 acre.
	Management Notes	All species got along well.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Unknown
Oklahoma City Zoological Park		Oklahoma City, Oklahoma, USA
<u>Species Mix:</u>	Exhibit Description	This exhibit was a large, open top yard without grass present. There was a rhino holding area, but no adjoining space for cranes.

1.1 Sarus Crane (<i>Antigone antigone</i>) 0.1 Greater One- Horned Rhino (<i>Rhinoceros unicornis</i>)	Management Notes	There was no adjoining crane holding area, which resulted in the cranes having to be moved when shelter was necessary. The cranes did not breed in this space; facility believes this may have been a result of this species mix.
	Challenges & Accommodations	This exhibit was successful for a number of years until one of the cranes was killed by the rhino. Facility indicated they would not repeat this species mix.
	Able to House Year- Round?	Yes

Omaha's Henry Doorly Zoo

Omaha, Nebraska, USA

<u>Species Mix:</u> Sarus Crane (<i>Antigone antigone</i>) White Pelican (<i>Pelecanus erythrorhynchos</i>) Waterfowl (various)	Exhibit Description	This exhibit was a 100ft x 80ft open top yard with a stream and a 20ft pond.
	Management Notes	Species do not pay much attention to one another. Sarus cranes have nested and raised chicks in this space.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Saint Louis Zoological Park

Saint Louis, Missouri, USA

<u>Species Mix:</u> 1.0 Sarus Crane (<i>Antigone antigone</i>) 0.2 Eld's Deer (<i>Rucervus eldii</i>)	Exhibit Description	This exhibit was between 10,000 and 20,000 ft ² .
	Management Notes	All animals were adults at time of introductions.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Unknown

Saint Louis Zoological Park

Saint Louis, Missouri, USA

<u>Species Mix:</u> 1.1 Sarus Crane (<i>Antigone antigone</i>) 1.3 Banteng (<i>Bos javanicus</i>) 1.1 Reeves's Munjtac (<i>Muntiacus reevesi</i>) 1.1 Sarus Crane (<i>Grus antigone</i>) 1.3 Banteng (<i>Bos javanicus</i>) 1.0 Speke's Gazelle (<i>Gazella spekei</i>)	Exhibit Description	This exhibit was between 10,000 and 20,000 ft ² .
	Management Notes	These species combinations represent different mixes over a period of years.
	Challenges & Accommodations	Exclusion feeders are provided for the cranes.
	Able to House Year- Round?	Yes

Terra Natura Benidorm		Benidorm, Alicante, Spain	
<u>Species Mix:</u> 0.0.1 Red- Crowned Crane (<i>Grus japonensis</i>) 0.0.2 Sarus Crane (<i>Antigone antigone</i>) Greater One- Horned Rhino (<i>Rhinoceros unicornis</i>) Eastern White Pelican (<i>Pelecanus onocrotalus</i>) Great Cormorant (<i>Phalacrocorax carbo</i>)	Exhibit Description	This exhibit was a 20,236 ft ² , open top yard with rockwork, trees, and structures to provide visual barriers from the rhinos.	
	Management Notes	<p>The introduction process consisted of the cranes being allowed to explore the yard alone before gradually introducing the rhinos into the space. The rhinos were initially curious about the cranes, but they soon stopped showing interest. Facility reports that the cranes were calm around the rhinos.</p> <p>Cranes did not breed in this space due to the amount of time they were housed in this species mix. Facility believes breeding may have been possible if an exclusion area was provided for the birds.</p> <p>The pelicans and cormorants were intended to stay in a pool that was inaccessible to the rhinos but chose to use the rhino pool without any problems.</p> <p>The cranes are no longer present in this species mix due to natural attrition.</p>	
	Challenges & Accommodations	When rhinos become excited, the cranes must be able to get out of their way quickly.	
	Able to House Year- Round?	Yes	
White Oak Conservation Center		Yulee, Florida, USA	
<u>Species Mix:</u> Sarus Crane (<i>Antigone antigone</i>) Antelope (various sp)	Exhibit Description	Cranes are housed in large hoofstock paddocks, most of which have at least one small natural pond. This yard was 14- acres.	
	Management Notes	<p>Cranes are hard introduced to the hoofstock in the very large paddocks.</p> <p>All antelope in this mix were male. This group worked well.</p>	
	Challenges & Accommodations	None reported.	
	Able to House Year- Round?	Yes	
White Oak Conservation Center		Yulee, Florida, USA	
<u>Species Mix:</u> 1.1 Sarus Crane (<i>Antigone antigone</i>) 4.8 Barasingha (<i>Rucervus divaucelii</i>)	Exhibit Description	This exhibit was between 1 and 3 acres.	
	Management Notes	Both species successfully reproduced in this space.	
	Challenges & Accommodations	None reported.	
	Able to House Year- Round?	Yes	

Zoo Neuwied		Neuwied,Rheinland-Pfalz, Germany	
<u>Species Mix:</u> 1.1 Sarus Crane (<i>Antigone antigone</i>) 1.1 Reeve's Muntjac (<i>Muntiacus reevesi</i>) 2.4 Domestic Chicken (<i>Gallus domesticus</i>)	Exhibit Description	This exhibit was a 4951 ft ² yard containing several mature trees and two small shelters: one for the cranes, and one for muntjac and chickens.	
	Management Notes	Animals had access to the shelters at all times, but only the chickens were secured overnight due to predators.	
	Challenges & Accommodations	The domestic chickens were of the Ayam Cemani breed.	
	Able to House Year- Round?	Yes	

Siberian Crane (*Leucogeranus leucogeranus*)

Livingston Ripley Waterfowl Conservancy		Litchfield, Connecticut, USA	
<u>Species Mix:</u> 1.1 Siberian Crane (<i>Leucogeranus leucogeranus</i>) 3.3 Smew (<i>Mergellus albellus</i>)	Exhibit Description	40 ft x 40 ft covered aviary with two ponds and a stream connecting them. Ponds are 10 ft x 5 ft.	
	Management Notes	Introduction process consisted of placing the smew with the cranes early in the morning. Observed for a full day with no signs of aggression.	
	Challenges & Accommodations	None reported.	
	Able to House Year- Round?	Unknown- new exhibit	

Wattled Crane (*Bugeranus carunculatus*)

Dallas Zoo		Dallas, Texas, USA	
<u>Species Mix:</u>	Exhibit Description	This exhibit is a 1/2 acre, open top yard with grassy zones, heavily shrubbed areas, and mature tree cover. There is a recirculating pond that is approximately 20 ft x 6 ft with a maximum depth of 20 inches. There is an attached holding	

1.1 Wattled Crane (<i>Bugeranus carunculatus</i>) 2.0 Spur- Winged Geese (<i>Plectropterus gambensis</i>)		yard that is approximately 800 ft ² . A 350 ft ² indoor holding area is provided for cold temperatures.
	Management Notes	<p>The attached holding yard is used for shifting, feeding, and training.</p> <p>The cranes had just been introduced to one another when the geese were moved into the space with them, and breeding activity was minimal. The male crane had been living with the geese prior to the female being added.</p> <p>The geese had to be removed from this exhibit after about a year due to aggression from the cranes.</p>
	Challenges & Accommodations	<p>Facility reports that the cranes began aggressing on the geese once their pair bond had formed, and the aggression did not coincide with breeding behavior. Geese were forced to occupy small areas of the exhibit by the cranes which necessitated their removal.</p> <p>This facility would be willing to try this species mix again with a different species of crane or different Wattled Cranes. The temperaments of the current pair do not lend themselves to mixed- species housing, and they are reactive to wild birds that enter their area.</p>
	Able to House Year- Round?	Yes

Disney's Animal Kingdom	Lake Buena Vista, Florida, USA	
<u>Species Mix:</u>	Exhibit Description	This exhibit is a savanna type yard that is between 3 and 8- acres in size.
0.0.1 Wattled Crane (<i>Bugeranus carunculatus</i>) Ankole Cattlee (<i>Bos taurus</i>) Common Waterbuck (<i>Kobus ellipsiprymnus</i>) Impala (<i>Aepyceros melampus</i>) Nyala (<i>Tragelaphus angasii</i>) Okapi (<i>Okapia johnstoni</i>)	Management Notes	This exhibit was reported in the AZA Ungulate TAG Mixed- Species Manual. No additional management information for the cranes were noted.
	Challenges & Accommodations	No challenges reported with cranes and ungulates.
	Able to House Year- Round?	Unknown

Red River Hog (<i>Potamochoerus porcus</i>) Steenbok (<i>Raphicerus campestris</i>) Thompson's Gazelle (<i>Eudorcas thomsonii</i>) Abyssinian Ground Hornbill (<i>Bucorvus abyssinicus</i>) East African Crowned Crane (<i>Balaerica regulorum gibbericeps</i>) Blue Crane (<i>Anthropoides paradiseus</i>) Ruppell's Vulture (<i>Gyps rueppellii</i>) Spur-winged Goose (<i>Plectropterus gambensis</i>)		
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Jackson Zoological Park	Jackson, Mississippi, USA	
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<u>Species Mix:</u> 1.0 Wattled Crane (<i>Bugeranus carunculatus</i>) 1.2 Grevy's Zebra (<i>Equus grevyi</i>) 1.1 Klipspringer (<i>Oreotragus oreotragus</i>) 2.0 Spur-winged Goose (<i>Plectropterus gambensis</i>) 1.2 Common Ostrich (<i>Struthio camelus</i>)	Exhibit Description	This exhibit was between 10,000 and 20,000 ft ² .
	Management Notes	The male zebra is secured in holding overnight. This exhibit was reported in the AZA Ungulate TAG Mixed- Species Manual. No additional management information for the cranes were noted.
	Challenges & Accommodations	Male zebra has shown aggression to birds, requiring the removal of ostrich from the exhibit. Facility reports a female Wattled Crane was injured in the past, presumably by the zebra.
	Able to House Year- Round?	Unknown

Jacksonville Zoo and Gardens	Jacksonville, Florida, USA	
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<u>Species Mix:</u> 1.1 Wattled Crane (<i>Bugeranus carunculatus</i>) Southern White Rhino (<i>Ceratotherium simum simum</i>) Greater Kudu (<i>Tragelaphus strepsiceros</i>)	Exhibit Description	Large open-air veldt that is under 2- acres. Holding areas are hoofstock style barns and yards.
	Management Notes	Introductions were howdies with a common fence line. The cranes did not breed, most likely due to the male being imprinted. The Wattled Cranes were moved out due to aggression from the Marabou Storks.

Marabou Stork (<i>Leptoptilos crumenifer</i>) Spur- Winged Goose (<i>Plectropterus gambensis</i>) Ostrich (<i>Struthio camelus</i>) Bontebok (<i>Damaliscus pygargus pygargus</i>)		The Spur- Winged Geese were eventually moved out due to attacking and killing a Grey- Crowned Crane that was introduced.
	Challenges & Accommodations	Bontebok were removed due to aggressing on other species. Marabou Storks and the geese prevent breeding and were dangerous to the cranes. Facility reports that they would try this species mix again, without Bontebok, Spur- Winged Geese, or Marabou Storks. This space is planned to be for crane exhibition only, and not breeding.
	Able to House Year- Round?	Yes

Omaha's Henry Doorly Zoo	Omaha, Nebraska, USA	
<u>Species Mix:</u>	Exhibit Description	This exhibit is a covered, approximately 2-acre aviary.
1.0 Wattled Crane (<i>Bugeranus carunculatus</i>)	Management Notes	The single wattled crane was moved to this aviary after losing his mate. This space has held up to 400 birds. Seasonal weather changes sometimes require moving birds.
Golden Pheasant (<i>Chrysolophus pictus</i>)	Challenges & Accommodations	None reported.
Bar- Headed Goose (<i>Anser indicus</i>)	Able to House Year- Round?	Yes
Barnacle Goose (<i>Branta leucopsis</i>)		
Black- Necked Swan (<i>Cygnus melanocoryphus</i>)		
Mute Swan (<i>Cygnus olor</i>)		
Mandarin Duck (<i>Aix galericulata</i>)		
North American Wood Duck (<i>Aix sponsa</i>)		
Northern Pintail (<i>Anas acuta</i>)		
Bahama Pintail (<i>Anas bahamensis bahamensis</i>)		
Ring- Necked Duck (<i>Aythya collaris</i>)		
Greater Scaup (<i>Aythya marila nearctica</i>)		
Ringed Teal (<i>Callonetta leucophrys</i>)		
Red- Crested Pochard (<i>Netta rufina</i>)		
Ruddy Duck (<i>Oxyura jamaicensis</i>)		
Ruddy Shelduck (<i>Tadorna ferruginea</i>)		
Common Shelduck (<i>Tadorna tadorna</i>)		

American Wigeon (<i>Mareca americana</i>) Chiloe Wigeon (<i>Mareca sibilatrix</i>) Gadwall (<i>Mareca strepera</i>) Cinnamon Teal (<i>Spatula cyanoptera</i>) Hooded Merganser (<i>Lophodytes cucullatus</i>) White Stork (<i>Ciconia ciconia</i>) Scarlet Ibis (<i>Eudocimus ruber</i>) Sacred Ibis (<i>Threskiornis aethiopicus</i>) Straw- Necked Ibis (<i>Threskiornis spinicollis</i>) Roseate Spoonbill (<i>Platalea ajaja</i>) Little Blue Heron (<i>Egretta caerulea</i>) Snowy Egret (<i>Egretta thula</i>) Cattle Egret (<i>Bubulcus ibis</i>) Inca Tern (<i>Larosterna inca</i>) Black- Crowned Crane (<i>Balearica pavonina</i>) American Flamingo (<i>Phoenicopterus ruber</i>)		
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Saint Louis Zoo	St. Louis, Missouri, USA	
<u>Species Mix:</u> 1.1 Wattled Crane (<i>Bugeranus carunculatus</i>) 1.2 Addra Gazelle (<i>Nanger dama</i>)	Exhibit Description	This exhibit was between 10,000 and 20,000 ft ² .
	Management Notes	Cranes have been exhibited with adult and juvenile gazelle. This exhibit was reported in the AZA Ungulate TAG Mixed- Species Manual. No additional management information for the cranes were noted.
	Challenges & Accommodations	Cranes are provided diet in exclusion feeders. At one time, a male gazelle directed aggression towards cranes.
	Able to House Year- Round?	Unknown
Saint Louis Zoo	St. Louis, Missouri, USA	
<u>Species Mix:</u>	Exhibit Description	This historical exhibit was between 10,000 and 20,000 ft ² .

1.1 Wattled Crane (<i>Bufo carunculatus</i>) 1.2 Addra Gazelle (<i>Nanger dama</i>) 2.0 Speke's Gazelle (<i>Gazella spekei</i>)	Management Notes	The Speke's Gazelles were juveniles when introduced to this mix and had never been in a breeding group. This exhibit was reported in the AZA Ungulate TAG Mixed- Species Manual. No additional management information for the cranes were noted.
	Challenges & Accommodations	The male Addra Gazelle could become aggressive to the cranes.
	Able to House Year- Round?	Unknown

White Oak Conservation Center		Yulee, Florida, USA
<u>Species Mix:</u> Wattled Crane (<i>Bufo carunculatus</i>) Eastern Bongo (<i>Tragelaphus eurycerus isaaci</i>) Giant Eland (<i>Tragelaphus derbianus</i>) Nile Lechwe (<i>Kobus megaceros</i>)	Exhibit Description	Cranes are housed in large hoofstock paddocks, most of which have at least one small natural pond.
	Management Notes	Cranes are hard introduced to the hoofstock in the very large paddocks. Single cranes, pairs, and pairs with chicks have been housed in this mix. The cranes have been housed with each of these antelope species in breeding groups.
	Challenges & Accommodations	Facility reports that there have been incidents breeding the cranes in mixed-species exhibits, more so than if they were housed in their own space.
	Able to House Year- Round?	Yes

White Oak Conservation Center		Yulee, Florida, USA
<u>Species Mix:</u> 1.0 Wattled Crane (<i>Bufo carunculatus</i>) Nile Lechwe (<i>Kobus megaceros</i>)	Exhibit Description	Cranes are housed in large hoofstock paddocks, most of which have at least one small natural pond.
	Management Notes	Cranes are hard introduced to the hoofstock in the very large paddocks. The single male crane in this mix was a juvenile.
	Challenges & Accommodations	Facility reports that this mix works well, but that the crane stuck close to the Lechwe herd, which made it very difficult to get to him.
	Able to House Year- Round?	Yes

White Oak Conservation Center		Yulee, Florida, USA
<u>Species Mix:</u> 0.0.3 Wattled Crane (<i>Bufo carunculatus</i>) Roan Antelope (<i>Hippotragus equinus</i>)	Exhibit Description	Cranes are housed in large hoofstock paddocks, most of which have at least one small natural pond. This yard was 10- acres.
	Management Notes	Cranes are hard introduced to the hoofstock in the very large paddocks. This cohort of cranes were all juveniles.

Lesser Kudu (<i>Tragelaphus imberbis</i>) Giraffe (<i>Giraffa camelopardalis</i>) Nile Lechwe (<i>Kobus megaceros</i>)		This species mix worked well.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

White Oak Conservation Center	Yulee, Florida, USA	
<u>Species Mix:</u> 1.1 Wattled Crane (<i>Bugeranus carunculatus</i>) 6.0 Slender- Horned Gazelle (<i>Gazella leptoceros</i>)	Exhibit Description	Cranes are housed in large hoofstock paddocks, most of which have at least one small natural pond. This yard was 6- acres.
	Management Notes	Cranes are hard introduced to the hoofstock in the very large paddocks. The cranes successfully nested and reared a chick in this mix.
	Challenges & Accommodations	Male crane would sometimes chase the gazelle around; usually when they were near a nest, but sometimes for no obvious reason. In general, facility tries to keep Wattled Cranes away from smaller antelope.
	Able to House Year- Round?	Yes

White- Naped Crane (*Grus vipio*)

Cleveland Metroparks Zoo	Cleveland, Ohio, USA	
<u>Species Mix:</u> 1.1 White- Naped Crane (<i>Grus vipio</i>) Tufted Deer (<i>Elaphodus cephalophus</i>) Muntjac (<i>Muntiacus sp</i>) Bar- Headed Goose (<i>Anser indicus</i>) Cackling Goose (<i>Branta hutchinsii leucopareia</i>) Red- Brested Goose (<i>Branta ruficollis</i>) North American Waterfowl (various)	Exhibit Description	Exhibit is a 1/4-acre, open air yard with mature trees. The holding space is a 12 ft x 12 ft hoofstock style barn stall.
	Management Notes	Introduction process consisted of allowing new species to explore the yard independently before sharing space. Visual howdy was sometimes provided. This mix does not affect the ability of birds to breed.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Columbus Zoo and Aquarium	Powell, Ohio, USA	
<u>Species Mix:</u>	Exhibit Description	This is a covered walk-through aviary.

1.1 White- Naped Crane (<i>Grus vipio</i>) Muntjac (<i>Muntiacus sp</i>) Magpie Geese (<i>Anseranas semipalmata</i>) White- Crested Laughing Thrush (<i>Garrulax leucolophus</i>) Black- Throated Laughing Thrush (<i>Garrulax chinensis</i>) Chinese Hwamei (<i>Garrulax canorus</i>) Golden Pheasant (<i>Chrysolophus pictus</i>) Waterfowl (various)	Management Notes	There were no challenges housing the cranes in a public walk-through aviary. This crane pair was older, and it is believed this was a contributing factor. This mix ended due to natural attrition of the cranes.
	Challenges & Accommodations	Facility reports that they would try this mix again, if a secondary space for the cranes is available should there be management challenges.
	Able to House Year- Round?	Yes

Memphis Zoological Garden & Aquarium

Memphis, Tennessee, USA

<u>Species Mix:</u>	Exhibit Description	This open top exhibit was between 1/4 and 1/2 acre.
1.1 White- Naped Crane (<i>Grus vipio</i>) Pere David's Deer (<i>Elaphurus davidianus</i>)	Management Notes	In the past, the cranes were able to raise chicks in this exhibit due to the temperament of the deer herd at the time. Breeding management had to change due to a male deer becoming aggressive to cranes when he was in rut. The male deer threw cranes into the air at one point. Following this, cranes were removed from exhibit when both they and the deer were breeding. At one point several young deer were present in the exhibit with the cranes and ran over a bird; this resulted in bone fractures and the crane did not survive. This exhibit mix was stopped when a new male deer was brought in and managers believed he was too risky to be in with cranes.
	Challenges & Accommodations	It was challenging to keep the deer out of the crane's diet, and variable feeding methods were tried. Facility advises to be ready to separate cranes and deer during peak breeding season. It is believed that an exhibit design that included a creep for the cranes to avoid the deer would have been more successful.

		Facility believes that juvenile or non- breeding cranes may work better in this species mix.
	Able to House Year- Round?	Yes
Memphis Zoological Garden & Aquarium		
Memphis, Tennessee, USA		
<u>Species Mix:</u> 0.0.1 White- Naped Crane (<i>Grus vipio</i>) Grey- Crowned Crane (<i>Balearica regulorum</i>) Ostrich (<i>Struthio camelus</i>) Grant's Gazelle (<i>Nanger granti</i>)	Exhibit Description	This was a 1/2-acre veldt exhibit.
	Management Notes	The White- Naped Crane was a juvenile.
	Challenges & Accommodations	At one time a coyote got into the exhibit and killed a Crowned Crane and a gazelle. The White- Naped Crane had a puncture wound which it later healed from. Outside of this species mix a gazelle attacked an ostrich, which had to be euthanized due to a leg injury. Facility advises taking individual behavior into consideration when attempting this mix.
	Able to House Year- Round?	Yes
Oklahoma City Zoological Park		
Oklahoma City, Oklahoma, USA		
<u>Species Mix:</u> 1.1 White- Naped Crane (<i>Grus vipio</i>) 1.2 Chinese Goral (<i>Naemorhedus griseus</i>)	Exhibit Description	This exhibit was a very large, open top, naturally planted exhibit. The holding area consisted of a small barn.
	Management Notes	This large exhibit lent itself well to this species mix. The goral were submissive to the cranes and kept their distance, especially during breeding season. The cranes bred and raised offspring on exhibit. This exhibit was renovated, resulting in cranes being moved off exhibit and goral being sent out.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes
Oklahoma City Zoological Park		
Oklahoma City, Oklahoma, USA		
<u>Species Mix:</u>	Exhibit Description	This historical exhibit yard was larger than 8- acres.

1.1 White- Naped Crane (<i>Grus vipio</i>) Black- Crowned Night Heron (<i>Nycticorax nycticorax</i>) Common Eider (<i>Somateria mollissima</i>)		
	Management Notes	Facility reports that this species mix works well. The eiders find natural cover or use nest boxes. The herons tend to stay up in the trees. The cranes do not breed in this aviary.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Saint Louis Zoological Park

St Louis, Missouri, USA

<u>Species Mix:</u>	Exhibit Description	This historical exhibit yard was between 1/2 and 1 acre.
1.0 White- Naped Crane (<i>Grus vipio</i>) 1.3 Banteng (<i>Bos javanicus</i>)	Management Notes	All individuals were introduced to each other as adults. Male banteng was with the group year-round and females were separated for calving.
	Challenges & Accommodations	No challenges were reported with the crane in this species mix. The crane was phased out after two years.
	Able to House Year- Round?	Unknown

Seoul Zoo

Gwacheon, Gyeonggi, South Korea

<u>Species Mix:</u>		
2.0 White- Naped Crane (<i>Grus vipio</i>) 11.17 Red- Crowned Crane (<i>Grus japonensis</i>) 1.0 Demoiselle Crane (<i>Anthropoides virgo</i>) 3.3 Eastern White Pelican (<i>Pelecanus onocrotalus</i>) 0.2 Canada Goose (<i>Branta canadensis</i>) 2.0 Whooper Swan (<i>Cygnus cygnus</i>) 2.9 Black Swan (<i>Cygnus atratus</i>) 3.1 Mute Swan (<i>Cygnus olor</i>) 1.0 Bean Goose (<i>Anser fabalis</i>) 0.3 Swan Goose (<i>Anser cygnoid</i>)	Exhibit Description	This large waterfowl aviary is a 98,834 ft ² (2.27 acre) covered exhibit that is approximately 100 ft tall. There are several large, man made ponds as well as mature trees, shrubs, and grassy areas. There is an attached off exhibit holding area for breeding and isolating birds. The holding space has four, 196 ft ² yards and 16 indoor pens; eight are 125 ft ² and eight are 140 ft ² . This exhibit was previously a public walk through but due to avian influenza, the public can no longer enter the bird's space.
	Management Notes	The cranes are free flighted in this aviary. Each species tends to have their own territories. The species get along well, but during breeding season the cranes can become territorial and attack other species.

		It has proven difficult to breed cranes in the main exhibit, as eggs have been broken by other birds. When breeding is required, breeding pairs are separated into the attached holding area to nest and raise chicks. The cranes usually do not have problems breeding in a different space.
		Birds are fed near the holding area so that they are habituated to the space. When it is necessary to isolate individuals, keepers wait for them to move off exhibit and close them in.
	Challenges & Accommodations	Birds can become aggressive during the breeding season and have challenges breeding on exhibit. If breeding is required, parent birds are moved off exhibit.
	Able to House Year- Round?	Yes

Tiergarten Nürnberg	Bayern, Nürnberg, Germany	
<u>Species Mix:</u> White- Naped Crane (<i>Grus vipio</i>) Siberian Musk Deer (<i>Moschus moschiferus</i>)	Exhibit Description	This exhibit is an open top yard with stables for holding space. Separation is possible for the cranes and deer.
	Management Notes	Introductions took place over a period of months with both species in side-by-side enclosures before giving access to each other.
	Challenges & Accommodations	The deer and cranes had to be separated temporarily due to cranes not allowing the deer into their holding space.
	Able to House Year- Round?	Yes

Trevor Zoo at Millbrook School	Millbrook, New York, USA	
<u>Species Mix:</u> 1.1 White- Naped Crane (<i>Grus vipio</i>) 1.1 Whooper Swan (<i>Cygnus cygnus</i>) Various Waterfowl	Exhibit Description	This is a large, open top fenced exhibit with a large pond.
	Management Notes	Breeding pairs are first introduced to each other off exhibit before being placed in the mixed- species exhibit. A variety of 1.1 pairs were present in this mix over the years, with ages ranging from 1-40 years old.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Trevor Zoo at Millbrook School	Millbrook, New York, USA	
<u>Species Mix:</u>	Exhibit Description	This exhibit is an open top yard.

1.1 White- Naped Crane (<i>Grus vipio</i>) Sika Deer (<i>Cervus nippon</i>) 1.0 Reeve's Muntjac (<i>Muntiacus reevesi</i>)	Management Notes	Breeding pairs are first introduced to each other off exhibit before being placed in the mixed- species exhibit. A variety of 1.1 pairs were present in this mix over the years, with ages ranging from 1-40 years old.
	Challenges & Accommodations	None reported.
	Able to House Year- Round?	Yes

Utica Zoo

Utica, New York, USA

<u>Species Mix:</u> 1.1 White- Naped Crane (<i>Grus vipio</i>) 2.0 Reeve's Muntjac (<i>Muntiacus reevesi</i>)	Exhibit Description	This exhibit is a 12,800 ft ² open top yard with a wooden holding structure for each species. There is an artificial recirculating stream and pond. Each holding structure is approximately 60 ft ² .
	Management Notes	<p>Cranes are age 10 and 40. Muntjac are age 9 and 10. This mix has been ongoing for 3- years.</p> <p>Facility was unable to howdy the animals before introductions but provided plenty of enrichment. Animals were observed by keepers and no significant aggression was seen.</p> <p>The cranes lay multiple clutches each year in this exhibit. Eggs have been infertile so far, but it is believed that this is a result of arthritis in the male.</p>
	Challenges & Accommodations	<p>The only necessary exhibit modification was making sure cranes could not enter the Muntjac holding. This is accomplished by having a shorter shift door that excludes the cranes.</p> <p>The cranes become more aggressive in the breeding season and superficial wounds have been found on the Muntjac. No significant changes have had to be made in breeding season.</p>
	Able to House Year- Round?	Yes

Wildlife Safari Inc

Winston, Oregon, USA

<u>Species Mix:</u> 1.1 White- Naped Crane (<i>Grus vipio</i>) Blackbuck (<i>Antelope cervicapra</i>) Fallow Deer (<i>Dama dama</i>)	Exhibit Description	This exhibit yard was larger than 8- acres.
	Management Notes	This is an exhibit that was reported in the AZA Ungulate TAG Mixed- Species Manual. No additional management information was given.
	Challenges & Accommodations	Larger numbers of Yak result in aggression.

Nilgai (<i>Boselaphus tragocamelus</i>) Sika Deer (<i>Cervus nippon</i>) Yak (<i>Bos grunniens</i>) Emu (<i>Dromaius novaehollandiae</i>) Greater Rhea (<i>Rhea americana</i>)	Able to House Year- Round?	Unknown
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Zoo Knoxville

Knoxville, Tennessee, USA

<u>Species Mix:</u> 1.1 White- Naped Crane (<i>Grus vipio</i>) 1.2 White- Faced Whistling Duck (<i>Dendrocygna viduata</i>) 1.1 Baer's Pochard (<i>Aythya baeri</i>)	Exhibit Description	This exhibit is an open top, ovular yard with bamboo growing along half of the fenceline. There is a 15 ft x 12 ft pond with a maximum depth of 3 ft. Tall grass was added near the pond so the waterfowl can hide from cranes.
	Management Notes	The ducks were introduced to the exhibit for several days before bringing the cranes in. Bug enrichment was provided to occupy the birds during introductions. The ducks tend to occupy the pond area while the cranes use the rest of the exhibit. This helps to minimize interspecies interactions. The cranes have raised chicks in this exhibit successfully and lay multiple clutches per year.
	Challenges & Accommodations	The ducks are currently not recommended to breed, though they do lay eggs. Facility reports that they would probably have to make changes to ensure duckling safety in this exhibit.
	Able to House Year- Round?	Yes

Zoo Koki

**Santo Domingo-Caudilla,
Toledo, Spain**

<u>Species Mix:</u> White- Naped Crane (<i>Grus vipio</i>) Himalayan Impeyan Pheasant (<i>Lophophorus impejanus</i>)	Exhibit Description	This exhibit is a 3229 ft ² meadow like, uncovered yard. Interior holding space is 322 ft ² . This yard includes theming elements, such as bridges and small ponds.
	Management Notes	Facility wing trims cranes to prevent egress.
	Challenges & Accommodations	Theming elements allow species to avoid each other. This facility was created in 2021 and no challenges have occurred so far.
	Able to House Year- Round?	Yes

Resources Cited

- AZA Ungulate TAGs. 2017. Ungulate Taxon Advisory Groups Mixed-species Exhibit Manual. Association of Zoos and Aquariums, Silver Springs, MD. pp 1031. <http://www.azaungulates.org/mixed-species>
- Taylor, Mike. 2021. Gruiformes, Eurypygiformes, Cariamiformes & Otidiformes Taxon Advisory Group Regional Collection Plan. Jacksonville Zoo: Jacksonville, FL
- ZIMS Species Holdings, (June 6, 2022). Species360 Zoological Information Management System. <http://zims.species360.org/>

Appendix I. List of SurveyMonkey Mixed- Species Survey Questions

1. Your Name
2. Your Facility
3. Your Email Address
4. Please list the species of cranes you have attempted (successfully or unsuccessfully) to house in a mixed- species exhibit as well as the species they were mixed with. Please include the age and sex ratios of the animals involved, if known.
5. Please describe the exhibit and holding space, including size, if it was covered or open air, and whether any modifications were needed to accommodate this species mix.
6. Were you able to house multiple species year-round?
7. Did your management strategy have to change to accommodate breeding (both for the cranes and the species they were mixed with)? If so, please describe.
8. Please describe the introduction process and any challenges you encountered.
9. If the mixed- species areas you described are no longer a current exhibit, why did you stop the mix?
10. Do you feel that your mixed- species exhibit affected the ability of the cranes to breed?
11. Would you have done anything different with the information you have now?
12. Would you try a mixed- species crane exhibit again? If yes, please specify whether you would do the same mix or a different one. If no, why not?

Appendix II. List of Institutions Responding to Digital Survey

ARTIS Amsterdam Royal Zoo
Assiniboine Park Zoo
Birmingham Zoo
Blackpool Zoo
Blank Park Zoo
Bronx Zoo
Capron Park Zoo
Cleveland Metroparks Zoo
Columbus Zoo and Aquarium
Dallas Zoo
Detroit Zoological Society
Franklin Park Zoo
Hirakawa Zoological Park
Jacksonville Zoo and Gardens
Kansas City Zoo
Livingston Ripley Waterfowl Conservancy
Memphis Zoo
Oklahoma City Zoo
Omaha's Henry Doorly Zoo
Palm Beach Zoo
Rotterdam Zoo
Seoul Zoo
Sunset Zoo
Terra Natura Benidorm
Tiergarten Nurnberg
Trevor Zoo
Utica Zoo
White Oak Conservation Center
Woodland Park Zoo
Zoo Augsburg
Zoo Dresden GmbH
Zoo Knoxville
Zoo Koki
Zoo Neuwied

Appendix III. List of All Institutions Included

ARTIS Amsterdam Royal Zoo
Assiniboine Park Zoo
Birmingham Zoo
Blackpool Zoo
Blank Park Zoo
Bronx Zoo
Capron Park Zoo
Cleveland Metroparks Zoo
Columbus Zoo and Aquarium
Dallas Zoo
Detroit Zoological Society
Disney's Animal Kingdom
Franklin Park Zoo
Hirakawa Zoological Park
Jackson Zoological Park
Jacksonville Zoo and Gardens
Kansas City Zoo
Lee Richardson Zoo
Livingston Ripley Waterfowl Conservancy
Los Angeles Zoo & Botanical Gardens
Memphis Zoological Garden & Aquarium
Mesker Park Zoo
Oakland Zoo
Oglebay's Good Children Zoo
Oklahoma City Zoological Park
Omaha's Henry Doorly Zoo
Palm Beach Zoo at Dreher Park
Rotterdam Zoo
Saint Louis Zoological Park
Seoul Zoo
Sunset Zoo
Terra Natura Benidorm
Tiergarten Nürnberg
Trevor Zoo at Millbrook School
Utica Zoo
White Oak Conservation Center
Wildlife Safari Inc
Woodland Park Zoo
Zoo Augsburg
Zoo Dresden GmbH
Zoo Knoxville
Zoo Koki
Zoo Neuwied