

# Chapter 2

## Housing and Enclosure Requirements

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### Introduction

Unfortunately, most current exhibits are open-air enclosures creating the need for the birds to be rendered flightless to prevent escape. Most common methods for restricting flight are pinioning and wing feather clipping. It has been shown that reproduction is severely hindered by pinioning, due to the male's difficulty in balancing himself during copulation. The recommendation is to keep flamingos full-winged and design new exhibits to accommodate a full-winged flock. Sadly, there are very few exhibits that are designed for full-winged flocks. There are advantages to keeping full winged or pinioned birds in an aviary. These include minimal threat of predation, reduced food stealing by gulls and mallards (Crieighton & Stevens-Woods 1990) and increased fertility (Yoshitake, M. Suuki, T., Yasufuku, M. & Murata, K. 1988). The same basic principles of exhibit construction apply to aviaries. Special care is needed to reduce the risk of injury to flamingos attempting to fly in large aviaries. An exhibit of this type would be very educational, have considerable public appeal, and would increase the likelihood of reproduction within a flock. The zoos that are successfully exhibiting full-winged birds are Sacramento (U.S.), San Antonio (U.S.), Basel (Switzerland), Kobe (Japan) and Xcaret (Mexico). Flamingos are colonial and are best kept in large flocks of at least 20 birds. Reliable breeding occurs with flocks of 40+ birds. A facility should be designed to hold the future desired number of birds and be able to accommodate potential offspring. "Display only" birds are not recommended, but some facilities will only house birds for exhibit purposes. Consideration should be made to ensure that these birds are housed in small flocks and not kept alone or in pairs. Most flamingo exhibits are large outdoor enclosures with some sort of pool or pond. In cold weather areas an indoor facility will need to be built to house the flock on cold days.

### Enclosure Requirements

In creating an enclosure for flamingos, the prime consideration must be to ensure the best possible conditions for the birds while taking into account the impact of the exhibit on the viewing public. The nesting area should be visible to the public and where possible designed in such a way that the public feels they are not just viewing a stage set but approaching a flamingo colony (Ounsted 1990).

### Outdoor Exhibits

#### Acceptable Minimal and Optimal Enclosure Sizes

Outdoor exhibits should be built with the maximum desired flock size in mind vs. the current flock size. There should be enough land space to allow a flamingo flock to engage in courtship displays and breeding activities. Areas for sunning and nesting should be taken into account. The recommended size for an outdoor enclosure is 1.4 m<sup>2</sup> or 15 ft<sup>2</sup> per bird, and hard abrasive

substrates should be avoided. The pool should be large enough for the entire flock to occupy the area at the same time. Water should be able to flow freely in all areas to avoid any possible buildups of botulism. Also, this area should be large enough to allow the flock to engage in any courtship displays. A nesting area should be large enough to accommodate the entire flock, with room to allow for potential aggression. A recommended size for a nesting area is  $.9\text{m}^2$  or  $10\text{ft}^2$  per bird. Always allow enough space to accommodate offspring and any future acquisitions. Additionally, where prevailing winds are common, windbreaks should be added to prevent even the pinioned birds from taking short flights. Enclosure orientation should also be looked at in these cases to eliminate long runs into the wind. If possible, also include a built-in catching and holding area.

## Aesthetics

Outdoor exhibits usually have natural plantings to help enhance the aesthetics of the enclosure. The plant density should be kept to a minimum to allow the birds to move unobstructed through the area. Flamingos are very prone to injuring themselves on bushes and trees. Several bird safety issues should be considered when placing plants inside an exhibit:

- a) Does the location of the vegetation pose a hazard for the birds?
- b) Low bushes should be avoided due to trip hazards, and the potential for a bird to get caught up in the vegetation.
- c) Plantings should be placed in areas that do not hinder flock movements. Flamingos have very long legs and can easily fracture a leg by tripping over low-lying plants.
- d) A large area should be free of plants to allow normal movement of the flock to occur.
- e) Large boulders and rocks are not advisable due to the trip hazard
- f) Problem plants: There are several species of plants that have proven to be problematic in flamingo exhibits. These plants are: Flax - birds can become trapped; Palms - potential eye injury; Coral trees and roses - can cause foot problems; Osier willows – cause sooty mold on feathers (see Health and Medicine Chapter).
- g) Tall grasses have worked well and do not pose any hazards.

In addition to enhancing an exhibit's visitor appeal, plants can also provide necessary shade and relief from the hot summer sun in warmer climates. Public barriers can be created through the use of vegetation to add a buffer zone between the birds and zoo visitors.

## Mixed Species

Many outdoor exhibits in zoos are mixed species, combining bird and mammal species to show the diversity in a specific habitat. Unfortunately, this theme is not a good idea for flamingos. It is not recommended to mix flamingos with any mammal species, especially hoof stock. These types of mixed species exhibits have the potential for injury to the flamingo flock, and the birds are more likely to be disturbed during their breeding cycle. Some flamingo exhibits do, however, mix other species of birds with their flamingos. There are some bird species that should be avoided, such as

swans and geese. These types of birds have a tendency to be aggressive and can cause injury to the flock and interfere with breeding activity. Some suitable species of birds to mix with flamingos are non-aggressive waterfowl species and ibis. There have been varied degrees of success using tree ducks in flamingo exhibits. Some institutions report aggression problems by tree ducks, and other zoos say that they mix well with flamingos. When considering a mixed avian species exhibit, special consideration should be made to separate feeding areas for species other than flamingos. There have been several incidences of Lesser flamingos becoming impacted on the sand and grit used in various waterfowl diets.

## Exhibit Maintenance

The maintenance of the exhibit should always be considered when designing a facility. Several zoos have reported a cessation in breeding activity with their flamingos during routine pool cleaning. The exhibit should be designed with potential nesting behavior and courtship displays in mind. Potential exhibit repairs and gardening should be taken into account. Many exhibits have substrates of grass that will need to be frequently mowed.

## Nesting Area

The future desired flock size should be considered when constructing a nesting area. It is better to err on the side of more space than less. A recommended size for a nesting area is .9 m<sup>2</sup> or 10 ft<sup>2</sup> per bird. Some institutions have nesting areas that are smaller than this and still get breeding from their flocks. Many species prefer to nest near shrubs and trees as well as areas that are in full sun. The nesting areas should be located in such a manner to offer the flock a choice and be located out of the general traffic pattern for the enclosure. The choice of substrate in a nesting area can be a very important decision. Some zoos have used clay, a clay/sand mixture, leaf mulch, and native soil from surrounding areas with success. The nesting area should be located in a secluded portion of the exhibit as far away from the general public as possible. Visitors should not be able to access the nest area. Several institutions have nesting areas located on islands, pool edges and on dry land in close proximity to the pool. The location of the nesting area in relation to daily exhibit servicing should be taken into account. Enough space should be provided for the keepers to do their daily work without disturbing nesting birds. Plants should not obstruct access to the area. A water source close to the nest site is vital to allow birds to construct their nest mounds. The nest area should always be located in close proximity to the pool, and there should be some ability to soak the area with water. This can be done through the use of soaker hoses, sprinklers, and by adjusting the level of a pool or lake to flood the area. Please refer to Chapter 4 - Reproduction for more information.

## Containment Barriers

A variety of containment barriers have been used in outdoor exhibits and are outlined below. Depending on the style of the exhibit, any of these barriers will work. Any fences should be constructed with the posts on the outside of the enclosure. Once settled in an enclosure pinioned flamingos will not normally cross fences one meter high although they are quite capable of jumping over such fences. Prevailing winds should be taken into account when designing new enclosures. In strong winds even pinioned flamingos may be able to fly/jump considerable distances. Banks, fences or trees can be used to form wind breaks and enclosures should not be oriented to allow long run ups into the wind.

a) Chain link: This type of barrier is inexpensive and available in a variety of heights and diameters. There is a considerable amount of flexibility with installation, but in all cases, posts should be placed on the outside of the enclosure. However, chain link is not naturalistic and can require a considerable amount of maintenance and upkeep over time. Birds can get feet and wings stuck in this type of fencing during captures.

b) Pipe fence: Although inexpensive and durable, this type of barrier is also not naturalistic and requires considerable upkeep such as yearly painting.

c) Split rail wooden fence: A fence of this nature can often be manufactured and installed in-house which can be inexpensive. It is an attractive alternative but will need periodic maintenance for repair/replacement of damaged rails. Split rail fencing can be an ineffective barrier against predators and the public. It can also pose a safety hazard to zoo visitors due to the fact that it will be used as a bench, and children find it irresistible to play on.

d) Brick: This type of barrier is durable with very little maintenance and is an effective barrier. However, brick can be expensive to install, is prone to graffiti, and can provide reduced visibility for smaller zoo patrons

e) Gunite: An attractive, naturalistic alternative, gunite can be utilized as an effective barrier. It requires expert installation and can be quite expensive. Depending on the surface applied, gunite can also be very abrasive to bird wings. This type of fence is hard to remove once installed.

f) Foliage: Natural planting can be a very attractive and naturalistic barrier for an outdoor exhibit. It is very high maintenance and requires frequent trimming, watering, and replacement of damaged plants. This does not provide an effective barrier against zoo patrons and predators.

g) Water: Some facilities use large bodies of water as a public barrier. This type can occur in the form of a lake or moat. It can effectively deter some predators.

A factor that should be considered when choosing an effective outdoor containment barrier is predator control. Several institutions have experienced losses within their flocks due to predation by feral dogs and, in Europe, foxes. Some alternatives that have been used in some zoos are electric fences, routine trapping of predators, and enclosed areas that have roofs or meshed ceilings that the flamingos are shifted into at night. Typically, flamingos are housed in open-air exhibits, which lend themselves to potential predator problems. Several zoos have minimal public barriers and keep their flocks contained without incident.

## Water Source

The water source for a flamingo exhibit typically occurs in the form of a pool. The pool is probably the most important feature of the exhibit and should be designed carefully. Construction should allow water to flow freely through every part of the pool with no dead ends where sediments or concentrations of botulism can build up. Flamingos rely heavily on the use of bodies of water for various activities, such as courting, copulating and sleeping. The depth of the pool should be anywhere from 1.5 –2.75 ft (46-70 cm). Some facilities provide deeper pools that allow birds to

swim. Flamingo pools can be a natural stream/lake or a man-made pool. Natural streams or lakes should be tested periodically for contaminants. The pool should allow the birds to easily access the water. Special attention should be paid to the slope, which should be gentle. A steep slope will pose a trip and slip hazard for the birds. A water flow adjustment should be built into a pool whenever possible. The ability to raise and lower the water level around the nest site would assist with the management of a breeding flock and diminish the amount of keeper intrusions.

There are several different types of man-made pools that can be utilized, such as dump and fill and recirculating/skimming. The dump and fill pool is probably the most common and is less expensive to install than recirculating/skimming pools. Dump and fill pools require weekly cleaning and can be a disruption factor with breeding birds.

Regardless of the type of pool installed, a substrate must be adhered to the surface of the pool. Several different types of pool substrates that have been used in zoos are outlined below:

- a) Natural bottom: A pool that contains a natural bottom typically has clay, sand, or mud. Sand is not recommended for lesser flamingos due to risk of ingestion and impaction. Pools with this type of substrate allow natural behaviors and are easy on bird feet. Clay, mud, or sand substrates do, however, pose a potential disease problem, and some species may ingest the substrate. If a natural substrate is installed in a man-made pool, it may need to be changed periodically. Again, testing for contaminants would be advisable with any type of organic substrate. A natural bottom pool is recommended only if there is good water flow.
- b) Concrete: This type of substrate can be inexpensive to install and is easy to clean. It can, however, be abrasive to bird feet and slippery if not textured.
- c) Fiberglass
- d) Combination of rock and concrete: This substrate can be attractive and naturalistic. Depending on the texture, it can be abrasive to bird feet.
- e) Gunitite formed concrete: This type of surface can also be made to look naturalistic. It also can be abrasive to bird feet and is expensive to install.
- f) Plastic liner: A substrate of this nature often occurs in recirculating pools and is designed to operate without routine cleaning. It can also be easy on bird feet. The surface can become slick and could pose a potential fall hazard for keepers and birds alike.

Another water source is salt water. This has not been widely used in zoological institutions but is an interesting concept. A source for fresh drinking water should be available for the birds, if a saltwater pool is installed. This type of water source should be checked periodically for contaminants.

Anti-erosion devices are often used around pools. These devices should not be jagged, and the use of netting is not advisable due to the potential for birds to get caught in it. Wooden piling is also advised against, as birds may catch or break their legs in it (Pickering, 2000). Enkamat, which is an anti-erosion product that is currently used by zoos for flooring, can be a safe alternative.

## Feeding Areas

It is recommended that when designing a new exhibit separate feeding areas should be set aside within the enclosure. These areas should be separate from the pool or main water source, with their own drainage system and water source. There should be access from all sides of the feeding area or pool to prevent aggression. A round design is recommended for pools and tubs, and all of the birds should appear to be comfortable approaching the feed station. A diameter of 3.8-5.9 ft (1-1.5 m) and a maximum depth of six inches (15.2 cm) work well. Placement at the front of the enclosure will draw the birds closer to the public during feeding. If using a container instead of a feeding pool, the container needs to be thoroughly cleaned on a daily basis with a disinfectant.

## Water Quality and Filtration

Water quality and filtration can be important issues when managing a flock of flamingos. There have been reported die-offs due to contaminants in the birds' water source. Some facilities use water filtration systems and skimmers in artificial pools to maintain water quality. If using a natural lake or stream, the water quality should be tested for coliform levels and contaminants. A separate water source and drain is recommended for feeding areas. There have been cases of birds becoming ill due to contaminants in the pool in exhibits that did not have separate feeding areas. Water for an exhibit can come from a variety of sources, such as: city water, well water, or natural pond or stream.

## Substrate/Topography

In an outdoor area the following substrates have been utilized:

- a) Grass: This substrate has been used the most in outdoor exhibits and is very good for flamingo feet. It does require frequent maintenance, such as watering and mowing. This substrate is recommended for use in outdoor enclosures.
- b) Soil/clay: Although this substrate does not require much maintenance, it has been attributed to numerous foot problems, and lesser flamingos are prone to ingesting it.
- c) Mulch: This substrate requires frequent replacement and can be quite expensive. It has also been attributed to numerous foot and leg problems.
- d) Sand and decomposed granite: These two substrates are often attractive and easy to maintain but ingestion has caused impaction. Lesser flamingos appear to be especially prone to ingesting sand (see Health and Medicine, Chapter 6). Numerous foot problems have been attributed to sand and decomposed granite substrates.

The topography of the exhibit should be as flat as possible. Steep hills and slopes should be avoided. A greater proportion of water to land should be part of the overall design whenever possible. The variety of different activity areas, such as feeding stations, loafing, and nest sites should be kept separate.

## Indoor Facilities

Two factors usually determine when flamingos need to be brought indoors. They are predators and weather. Northern zoos are faced with cold weather during the winter months that necessitate the

birds coming indoors for a portion of the year. These indoor facilities should be built adjacent to the exhibit to allow the birds to move into winter holding without capture. It is not recommended to capture birds and move them to a winter holding area that is away from the exhibit. This building does not need to be as large as the outdoor exhibit space but should be large enough to allow the birds to move freely and separate from aggressive members of the flock. If the birds need to be kept indoors during part of their breeding season, larger quarters should be considered to allow display behavior (Heldstab and Studer-Thiersch, 2001, unpublished paper). A recommended size (land and pool space combined) is 1.4 m<sup>2</sup> or 15ft<sup>2</sup> per bird. The depth of the pool should be at least 30-60cm or 1-2 ft. with gently sloping sides. It is also recommended that the keeper service area be kept separate from the bird areas and that all floors be sloped to the drains. Built-in footbaths allow easy treatments of foot problems as well. Ideally, a public viewing area should be designed into any new winter holding structure, with viewing limited to one side. This arrangement has been very successful at The Wildfowl & Wetlands Trust in Slimbridge, United Kingdom (Pickering, 2000).

Note: Since most indoor holding facilities' floors can remain damp for long periods of time and are usually constructed of concrete it is essential that rubber, vinyl, or other easy-to-clean fast-drying matting material be used to separate the birds' feet from the caustic and abrasive properties of concrete. Long term exposure to damp concrete causes the birds' feet to become receptive to abrasions thus opening up the opportunities for infection and the debilitating condition known as bumblefoot.

## Containment Barriers

Some of the types of barriers that have been used in winter holding facilities are:

- a) Chain link/ expanded wire: This type of mesh is versatile, easy to install, inexpensive, and provides increased airflow. However, wings and legs can get caught within the mesh, and it can be abrasive to bird wings. Debris and feathers can be difficult to clean off of the surface of the wire.
- b) Concrete or CMU block: This material provides a solid barrier, can be glazed to aid in cleaning efforts, provides durability, and requires little maintenance. It can be expensive to install, and if it is painted instead of glazed, it will require periodic repainting.
- c) Metal walls: Metal provides a solid barrier and is easy to clean. This material can be expensive to install and does not have any insulation properties.

The placement of barriers within the facility is important. Several institutions have built shift stalls to allow the flock to be shifted during routine cleaning. Shift stalls also provide areas to separate birds if aggression occurs. Typically an indoor facility will house more than just flamingos, and the interior walls should act as a separation between species that cannot be housed together. Solid interior walls up to six feet with mesh extending from the top of the wall to the ceiling are recommended. The mesh will allow for good air circulation within the building.

Sometimes it is necessary to catch up birds while they are in their holding area. If the walls are concrete or metal, the following method, used at the Los Angeles Zoo in California, can help prevent any injuries:

“Metal lag screws/ bolts are put into the wall at about two foot intervals around the room, about five feet up from the floor. The bolts stick out from the wall approximately eight to

nine inches. A piece of PVC pipe is put on the bolt as a spacer to keep a curtain out from the wall. The curtain itself can be made of indoor/outdoor carpeting, shade cloth, canvas or anything with enough body to give a little resistance when the birds hit it. This has greatly cut down on the incidence of scraped and bloody wings, hocks, etc.”

## Outdoor Access

Access to the outdoors during the winter months is essential for birds that are housed in winter holding facilities. This practice allows the birds to go outside on nice days and keeps the flock acclimated to outdoor temperatures. An acclimated flock will be able to go outside sooner in the spring. Many northern zoos have courtyards that connect to the building to allow the birds limited access to the outside. Snow on the ground can cause foot dryness and cracks. Some institutions shovel the excess snow out of the area and put down a bed of straw to prevent these foot problems. Doors to the outside should be as wide as possible to prevent injuries from crowding. If possible, a built-in footbath should be placed in front of the door. Among other things, this makes it easier to treat foot disorders with saltwater or other solutions.

## Predator Control

Predators can be a problem in such a small, enclosed area and it is recommended that this be taken into consideration. Some methods of preventing depredation include the use of electric wire on the top of the fence and a mesh ceiling to prevent predator access to the area.

## Air Quality

Air quality within the building is always a concern during long winter months. The building should have adequate ventilation, and there should be at least ten air changes per hour.

## Substrate/Topography

The substrate/topography of indoor enclosures should be carefully considered. Flamingos are especially prone to foot problems, and there are some materials that the birds will actually ingest. There are several substrates that have been used in indoor facilities. These substrates are outlined below:

a) Concrete: This substrate can be extremely caustic and abrasive to feet and legs without protective matting between the birds' feet and the surface. It is the easiest to clean and disinfect on a daily basis. Concrete should be brushed at pouring to give a just a little texture. (This has worked well for Chilean flamingos at the Wildlife Conservation Society/Bronx Zoo; Caribbean flamingos needed mats.) However, a floor covering for all species of flamingos is recommended to prevent foot and leg injuries. Rubber, vinyl, or other soft synthetic matting have been used successfully and are easy to disinfect. Some institutions use wood shavings and straw. Although these two substrates are inexpensive, they must be kept dry at all times and pose an aspergillosis (mold, fungus) risk to the birds. Straw and wood shavings must be cleaned regularly to reduce health risks to the birds. Lincoln Park Zoo uses sphagnum moss over sand. The moss is replaced once a week, and

it is hosed everyday to keep it moist. Rubber flooring can also be affixed permanently to the concrete. This can be very expensive and difficult to repair. Also, several institutions have had difficulty with the slick surfaces that these types of floors often have. A list of flooring vendors can be found at the end of this chapter under product information.

b) Soil/clay: This soft surface can be effective in preventing foot and leg problems. Using this type of substrate poses several problems. A soil floor poses an aspergillosis (mold, fungus) risk to the birds and can be difficult to clean and disinfect. This type of substrate also needs to be removed regularly and replaced which is the most labor intensive of all.

Generally speaking, concrete floors with a washable soft surface to keep the birds' feet from coming in direct contact with concrete is recommended. Since most indoor holding facilities' floors can remain damp for long periods of time and are usually constructed of concrete it is essential that rubber, vinyl, or other easy-to-clean fast-drying matting material be used to separate the birds' feet from the caustic and abrasive properties of concrete. Long term exposure to damp concrete causes the birds' feet to become receptive to abrasions thus opening up the opportunities for infection and the debilitating condition known as bumblefoot.

## Temperature/Humidity

We think of flamingos as tropical birds and sensitive to cold. The three species most often managed in zoo and aquarium collections are surprisingly hardy and can benefit from some limited exposure to mild low temperatures. Temperature and humidity should be taken into consideration when housing flamingos. A suggested general minimum ambient cold temperature for the birds to remain outside is  $-6^{\circ}\text{C}$  ( $24^{\circ}\text{F}$ ). However, wind chill will more often be the determining factor. Once the outside temperature has fallen to this level, the birds should be brought into a heated facility and definitely if snow or ice are present. In some areas summer temperatures can be extremely hot. Misters and sprinklers are used to provide relief for the birds. Shade from natural vegetation can also provide relief from the sun. Flamingos can suffer from dry skin on their feet and legs. Providing at least 40-50% humidity may provide relief for flocks that reside in dry, heated buildings during winter months. A recommended indoor temperature is  $10^{\circ}\text{C}$  ( $50^{\circ}\text{F}$ ). Appendix 1 lists the results of a survey of winter lock-in parameters and holding shelters of U.S. Zoos that can be used as a guide. Contributions from the European community are invited and will be added to the survey.

## Utilities

In areas that have short day lengths, supplemental lighting might be interesting to try and simulate the even day/night hours of the natural range. Supplemental lighting can be provided in a number of ways. Skylights are an option and provide the ability to use natural day length, although it may not correspond to the species' native photoperiod. This type of lighting is also able to provide a larger quantity of light. The installation of skylights can be expensive, and they have a tendency to leak. Several different types of windows can be installed in a building to provide light. Two types that have been used in various facilities are glass block and regular windows. Artificial lights can be installed in indoor facilities to provide lighting. It is advisable to place the lights on timers to allow for the setting of photoperiods. Two types of artificial lights are that are utilized in zoos are fluorescent and UV spectrum.

## Short-term holding

Short-term holding is defined as one week or less. Many southern zoos are faced with severe weather that necessitates bringing the flock inside a shelter. Some of the reasons for bringing a flock of flamingos into a short-term holding are: 1) brief cold snaps 2) severe thunderstorms and hail 3) hurricanes 4) tornadoes, etc. The Fort Worth Zoo has a 12' x 16' (3.6m x 4.9 m) shelter for a flock of 20-30 birds. This shelter appears to be adequate to house a flock of this size without problems for approximately one week. Moving a large flock into a shelter can be quite stressful. The stress on the birds should be weighed carefully against the severity of the storm and the potential loss of life. There have been several reports of flamingos surviving hurricanes by immersing themselves in deep water for the duration of the storm. In this circumstance it may be better to leave the birds with access to their pool, if it is deep enough, vs. putting into a shelter that may be blown away by hurricane force winds. These types of decisions must be made on a case-by-case basis, with the needs of the birds kept in mind.

## Utilization Of Space / Indoor And Outdoor

There are several considerations for utilization of space that need to be taken into account regarding both outdoor and indoor space. For both outdoor and indoor space, courtship and aggression should be considered. The nest site location in an outdoor area should be located some distance from the public. The keeper activities should be kept in mind when placing a nesting area. Some keeper activities to consider are pool cleaning, feeding, exhibit servicing, and gardening activities (i.e. lawn mowing, pruning etc). An indoor facility puts the birds in close proximity to the keeper staff, and room should be given for the birds to be able to move away from the keeper during stall servicing.

Public viewing can be a factor for both indoor and outdoor facilities. Some institutions have indoor facilities that can be viewed by the public year round. It is ideal to allow only two to three sides of an exhibit for public viewing. There are exhibits that have public viewing from four sides, and they still get breeding. The location of nesting areas should be considered when designing public space. The birds should have some distance between their nesting area and the zoo visitors.

## Capture And Handling Facilities

Many exhibits have attached holding areas that the birds can be herded into. This type of area can be very useful when dealing with medical procedures, exhibit maintenance, and flock management activities, such as ringing/banding. The area should be large enough to hold the flock comfortably for an extended period of time and be predator proof. A mesh roof is highly recommended for a capture stall, but not required.

## Isolation From Similar Or Same Species

A quarantine area can be a separate facility or a modified stall within an existing hospital/quarantine space. Flamingos are very prone to foot problems, such as bumblefoot. The floor should be covered with some sort of substrate to prevent potential foot problems. Please see the section on substrate/topography for a discussion on floor substrates for an indoor facility. There is also a list of products at the end of this chapter. The same type of caging that is used in a winter holding facility should be utilized here. The air quality should be monitored, and adequate ventilation should be available. The space should allow for more than one bird to be housed at a time, as flamingos

typically do better when housed with one or more birds. A shallow pool should be provided for birds in quarantine. It may be permanent or removable, as space permits.

There should be some plan for medically treating flamingos. The same considerations outlined above for a quarantine facility should be taken into account for medical holding areas. Existing caging can be modified for use as medical holding areas. See Management, Chapter 3 for further details.

## Special Features

Fountains have been placed in several outdoor exhibits. Although this can be a very attractive addition to an exhibit, it should be designed with the birds in mind. In zoos that have fountains, the birds really enjoy bathing in them, but some designs pose potential trip hazards for the birds.

Enrichment has been provided to several flamingo flocks, mostly to stimulate breeding in small or inactive flocks. Audiotapes of flamingo vocalizations have been used to stimulate breeding as well as to encourage new or sick birds to eat. Mirrors have been used in some institutions to stimulate small flocks to breed. The mirrors are supposed to fool the birds into thinking that the flock is much larger than it actually is.

## Severe Weather

All zoos that receive severe weather should have an emergency preparedness plan for their flamingos. The potential for severe weather includes hurricanes, tornadoes, severe thunderstorms, hail, flooding, extreme temperatures (hot or cold), ice storms and blizzards. Some southern zoos have used public bathrooms as safe areas for their birds during severe weather. Other zoos have set contingency plans and designated holding areas. Appendix 1 lists the results of a winter holding criteria survey.

## Appendix 1

Cold weather lock-in parameters for zoos in North America. All temperatures are in degrees Fahrenheit.

Zoo/Institution	Tulsa Zoo	Pittsburgh Zoo	Tracy Aviary	Cleveland Metroparks Zoo
Determining Factor for bringing Flamingos Inside	predators, low temps.	in every night, regardless	low temps.	experience
Determining date or temp.			<20	consistently in 30's
Judgment call factors	wind, precip, sun			cold rain
When outside, is there access to shelter or heat?	yes	no	yes	no (lessers only)
Is the shelter or heat over water or land?	both		both	
Do the birds use the shelter by choice?	no, trained to come in		no, door too small	no, walked in
Factors to keep birds locked in the shelter	ice on ground or pool	temps. below 40°, precip.		
Temps. when birds are allowed to go outside (degrees F)	over 25 if clear or over 30 if precip.		over 20° heat lamp if <10°	
Notes				

Zoo/Institution	Denver Zoo	Roosevelt Park Zoo	Dallas Zoo	Columbus Zoo and Aquarium
Determining Factor for bringing Flamingos Inside	(into winter holding) – 5-7 days	low temps., violent rains	low temps., precip.	temps. and weather
Determining date or temp.	consec, of <20 night low temp.	<32 at night	<32 at night	<25
Judgment call factors	or 3-5 days consec. of <5 real temp/wind chill or 12-18+ inches snow accum. in 24 hrs with no 40+ temps in the next week		wind, precip.	wind chill
When outside, is there access to shelter or heat?	no	shelter only	yes	yes
Is the shelter or heat over water or land?		land	yes	yes
Do the birds use the shelter by choice?		no	yes, on rare occasions	yes
Factors to keep birds locked in the shelter			ice, wind chill, <40	low temps. and precip.
Temps. when birds are allowed to go outside (degrees F)			32, no wind	mid 20's with no wind
Notes	winter facility separate from exhibit. Birds let out in mid to late April, depending on weather.	winter facility separate from exhibit	often kept themselves in once herded in	

Zoo/Institution	Topeka Zoo	John Ball Zoological Gardens	Detroit Zoo	Akron Zoo
Determining Factor for bringing Flamingos Inside	n/a	temps.	low temps.	ice or snow on ground
Determining date or temp.		<32 for several nights	20's at night	
Judgment call factors		ice on their pond		
When outside, is there access to shelter or heat?		no, vegetation only	yes	no, vegetation only
Is the shelter or heat over water or land?			yes	both
Do the birds use the shelter by choice?			no, walked in	no, walked in
Factors to keep birds locked in the shelter			<10 or snowing heavily	
Temps. when birds are allowed to go outside (degrees F)		when stays at 40 at night		
Notes	only 2 birds, never been outside	birds are put inside for the winter		

Zoo/Institution	Tautphaus Park Zoo
Determining Factor for bringing Flamingos Inside	temps
Determining date or temp.	<32
Judgment call factors	
When outside, is there access to shelter or heat?	yes
Is the shelter or heat over water or land?	land
Do the birds use the shelter by choice?	no, walked in
Factors to keep birds locked in the shelter	temps.
Temps. when birds are allowed to go outside (degrees F)	over 20
Notes	

## References

Pickering, Simon. 2000. Flamingo Husbandry draft document produced through the Wildfowl and Wetlands Trust Slimbridge, England.

## List of Products

Enkamat 7010  
American Excelsior Co.  
P.O. Box 249  
Sheboygan, WI 53082-0249  
Phone: (414) 458-4333

Dri-Deck Tiles  
R.C. Steele  
1989 Transitway  
Box 910  
Brockport, NY 14420-0910  
Phone: 1-800-872-3773

Turtle Tiles  
Turtle Plastics, The Recycled Products Co.  
7450 A Industrial Park  
Lorain, Ohio 44053  
Phone: (440) 282-8008 FAX: (440) 282-8822.

Bandettes used by Disney's Animal Kingdom  
Any poultry supply company or

National Band and Tag Company  
721 York St. P.O. Box 72430  
Newport, Kentucky 41072-0430  
tags@nationalband.com

For Europe please contact the EAZA Office

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