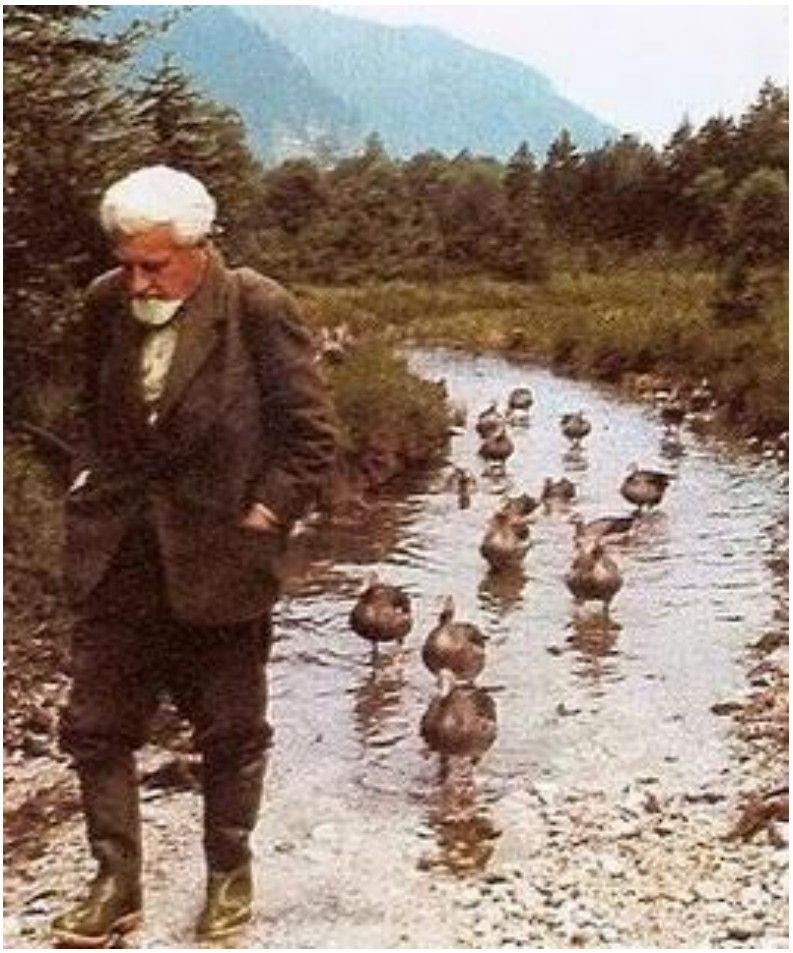
DEONTOLOGIA
Imprinting d'animals de zoològic



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1) MOTIVACIÓ I AGRAÏMENTS

Si fa un parell d'anys algú m'hagués preguntat que és un animal troquelat o què significa fer imprinting en un animal hagués respost que era la primera vegada que sentia aquests termes. Però això va canviar a arrel d'un cicle de conferències que va realitzar AVAFES a la Facultat de Veterinària de la UAB. Una de les xerrades la va fer un veterinari, el qual tenia en aquell moment un lleó de sis mesos a casa. El lleó era del zoo on ell treballa i el tenia a casa per tal d'habituar-lo al tracte humà. Però ell no n'era l'únic. Una companya seva era la cap de manada d'un grup de lleones que també havia criat. Aquests lleons són el que es coneix amb el nom d'animals troquelats. Són animals imprintats que perden l'identitat de la seva espècie i es creuen humans.

I va ser aquí on van començar les preguntes. És això beneficiós per aquests animals? Realment ajuda en el seu benestar? Què passa si aquests animals es volen reintroduïr a la natura? I si els volem reproduïr?

Aprofitant l'oportunitat que se'ns ofereix a l'assignatura de deontologia de realitzar un treball de temari obert, he decidit tractar aquest tema i indagar sobre les repercussions de imprintar els animals de zoològic.

Agraeixo la col·laboració de Xavier Manteca, Hugo Fernàndez i Javier Bermúdez. Ha estat un gran plaer poder parlar amb ells perquè em donessin la seva opinió professional sobre aquest tema.

I sense més preambuls, anem a intentar explicar i comprendre que és això de l'imprinting...

2) UNA MICA DE TEORIA

2.1. Definició

Es denomina animal troquelat aquell al qual se li intervé la impronta amb l'objectiu de que es cregui, total o parcialment, com part d'una altra espècie, majoritàriament de l'espècie humana.

L'imprinting és un procés biològic d'aprenentatge, pel qual les cries s'identifiquen amb els adults de la seva espècie i aprenen d'ells, mitjançant l'observació i imitació, els diferents mètodes de supervivència, recerca d'aliments i refugi, així com mètodes de defensa, atac, convivència, aparellament… És el procés d'aprenentatge irreversible pel qual un individu pren consciència sobre quina és l'espècie de la qual forma part.

En línies generals, el procés d'imprinting es dona durant les primeres hores de vida, en que la cria associa com a figura materna allò que és mou en primera instancia, l'individu que està present durant el naixement i les hores posteriors.

Tipus

Hi ha dos tipus d'impromtes que influeixen en el comportament que tindrà l'animal la resta de la seva vida: una és l'impromta filial (per la qual l'animal connecta amb l'espècie dels seus progenitors) i l'altre és la sexual (orientarà a l'animal, quan arribi el moment, a sentir-se atret pels individus de la seva espècie).

Konrad Lorenz

L'impronta filial, per la qual un animal jove aprèn les característiques dels seus progenitors, la veiem clarament reflectida en els ocells ja que els pollets, al sortir de l'ou, s'imprinten i persegueixen els seus pares. Douglas Spalding fou el primer en descriure aquest fet en pollets i va ser redescobert i popularitzat per Konrad Lorenz, qui va demostrar com un grup d'oques van fer imprinting humà en ell quan van sortir de l'ou ja que va ser amb el primer ésser amb el que van tenir contacte.

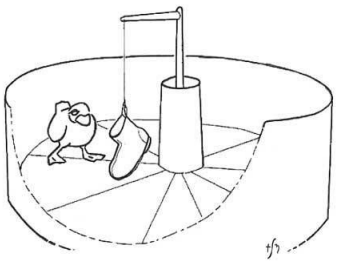
L'impronta sexual és un procés a través del quals un animal jove aprèn les característiques desitjables de la seva parella. Per exemple, un pinsà zebra mascle prefereix una femella que sàpiga criar pollets que no pas una femella de la seva pròpia espècie.

L'imprimpting filial es pot mesurar per la quantitat d'atenció que la cria li fa a la figura materna, el temps que passa a prop seu, el temps que passa seguint els seus moviments…

En canvi, l'imprinting sexual es valorarà més a llarg termini, quan observem com les seves experiències durant la infancia afecten en l'elecció dels patrons sexuals a la maduresa.

Característiques de l'imprinting

1. Període crític sensible
   L'imprinting suceeix en un moment en concret (anomenat període sensible) durant la vida postnatal. Per exemple, en els anseriformes (ànecs i similars) el període d'imprinting és 24.48h després de sortir de l'ou. Durant aquest període, la cria apren a perseguir la seva mare que sol ser el primer individu que veuen moure's.
   No obstant, l'estímul visual que imprinta la cria no ha de ser la mare. Pot ser qualsevol objecte o animal amb una mida concreta i amb colors/mida semblants. El moviment ajuda a captar la seva atenció però no és essencial.
   Encara que el sentit dominant en l'imprintig és la vista, també influeixen el so i l'olfacte. De fet, en diversos experiments els pollets són imprintats per humans, blocs de fusta i botes de goma. S'aferren a un ítem i el seguiran allà on vagi.
   Encara que fou Lorenz el primer en descriure aquest fet científicament, l'essència de l'imprinting és molt antiga.
   L'imprinting sembla ser més important en les espècies precocials, en que les cries són menys dependents de les seves mares i han d'aprendre ràpid d'elles per aconseguir menjar. En canvi, les espècies altricials són alimentades per la mare durant un cert període de temps i aprendran durant el que s'anomena període de sociabilització. Durant aquest període aprendran de la mare i d'altres individus de la seva espècie.
   A més, l'inici i durada del període sensible varia en funció de l'espècie. En gossos dura entre 3 i 10 setmanes, en gats entre 2 i 7 setmanes i en primats entre 6 i 12 mesos. Els estímuls als quals l'animal sigui exposat durant aquest període seran acceptats com a "normals".
2. És irreversible:
   Allò après durant el període sensible dura per tota la vida.
3. L'imprinting estableix unes preferències individuals cap a certes espècies:
   Contrariament al que un pot pensar referent a la tenència genètica, els animals, un cop imprintats, prefereixen seguir aquells estímuls apresos que no pas als membres de la seva espècie.
4. Alguns comportaments estan més afectats per l'imprinting que d'altres:
   No tots els comportaments estan afectats per l'imprinting. En Lorenz va poder comprobar com certs ocells que havien estat imprintats, intentaven guanyar-se el seu favor mostrant-li cucs i intentant posar-li a l'orella. Obviament, aquest és un comportament propi de la seva espècie, innat. En les espècies dimòrfiques (en les que es veu la diferència de sexe externament) l'imprinting sexual varia depenent de si la cria és mascle o femella. Per exemple, els mascles d'ànec buscaran la seva parella a imatge i semblança de la seva mare, cosa que no es compleix en femelles.
5. Estímuls estressants enforteixen l'imprinting
   Si hi ha un increment dels nivells d'ansietat al moment de l'inici de l'imprinting, l'aprenentatge és més fort de l'habitual. Prenent com a exemple la ilustració, si posem obstacles entre l'ànec i l'objecte a seguir la persecució és més enèrgica i determinant. Això demostra que l'imprinting és més fort si hi ha depredadors i altres obstacles a la natura.



L'imprinting ha estat un mètode molt utilitzat en primats. Tots recordem les guarderies per ximpanzés on una cuidadora jugava amb ells i els acostumava al contacte humà. No obstant,

avui en dia és una pràctica que està decreixent i s'intenta que tots els animals siguin criats pels seus progenitors.

Però, inevitablement, és necessari que els animals del zoològic s'acostumin a la presència de les persones per evitar que es posin nerviosos i ajudar a la convivència. Quina alternativa ens queda, doncs?

Després de l'imprinting hi ha dos categories d'aprenentatge: associatiu (condicionament classic i condicionament operant) i no-associatiu. Aquest aprenentatge podria ser una alternativa vàlida a fer imprinting ja que en aquest cas l'animal no perd la seva identiat sino que apren a conviure amb els humans.

Dins de l'aprenentatge no associatiu trobem la habituació, que consisteix en la desaparició d'una resposta en front a un estímul que no té conseqüències per l'animal.

El condicionament clàssic està basat en l'associaició de dos estímuls. Alguns estímuls desencadenen una resposta de forma espontània, sense que sigui necessari un procés d'aprenentatge (estímuls no condicionats). Si l'estímul no condicionat es presenta repetides precedit per un altre estímul que en principi no causava resposta, aquesta acabarà apareixent com a conseqüència de la presentació del nou estímul sense necessitat de l'estímul no condicionat. Es va fer un experiment en que es va aconseguir que un grup de gossos associés el so d'una campana amb l'aparició de menjar, de tal manera que ja començaven a salivar només de sentir el seu so.

El condicionament operant consisteix en que la freqüència d'una determinada conducta augmenta o disminueix en funció de les seves conseqüències. Si la conducta va seguida d'un reforç agradable, la seva presència augmentarà. Pel contrari, si va seguida d'un estímul negatiu, la conducta disminuirà.

Aquest condicionament operant s'utilitza com alternativa a l'ús de l'imprinting per tal de poder interaccionar amb els animals sense necessitat d'alterar la seva identitat.

Per suposat, tots els animals captius han de ser "manipulats" de manera ocasional, ja sigui per administrar tractaments mèdics, per procediments veterinaris rutinaris, per transportar-los... Estudis realitzats en granges, mostren que aquest maneig provoca ansietat en els animals.
Aquesta ansietat produïda pel maneig es pot reduir de diverses maneres. No obstant, la manera més simple és mitjançant ensinistradors que calmin els animals durant la manipulació. Aquesta facilitat en el maneig seria la part positiva del tema. Però com tot, també té la seva part negativa, i és que es redueix el grau de ferocitat i aversió cap al tracte humà: massa maneig o exposició als humans pot tenir un efecte determinant en el comportament i/o reproducció de les espècies en captivitat.

En els zoològics, constantment es manipula l'ambient on es troben els animals i això influencia en el seu comportament actual i futur. És el que es coneix amb entrenament passiu. Per exemple, poden associar el soroll de les claus amb l'arribada de l'ensinistrador.

Per altra banda trobem l'entrenament actiu, que podem aconseguir a través de canvis planejats en l'ambient on es troba l'animal o en moments d'interacció persona-animal.
Si els animals de zoo han de ser entrenats o no és un gran debat ja que hi ha associats grans beneficis i problemes.

Avantatges	Desavantatges
Facilitar la cria	Incrementa la domesticació dels animals
Millorar la salut i benestar de l'animal	Pot ser massa invasiva
Enriqueix	Pot alterar el comportament fora de les sessions d'entrenament. - Redueix el valor de conservació - Augmenta la interacció humà-animal - Afecta les interaccions animal-animal
Augmenta la interacció animal-home	

Antigament els animals s'entrenaven per fer espectacles davant del públic, com en els cas dels dofins i els lleons marins. Avui en dia, aquest fet ja no agrada tant a la societat. Però es vol fer entendre que un cert entrenament és adequat per tal de generar menys ansietat en els animals durant activitats rutinàries com pot ser treure mostres de sang, medicar, inseminar...
Es va fer un estudi amb 6 micos *Macaca mulatta* en el qual primer se'ls manipulava sense entrenar i es veu que el cortisol (hormona que s'allibera davant una situació d'ansietat) augmenta molt més que un cop entrenats.

Extracció de sang	Mitjana de la concentració de cortisol		Diferència (significativa)
	Primera extracció	**Segona extracció**	
Tradicional	20.1+/-4.5µg/dl	33.8+/-5.3µg/dl	P<0.001
Ensinistrats	19.6+/-3µg/dl	22.3+/-5µg/dl	P<0.1

Encara que l'entrenament ha estat implantat a la majoria de zoos, hi ha pocs estudis que s'hagin destinat exclusivament a estudiar l'impacte sobre el comportament i la biologia dels animals. Sabem els beneficis que es poden obtenir, per exemple que aprenguin a restar immòbils per no haver de fer una contenció física o química cada cop que se'ls hagi de manipular. Podem intentar també eliminar conductes estereotipades o conductes que provoquin automutilació.

Em de recordar que el comportament està influenciat tant per la variació genètica com per allò que s'aprèn durant la vida de l'animal. Degut a això, és important que aquells comportaments que són necessaris per la supervivència a l'àmbit salvatge no es perdin dins la població captiva.
Per tant, un dels temes més importants és evitar la domesticació, que pot succeir sorprenentment ràpid. Per exemple, un grup de guineus Vulpes vulpes seleccionades per la seva baixa agressivitat i docilitat van presentar canvis fisiològics i genètics després de 30 generacions i, per suposat, comportamentals.

Mantenir la diversitat de comportament és especialment important per aquells animals que volen ser reintroduits a la natura. No obstant, el criteri per portar a terme qualsevol programa de cria en captivitat hauria de ser el fet de mantenir el potencial per la supervivència al món salvatge ja que, per moltes espècies, la reintroducció serà el camí de supervivència en un futur, potser no molt llunyà. Així doncs, els individus que es reintroduiran encara estan per néixer.
Un apropiat enriquiment ambiental i entrenament poden ser mètodes per preparar els animals per la reintroducció. El propòsit d'això és assegurar-se que els animals seran comportamentalment competents per poder sobreviure a la natura.

2.2. Articles científics (articles complets a l'annex 1)

1. **Effects of hand-rearing on the reproductive success of western lowland gorillas in north America**
   Resum: estudi que valora els efectes de la cria de goriles per part dels humans sobre la reproducció dels diferents individus. En l'estudi s'inclouen 697 goriles (257 nascuts en estat salvatge, 440 nascuts al zoo). Es fan dos comparatives: la primera segons l'origen (salvatge o captiu) i l'altre sobre el mètode de cria (cria materna, totalment per humans o parcialment per humans). Centrant-nos primer en l'origen, cal dir que no va haver diferències significatives entre l'èxit reproductiu de les famelles salvatges i les de zoo. En canvi, sí hi va haver una diferència significativa en els mascles: els salvatges van tenir més èxit.
   Si ens centrem en el mètode de cria, cal dir que els individus criats per la mare tenen més èxit reproductiu que els criats a mà.
   Observacions: aquest estudi ens demostra que els goriles criats per humans tenen menys èxit reproductiu i que, a la llarga, això pot desenvocar en el fracàs de la reintroducció d'aquests animals ja que poden morir sense descendència.

2. **Entrenamiento de animales de zoológico para finalidades médicas**
   Resum: el fet d'implementar un programa d'entrenament animal ha permès modificar conceptes i formes de maneig antics i en moltes ocasions agressius pels animals (com la necessitat de sedació per extreure mostres de sang), proporcionant-lis, així, una millor qualitat de vida en captivitat. L'experiència ha permès arribar a realitzar gairebé qualsevol tipus d'intervenció mèdica a excepció d'aquelles que requereixen d'una anestèsia encara que l'animal cooperi.
   Observacions: aquest estudi ens demostra que només amb un entrenament basat en el reforç positiu ja es pot minimitzar l'ansietat i facilitar la manipulació dels animals, fent innecessari que siguin criats per humans.

3. **Hand raising and diet supplementation of calves**
   Resum: la part que ens interessa de l'article recau en l'apartat de comportament (behaviour).
   Ens diu que els elefants criats per humans ràpidament queden imprintats per els cuidadors. Poden ser reintroduits a les seves mares com a molt 10 dies després d'haver estat separat i en contacte amb humans. A més, durant la cria a mà, hem de permetre un cert contacte amb la mare o altres animals de la seva espècie.
   A més, els elefants criats a mà, al igual que la majoria d'espècies, prefereixen la companyia de les persones que d'individus de la seva espècie. Per tant, és necessari que s'estipulin periodes de contacte amb altres elefants. També ens diu, però, que serien necessaris altres estudis que ens mostressin l'efecte de la cria a mà sobre la comunicació i les capacitats de sociabilització quan l'animal és integrat en un grup.
   Observacions: aquest article ens mostra, novament, la dificultat de reintroduir un elefant dins d'un grup d'individus de la seva espècie ja que s'aferren més als humans.
4. **A website for hand rearing of birds – why?**
   Resum: criar a mà no és el més ideal. La cria per part dels progenitors és una millor opció i hauria de ser l'objectiu de tots els zoològics. Si la cria a mà no es realitza correctament, els pollets poden quedar imprintats pels humans i, com a conseqüència, no poder-se reproduir mai. No obstant, la cria a ma d'espècies rares o en perill poden ajudar a incrementar i mantenir la diversitat genètica en cpativitat.
   Observacions: tornem a veure, en aquest cas en ocells, com la capacitat reproductiva es veu alterada. No obstant, aquí es defensa que per tal de reproduir espècies en perill, si fem un control molt acurat, podem arribar a aconseguir que es reprodueixin o,

fin i tot, podriem intentar la inseminació artificial gràcies al contacte i la confiança que dipositen aquests animals en els humans.

5. **'Stereotypic Animal Behaviour – Fundamentals and Applications for Welfare'**

Resum: pels primats, el fet de no ser criats per la mare té un efecte més greu. Els animals imprintats desenvolupen més estereotipies ja que aquests animals aprenen comportaments per imitació. Com que no han estat en contacte amb la seva mare no tenen l'experiència necessària i es donen conducte aberrants, com per exemple, automutilació. A més, mostren altres canvis com manca de habilitat i alteracions hormonals.

Observacions: aquí comencem a veure com la idea que l'imprinting disminueix l'ansietat en els animals no és certa. Incrementen les conductes aberrants ja que l'animal desconeix el comportament de la seva espècie i no sap com reaccionar davant dels seus congeneres.

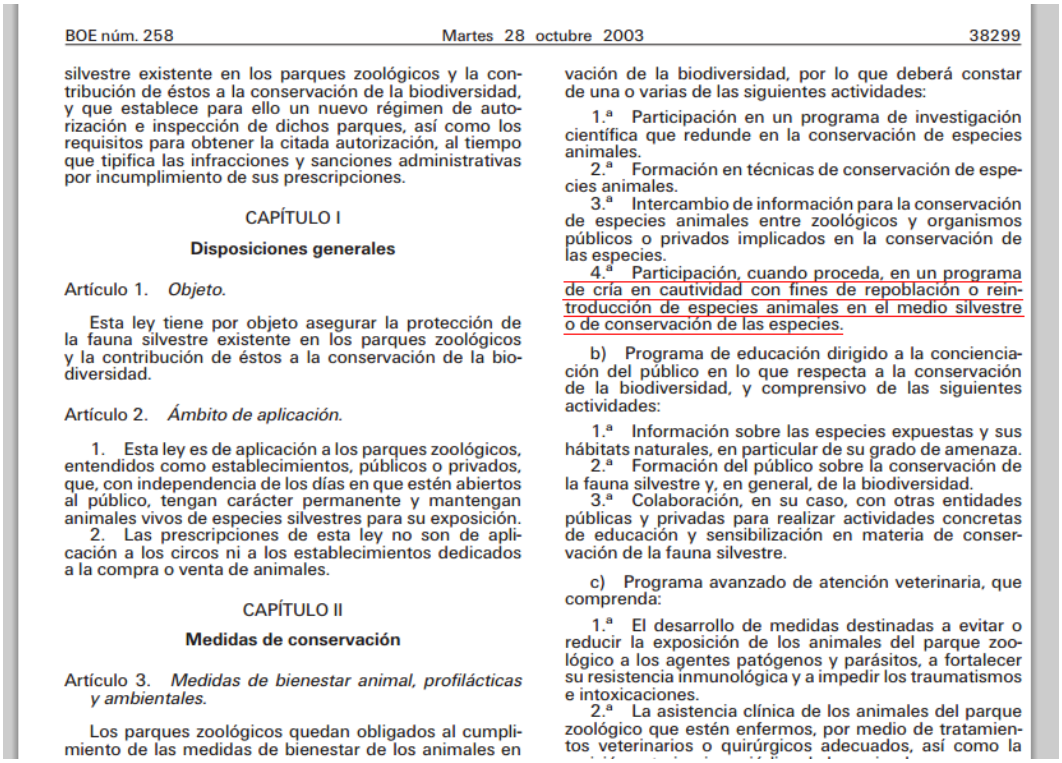
2.3. Legislació:

2.3.1. Espanyola: Llei 31/2003 – Article 4

No hi ha cap punt de la legislació vigent que ens parli sobre la domesticació i imprinting dels animals, per tant, no es pot considerar penalitzat per la llei. No obstant, si que ens diu que els zoològics de l'estat están obligats a desenvolupar programes de conservació "ex situ" (fora del zoo) d'espècies de fauna silvestre que han d'estar orientats a contribuir en la conservació de la biodiversitat. Per tant, ha de constar la realització d'una o diverses de les activitats següents:

- Participació en un programa d'investigació científic que es basi en la conservació d'espècies animals.
- Formació en tècniques de conservació d'espècies animals.
- Intercanvi d'informació per a la conservació d'espècies animals entre zoològics i organismes públics o privats implicats en la conservació de les espècies.
- Participació, quan procedeixi, en un programa de cria en captivitat amb la finalitat de repoblar o reintroduir una espècie animal en el medi silvestre o de conservació de les espècies.

Per tant, entrem en controvèrsia amb l'últim punt, ja que si un animal és imprintat ja no pot ser reintroduit al seu medi natural ja que no sabrà relacionar-se amb els individus de la seva espècie. Així doncs, si tots els zoològics imprinten els seus animals, qui s'encarregarà de la repoblació i reintroducció en cas que fos necessària?



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silvestre existente en los parques zoológicos y la contribución de éstos a la conservación de la biodiversidad, y que establece para ello un nuevo régimen de autorización e inspección de dichos parques, así como los requisitos para obtener la citada autorización, al tiempo que tipifica las infracciones y sanciones administrativas por incumplimiento de sus prescripciones.

CAPÍTULO I

Disposiciones generales

Artículo 1. *Objeto.*

Esta ley tiene por objeto asegurar la protección de la fauna silvestre existente en los parques zoológicos y la contribución de éstos a la conservación de la biodiversidad.

Artículo 2. *Ámbito de aplicación.*

1. Esta ley es de aplicación a los parques zoológicos, entendidos como establecimientos, públicos o privados, que, con independencia de los días en que estén abiertos al público, tengan carácter permanente y mantengan animales vivos de especies silvestres para su exposición.
2. Las prescripciones de esta ley no son de aplicación a los circos ni a los establecimientos dedicados a la compra o venta de animales.

CAPÍTULO II

Medidas de conservación

Artículo 3. *Medidas de bienestar animal, profilácticas y ambientales.*

Los parques zoológicos quedan obligados al cumplimiento de las medidas de bienestar de los animales en

vación de la biodiversidad, por lo que deberá constar de una o varias de las siguientes actividades:

1.ª Participación en un programa de investigación científica que redunde en la conservación de especies animales.
2.ª Formación en técnicas de conservación de especies animales.
3.ª Intercambio de información para la conservación de especies animales entre zoológicos y organismos públicos o privados implicados en la conservación de las especies.
4.ª Participación, cuando proceda, en un programa de cría en cautividad con fines de repoblación o reintroducción de especies animales en el medio silvestre o de conservación de las especies.

b) Programa de educación dirigido a la concienciación del público en lo que respecta a la conservación de la biodiversidad, y comprensivo de las siguientes actividades:

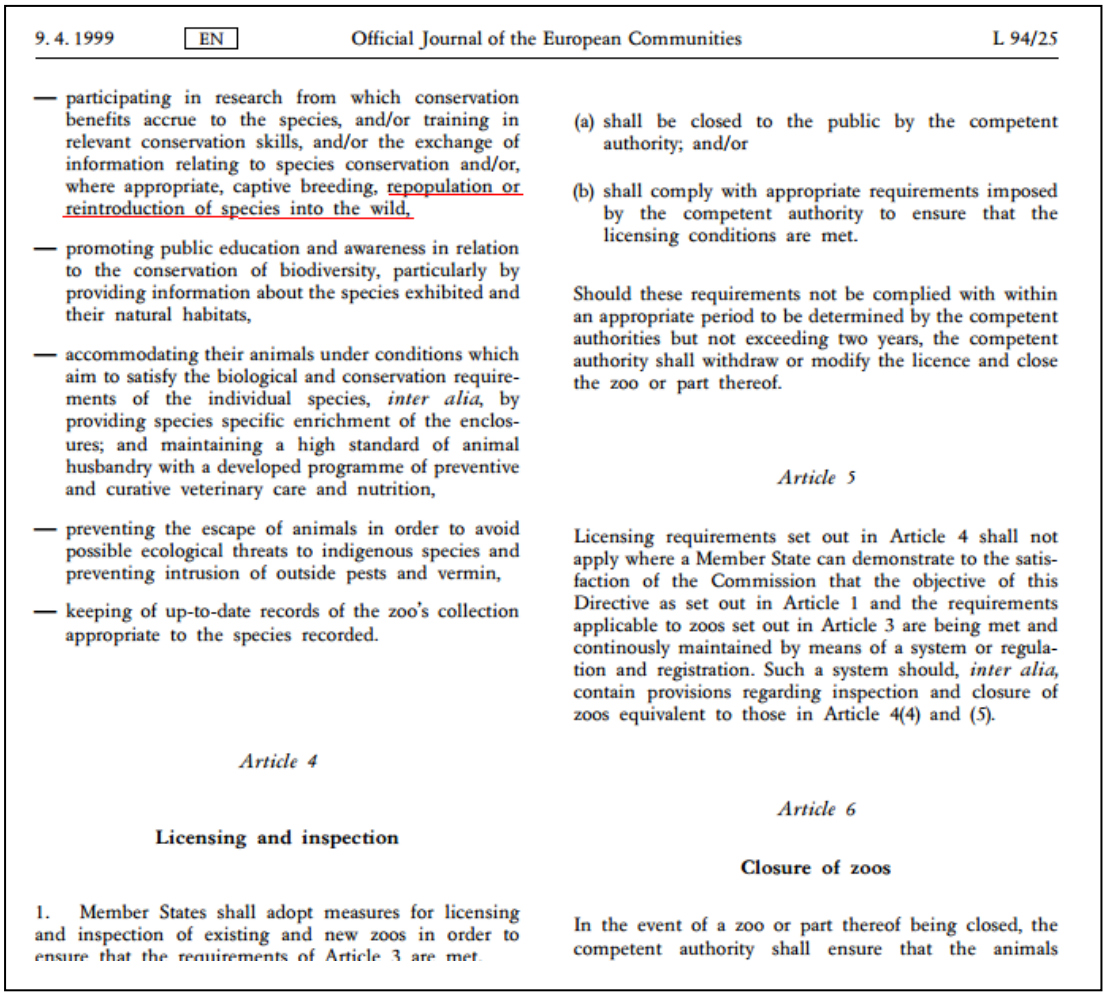
1.ª Información sobre las especies expuestas y sus hábitats naturales, en particular de su grado de amenaza.
2.ª Formación del público sobre la conservación de la fauna silvestre y, en general, de la biodiversidad.
3.ª Colaboración, en su caso, con otras entidades públicas y privadas para realizar actividades concretas de educación y sensibilización en materia de conservación de la fauna silvestre.

c) Programa avanzado de atención veterinaria, que comprenda:

1.ª El desarrollo de medidas destinadas a evitar o reducir la exposición de los animales del parque zoológico a los agentes patógenos y parásitos, a fortalecer su resistencia inmunológica y a impedir los traumatismos e intoxicaciones.
2.ª La asistencia clínica de los animales del parque zoológico que estén enfermos, por medio de tratamientos veterinarios o quirúrgicos adecuados, así como la

2.3.2. Europea

Al igual que en el cas de la legislació Espanyola, desde Europa no se'ns parla de la legalitat referent a l'entrenament dels animals però també fa esment de la necessitat de poder reintroduir-los. Aquest fet no serà possible si s'influeix en el període d'imprinting d'aquests animals.



9. 4. 1999 EN Official Journal of the European Communities L 94/25

— participating in research from which conservation benefits accrue to the species, and/or training in relevant conservation skills, and/or the exchange of information relating to species conservation and/or, where appropriate, captive breeding, repopulation or reintroduction of species into the wild,

— promoting public education and awareness in relation to the conservation of biodiversity, particularly by providing information about the species exhibited and their natural habitats,

— accommodating their animals under conditions which aim to satisfy the biological and conservation requirements of the individual species, *inter alia*, by providing species specific enrichment of the enclosures; and maintaining a high standard of animal husbandry with a developed programme of preventive and curative veterinary care and nutrition,

— preventing the escape of animals in order to avoid possible ecological threats to indigenous species and preventing intrusion of outside pests and vermin,

— keeping of up-to-date records of the zoo's collection appropriate to the species recorded.

Article 4

Licensing and inspection

1. Member States shall adopt measures for licensing and inspection of existing and new zoos in order to ensure that the requirements of Article 3 are met.

(a) shall be closed to the public by the competent authority; and/or

(b) shall comply with appropriate requirements imposed by the competent authority to ensure that the licensing conditions are met.

Should these requirements not be complied with within an appropriate period to be determined by the competent authorities but not exceeding two years, the competent authority shall withdraw or modify the licence and close the zoo or part thereof.

Article 5

Licensing requirements set out in Article 4 shall not apply where a Member State can demonstrate to the satisfaction of the Commission that the objective of this Directive as set out in Article 1 and the requirements applicable to zoos set out in Article 3 are being met and continously maintained by means of a system or regulation and registration. Such a system should, *inter alia*, contain provisions regarding inspection and closure of zoos equivalent to those in Article 4(4) and (5).

Article 6

Closure of zoos

In the event of a zoo or part thereof being closed, the competent authority shall ensure that the animals

2.4. Articles de premsa (articles complets a l'annex II)

1. **Knut, a polar bear**
   Resum: la mort prematura (als 4 anys) d'un os polar criat a mà obre la polèmica. Es sap que tenia problemes de comportament i s'investiga si aquest fet pot estar relacionat amb la seva mort.

2. **The dangers of wildlife imprinting**
   Resum: l'imprinting en animals salvatges és un tipus d'aprenentatge associatiu on un animal apren a reconèixer un individu com a progenitor substitutiu o com a company. Així, els animals es tornen dependents dels humans i es creuen un de nosaltres. És un procés molt difícil i, fins i tot a vegades, impossible de revertir.
   Aquests animals imprintats suposen un perill tant per les persones (ja que en qualsevol moment els poden atacar) com per ells mateixos i els de la seva espècie. No podem contemplar fer ús d'aquesta tècnica si el que volem és retornar l'animal a la natura.

3. **Should humans be able to touch zoo animals?**

   Resum: al zoo de Lujan (Argentina) els animals són criats de ben petits entre humans i altres espècies per tal que no es mostrin agressius de grans i que els visitants puguin tocar, per exemple, els lleons. Això suposa, en primer lloc, que aquests animals ja no poden ser reintroduïts al seu hábitat i, a més, suposa un greu perill ja que no deixen de ser animals salvatges que poden atacar en qualsevol moment.

4. **Raising babies by hand**

   Resum: i ha vegades que els pares rebutgen a les cries i aquestes han de ser criades per humans. Inevitablement es produirà un imprinting, però haurem de procurar que la cria mantingui sempre un mínim contacte amb els progenitors i a més hem d'intentar reïntroduir la cria el més aviat possible amb els seus congèneres. Un altre cas necessari d'imprinting el trobariem en les espècies en perill d'extinció ja que no ens podem arriscar a que hi hagi una mala praxis per part de la mare i la cria mori.

3) PUNTS CONFLICTIUS

De la teoria trobada i els (pocs) articles científics que hi ha disponibles en podem treure algunes conclusions:

1. L'imprinting és un procés irreversible que es dona durant les primeres hores de vida de l'animal i que li condicionarà tota la vida.

2. Es veurà dificultada la reproducció ja que hi haurà desconeixement dels comportaments propis de la espècie. Es poden donar, fins i tot, conductes d'agressivitat.

3. L'animal imprintat no podrà ser retornat al seu hábitat natural, ja que no reconeixarà els seus congéneres com a mateixa espècie.

4. Dels punts dos i tres es conclou que no es podrà complir amb el propòsit dels zoològics de contribuïr a la conservació ja que els animals no podran tenir descendència.

5. Es parla d'un increment de les estereotípies i, fins i tot, se li atribueix ser una possible causa de mort.

6. Suposa un perill pels cuidadors ja que es poden confiar massa i oblidar que estan tractant amb animals salvatges. No parlem ja del perill que suposa que els visitants del zoo puguin tocar els animals.

7. Per evitar tots aquests inconvenients, podem entrenar els animals per tal de poder realitzar les pràctiques veterinàries rutinàries i per millorar el contacte amb els humans.

Tot seguit anem a veure què n'opinen els que toquen d'aprop aquest tema...

4) CONSULTA DELS SECTORS AFECTATS

L'imprinting és un tema que el ciutadà desconeix. És per això que no s'han realitzat enquestes en aquest sector de la població.

S'ha preferit demanar la opinió a tres persones que dominen el tema i que ens poden donar una opinió basada en l'experiència i fets viscuts. Així doncs...

Què n'opinen els professionals?

Hugo Fernandez – veterinari del zoològic de Barcelona

"La meva sensació, és una opinió molt personal, és que l'imprinting és quelcom pràcticament de circ. Són animals en els quals estàs introduint unes pautes de conducta específicament vers els humans que en el menor dels casos que sembla que fan és que t'acceptin a la seva espècie, però el que passa és que són ells els que s'equivoquen d'espècie. Una manada de lleons imprintada no es considera lleons, es consideren humans.

Nosaltres com a institució en cenyim a uns criteris no comercials. Som una empresa que ha de guanyar diners, com tots els zoos. Dit això, la gran majoria de zoos, per sort, per molt que siguem empreses, tenim de fa anys unes guies de funcionament, uns objectius no comercials que queden resumits en educació, conservació i investigació. Els zoos han passat de ser exhibicions d'animals vius a ser institucions amb caire conservacionista i per tant has d'educar i contribuir en el coneixement. A Europa la gran majoria de zoos han incorporat de bon grat aquesta filosofia. A més, ara hi ha una llei que especifica com em de treballar els zoos en certa manera. Per tant, sota aquest context, els animals els tens per temes de conservació i educació. Dins d'això, és obvi que es preten tenir els animals amb màxim benestar.

Per a què podria servir l'imprinting amb aquests objectius? Educació? El fet de revolcar-se amb lleons pot ser educatiu? Es podria considerar educatiu el fet de poder observar els animals tant d'aprop. Personalment, tinc seriosos dubtes de que això sigui així. Crec que això seria més aviat una mascota.

Per altra banda, quedaria l'ús conservacionista. L'únic motiu que se m'acut és si hi ha necessitat de fer, per exemple, inseminació artificial, en que el contacte amb l'animal ha de ser molt proper. Però, la meva experiència em diu, que sota cap altra concepte això és bo. Abans, quan els goriles es criaven a les guarderies i es retornaven al grup quan eren semiadults mai aconseguiem fer amb ells una pauta reproductiva normal. En el cas dels goril·les i moltes altres espècies, la reproducció té un component cultural molt important. És molt important també, el joc. El joc intraespecífic, i no amb humans. Així és com aprenen a comportar-se com a individus de la seva espècie. Pots arribar a situacions drmàtiques, animals imprintats que són incapaços de relacionar-se amb altres individus de la seva espècie. Poden haver problemes a l'hora de traslladar un animal imprintat a un altre zoo ja que han perdut la capacitat de relacionar-se.

Tampoc crec que l'impriting sigui necessari per reduïr l'ansietat dels animals. Ells ja s'acostumen als cuidadors i, de fet, els associen amb una cosa positiva ja que quan entren a les instal·lacions és per, per exemple, donar-los el mejar. I per realitzar pràctiques mèdiques, crec que amb un bon entrenamen ja és suficient. Els animals aprenen a conviure amb nosaltres sense necessitat de creure's de la nostra espècie"

Xavier Manteca – Responsable del Servei d'Etologia de la Universitat Autònoma de Barcelona

"El punt crític que hem de tenir en compte en primer lloc, és diferenciar si estem parlant d'un imprinting o d'una correcta sociabilització amb les persones. Un animal salvatge que està sociabilitzat amb les persones és un punt positiu pel benestar: els responsables el podran manipular millor, l'animal no tindrà por de les persones, etc.

Si es tracta d'un imprinting en el sentit estricte de la paraula el problema apareix, sobretot, si aquest animal es vol dedicar a la reproducció ja no será capaç de relacionar-se correctament amb els animals de la seva espècie. Hi ha un altre possible problema que s'ha vist en aus i també en mamífers i és que quan arriba l'èpica reproductiva es donen moltes conductes d'agressivitat en vers les persones. Això es dona molt freqüentment en cèrvols.
En resum, jo diria que si parlem d'una sociabilització que no implica un imprintig reproductiu els avantatges són més abundants que els inconvenients. Per altra banda, si és un imprinting amb aquest component reproductiu tindràs problemes amb la reproducció i no podràs assolir l'objectiu de conservació de l'espècie.
Dins d'aquesta socialització podem trobar els entrenaments que es realitzen amb els animals amb reforç positiu que afavoreixen, entre altres coses, les pràctiques veterinàries rutinàries. Aquest entrenament mèdic es considera un punt positiu de benestar ja que així l'animal no s'espanta i pateix menys ansietat. En aquesta socialització no té una identitat d'espècie estranya i ja contribueix en el seu benestar. Conclueixo doncs, que l'impriting no el considero necessari per garantir el benestar dels animals en els zoològics".

Javier Bermúdez – veterinàri a la Clínica d'Animals Exòtics

"La tenencia de animales exóticos en los hogares españoles ha ido incrementándose desde la última década. La facilidad de compra venta de estos animales por internet y en ferias de mascotas junto con el gran aumento de criadores no registrados, han propiciado la aparición de estos nuevos animales de compañía, los cuales, no son aptos para este fin y son mayoritariamente abandonados o donados a zoos y alberges de animales.
Actualmente existen normativas que prohíben la tenencia, cría y venta de una lista de especies que se consideran invasoras debido al gran impacto que han realizado en los ecosistemas españoles. Un claro ejemplo es la tortuga acuática "*Trachemys scripta*". Este reptil tuvo un gran auge en el mercado de mascotas y aquellas que alcanzaron un estado adulto se convirtieron en un autentico problema ya que no podían mantenerlas, siendo abandonadas en ríos, estanques, fuentes y hasta en playas.
En mi experiencia clínica, muchos propietarios adquieren mascotas que requieren un gran enriquecimiento ambiental, interacción social con miembros de la misma especie, dietas variadas y tediosas de preparar, que si no se cumplen, pueden desencadenar graves deficiencias nutriciones. Por otra parte, el tamaño que puede alcanzar un individuo adulto es importante, ya que hay especies como las pitones birmanas (*Python molurus bivittatus*) y tortugas de espolones (*Geochelone sulcata*) que se venden con un tamaño que caben en la palma de la mano (100-200 g) y tras 15- 20 años pueden alcanzar un peso de 30-40 kilos.
Otro de los problemas que frecuentemente vemos en consulta son los relacionados con comportamientos no deseados. Las especies que requieren una alta interacción social o enriquecimiento ambiental pueden derivar su frustración en agresividad, automutilaciones, destrucción de las plumas (picaje), ingesta de pelo o sustrato. Las aves psitácidas junto algunos mamíferos como peritos de las praderas (*Cynomys ludovicianus*), ardillas de richardson (*Spermophulis richardsonii*), petauros del azúcar (*Petaurus breviceps*) y cerdos vietnamitas (*Sus scrofa domestica*) son algunos ejemplos de especies que con mayor frecuencia desarrollan comportamientos aberrantes derivados de un mal manejo.
En conclusión, la adquisición de animales exóticos de compañía implica, a demás de una responsabilidad, adquirir los conocimientos básicos sobre necesidades y requerimientos junto con la disposición de infraestructuras que garanticen el bienestar tanto físico como psicológico de la especie. Por desgracia, los centros de recuperación de animales y los alberges así como protectoras y asociaciones cada día se ven más desbordados por la avalancha de abandonos y donaciones. Los veterinarios clínicos tenemos la responsabilidad de orientar, informar y concienciar de la tenencia responsable de dichas mascotas."

5) ANÀLISI CRÍTIC DE LA SITUACIÓ TEÒRICA I PRÀCTICA TROBADA EN LES ENTREVISTES

L'Hugo Fernàndez ens ha fet referència a la pèrdua d'identitat dels animals imprintats, ja que no es que s'adaptin a nosaltres, sino que es creuen un més de nosaltres. Seguidament ha fet esment dels objectius legals del zoo relacionant-los amb l'imprinting. Primer a parlat de l'educació. Creu que algú podria arribar a creure que apropar tant el públic als animals potser quelcom constructiu que farà que coneguem millor els animals. La seva opinió, però, és que aquesta no serà una imatge fidel del que és l'animal en realitat. Pel que fa la conservació creu que, en casos molt concrets, com per exemple si s'hagués de fer inseminació artificial, podria arribar a ser útil. Però sota cap altre concepte, ja que l'imprinting dificulta les relacions amb individus de la mateixa espècie cosa que dificulta l'intercanvi d'animals entre zoològics i digiculta també la reproducció natural. Finalment, ens diu que un entrenament adequat ja afavoreix la relació animal-cuidador.

En Xavi Manteca ens ofereix una opinió similar i ens inclou el tema de l'agressivitat en vers els humans, sobretot en l'època reproductiva, ja que entren en zel i no saben com han d'actuar. Conclueix que un entrenament adequat és suficient per assegurar el benestar dels animals en captivitat.

El Javier Bermúdez ens dóna un punt de vista diferent. Ens parla dels animals exòtics que avui dia es tenen en captivitat que, de fet, els imprintes si els tens de ben petits. Ens parla també de problemes de comportament d'aquests animals criats a casa i del desconeixement que els propietaris tenen de les seves necessitats. Per tant, veiem que és molt important la interecció amb els individus de la seva espècie per tal de desenvolupar un comportament adequat als seus congèneres, assegurar que disposen de l'espai necessari, així com també d'una alimentació adequada.

Veiem, doncs, que el sector professional no troba necessari aplicar l'imprinting per millorar el benestar dels animals en captivitat i que un bon entrenament ens permetrà manipular els animals i mantenir una bona convivència amb ells. Expliquen que l'imprinting pot ser perillós tant per les persones com pels animals que conviuen amb animals troquelats ja que es poden mostrar agressius perquè no deixen de ser animals salvatges.

6) DISCUSSIÓ I CONCLUSION PRÒPIES

Després d'haver-me endinsat en el món de l'imprinting i dels animals troquelats, crec que ja puc donar una opinió pròpia sobre el tema.

La primera conclusió que en trec és que són necessaris més estudis que demostrin si l'imprinting millora realment el benestar dels animals, ja que aquest és el motiu que donaven els veterinaris d'aquell zoo on imprintaven els lleons.

El que sí està demostrat és que l'imprinting té un efecte negatiu sobre la reproducció dels animals i sobre les relacions que s'estableixen entre els congèneres ja que ells es creuen de la nostra espècie. Això deriva en situacions d'agressivitat en vers altres animals i, fins i tot, envers les persones. Hem de pensar també que si aquests animals es reproduïssin no sabrien cuidar de les seves cries i també les hauriem de criar a mà i entrariem en un cercle viciós. A més, suposa un problema pel propi animal ja que es donen conductes estereotipades que poden arribar a derivar en automutilació.

Un cop contemplat el benestar animal (que el considero el punt més important) ens centrem en la legislació. El fet d'imprintar els animals va en contra de la llei ja que es contradiu amb el punt de la conservació. Els animals imprintats no es poden reintroduir i hi ha dificultat per reproduir-los. És per això que no contribueix a l'objectiu de conservar les espècies.

Conclueixo, doncs, que l'imprinting no és una bona alternativa per criar els animals ja que aporta molts inconvenients i l'únic avantatge que diuen que aporta (augment de benestar) no està documentat ni demostrat.

A més, disposem de l'entrenament per habituar els animals al contacte amb les persones i per millorar el seu benestar en captivitat. Vaig tenir l'oportunitat de presenciar l'entrenament d'uns elefants i, realment, veus com l'animal coopera i interecciona amb el cuidador sense cap mena de problema. A més, el cuidador no entra a les instal·lacions, sino que les instal·lacions s'adapten per tal de poder realitzar aquests exercicis de manera segura.

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ANNEX I

ANNEX II

A website for hand rearing of birds – why?

By EAZA Passeriformes (vice) chair(s): David Jeggo, Jersey and Theo Pagel, Cologne

Self-sustaining populations of birds urgently need to be established in our aviaries and zoological gardens. It is imperative that collections collaborate to share knowledge and experience in all aspects of avian husbandry, including hand-rearing.

Due to the special situation imposed by the indefinite ban on the import of wild birds into Europe, the EAZA bird Taxon Advisory Groups had discussions during their meeting in Athens (Greece) in May 2009 and decided that it is very worthwhile to support a hand-rearing website.

In general hand-rearing is not the ideal, natural rearing by the parents is a better solution and should be our goal. If hand-rearing is not done carefully chicks can become imprinted on humans to such an extent that they may never go on to be successful breeder themselves. Never the less hand-rearing, when done responsibly, can be a useful tool in bolstering the numbers of those species we seek to build self-sustaining populations in our collections. If correct protocols are followed it can be reliable and result in birds fully able to contribute to breeding programmes.

It is also possible to foster eggs or chicks. We know for example that Barbary Doves are good at rearing other pigeon species.

Hand-rearing rare and endangered species can help to increase numbers and maintain genetic diversity *in situ* as well as in captivity. The hand-rearing of failing chicks of many species can ensure they reach maturity when otherwise they would not have done.

The aim is not to advocate hand-rearing over parent rearing but to say it does have its place and best practice is necessary to prevent mistakes being made, particularly repeating the same mistakes made by others. We are therefore thankful to Louise Peat; of Cotswold Wildlife Park; who has taken the initiative to produce such a website. We all know this has to be used very carefully. The results can only be as good as the information provided to the website. All bird specialists are therefore encouraged to add, control and use this site with the necessary ethical and biological professionalism. The site should provide us with the most useful protocols and best practices currently available. Our hope is that by using these formulas we will be much more effective to the good of our birds and their populations.

Initiated by the EAZA Bird TAGs (Verona September 2010)
Approved by the EEP Committee, Amsterdam, March 2011

Zoo Biology 21:389–401 (2002)

Effects of Hand-rearing on the Reproductive Success of Western Lowland Gorillas in North America

Sadie Ryan,* Steven D. Thompson, Amber M. Roth,† and Kenneth C. Gold

Department of Conservation and Science, Lincoln Park Zoological Gardens, Chicago, Illinois

This study sought to assess the potential effects of hand-rearing by evaluating the relationships among rearing type and reproductive success in the American Zoo and Aquarium Association's Species Survival Plan® for western lowland gorillas. Our study included data on 697 gorillas: 257 wild-born (WB) and 440 born at zoos or related facilities in North America. We found no significant differences in the number of reproductive zoo-born (ZB) and WB females, but more WB males sired infants than their ZB counterparts. This was influenced by a skew in the number of reproductive years for WB males in the studbook. ZB males showed no difference in infants produced per reproductive year, as compared to WB males, while ZB females produced more infants per reproductive year than did WB females. Mother-reared (MR), ZB females produced more offspring and used more reproductive opportunity than hand-reared (HR) females, whereas rearing had no effect on the reproductive success of ZB males. Moreover, MR and partially hand-reared (PHR) females were more likely to become nurturing mothers themselves. Zoo Biol 21:389–401, 2002. © 2002 Wiley-Liss, Inc.

Key words: Species Survival Plans®; western lowland gorillas; reproductive success; mother-rearing; socialization

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INTRODUCTION

The potentially adverse impacts of maternal and social deprivation on sexual behavior and reproductive success in primates are well documented (e.g., rhesus monkeys [Harlow and Harlow, 1965; Harlow, 1971; Davenport, 1979], chimpanzees [Rogers and Davenport, 1969; King and Mellen, 1994], and lowland gorillas [Meder, 1990, 1992; Beck and Power, 1988]). Individuals raised in isolation or hand-reared by human caregivers often 1) exhibit stereotypies, asociality, and other abnormal behaviors [Erwin and Deni, 1979]; 2) fail to establish appropriate sexual posturing for copulation; or 3) lack social-sexual behavior entirely [Mitchell et al., 1979]. Reports that hand-reared (HR) western lowland gorillas have fewer offspring than individuals raised by their mothers [Beck and Power, 1988; Meder, 1993] have been of particular concern to the American Association of Zoos and Aquariums' (AZA) Species Survival Plan® (SSP®) for western lowland gorillas. If HR individuals are less likely to reproduce than mother-reared (MR) individuals, hand-rearing could compromise the demographic and genetic management tactics that the SSP® uses to ensure the maintenance of a self-sustaining population. This study evaluates the potential effects of rearing experience on the reproductive success of gorillas in North American zoos.

Early in the history of the North American zoo gorilla population, hand-rearing was a common practice (Fig. 1). The fear that mother-rearing put gorilla infants at higher risk of death was substantiated by at least one survey [Satterfield and Kiser, 1981], and with the advent of the western lowland gorilla SSP® in 1982, strong emphasis was placed on socialization with conspecifics of the appropriate ages and genders, under the presumption that this would foster natural social behavior and improve breeding success. The SSP® husbandry manual recommended that the average size of a social group be increased to more closely imitate a natural social group and mating structure [Ogden and Wharton, 1997], and mother-rearing was recommended as the preferred method for rearing infant gorillas [Conway et al., 1985], with the explicit stipulation that "[i]nfants should not be removed for hand-rearing unless there is a significant threat to the health of the mother or infant" [Beck and Power, 1988]. "Care should be taken against the premature removal of infants due to anticipated or perceived maternal incompetence…many gorillas show improvement in maternal care during the first few days of an infant's life" [Dubois, 1997]. Other recommendations included improved social integration techniques [Meder, 1990], rearing with conspecifics [Maple et al., 1977; Reichard et al., 1990; Meder, 1992; King and Mellen, 1994], increased caretaker contact [Maple, 1980], introduction of poor breeders to new potential mates [Reichard et al., 1990], varying group composition [Miller-Schroeder and Paterson, 1989], and increased environmental complexity for adults [Miller-Schroeder and Paterson, 1989] and infants [Maple et al., 1977].

Prior studies have suggested that HR female gorillas have lower reproductive success than either MR or wild-born (WB) gorillas [Beck and Power, 1988; Meder, 1993]. However, these studies had relatively small sample sizes, and pooled some rearing types and birth origins. One potential drawback of these earlier studies was that most zoo-born (ZB) specimens had yet to reach maturity, and thus the data disproportionately favored WB over ZB specimens. More than 10 years later we were able to use a much larger database to investigate the possible effects of four

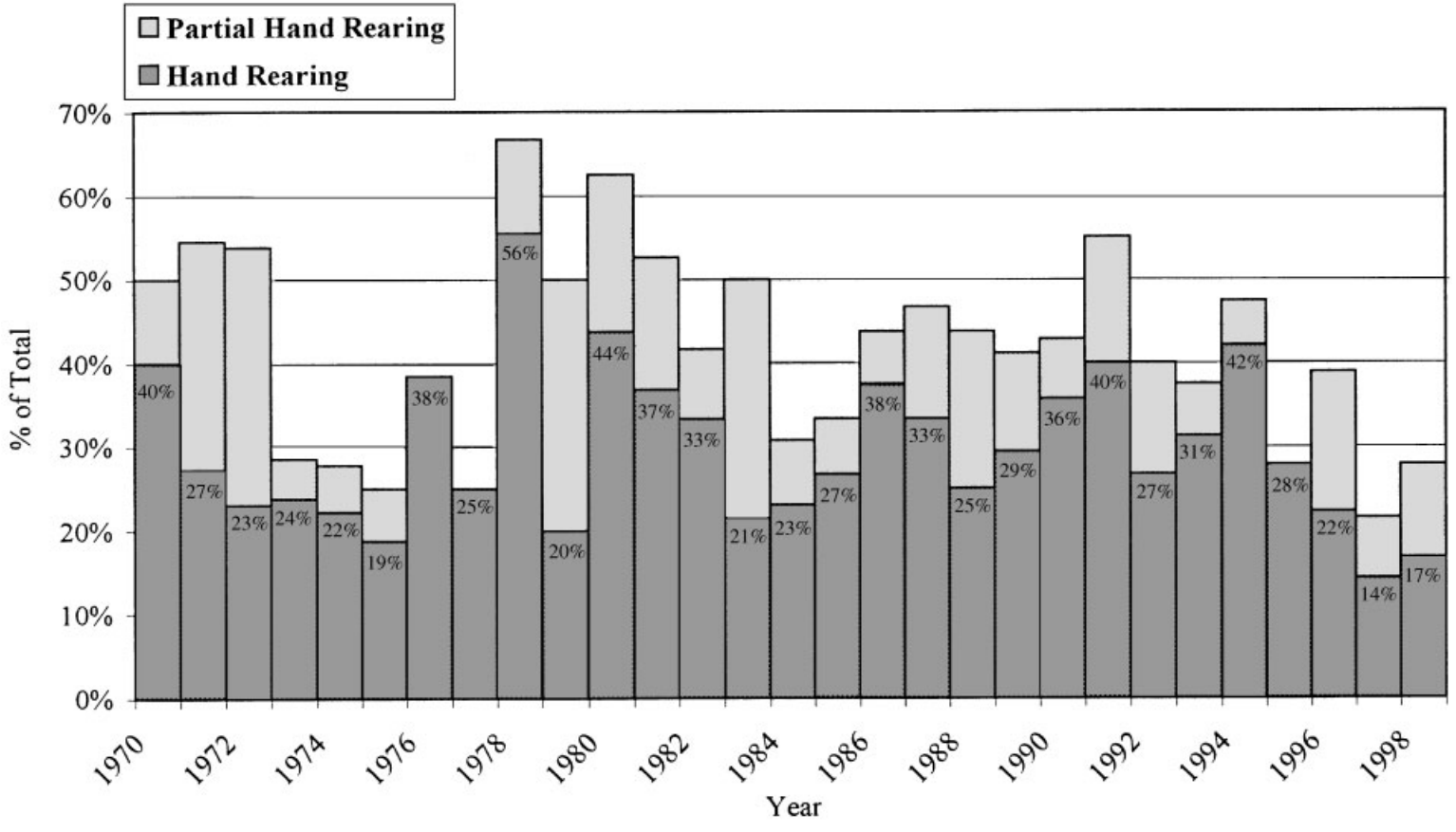

Fig. 1. Proportional frequencies of hand-rearing and partial hand-rearing since 1970.

different rearing situations (HR, partially hand-reared (PHR), MR, and WB) on reproductive success of gorillas in North American zoos. Due to an increased number of specimens and more than 10 additional years of data, our sample represents a nearly threefold increase in reproductive opportunity for captive-born (CB) females over that analyzed by Beck and Power [1988].

METHODS

Data on hand-rearing were extracted from the *North American Studbook of the Western Lowland Gorilla* [Wharton, 1995]. These data were amended and supplemented with data on rearing status obtained by surveys and direct interviews of animal-care and records-keeping staff (Gold, unpublished results). Studbook data were current through February 25 1999, but all analyses of annual bases included data through 1998 only. Data from 1999 were included in analyses when data were pooled across years.

Individuals were classified as MR, HR, PHR, WB, or rearing type unknown. MR gorillas were those that remained with their mother for at least the first 2 years of life. HR gorillas were separated from their mother within 72 hr of birth and cared for by humans until about 2 years of age or older (often younger than 2 in recent years, and usually older than 2 in earlier years). PHR gorillas, as defined by the SSP® and recorded in the studbook, remained with their mother for at least the first 72 hr of life, but were later removed and cared for by humans. They were usually not reintroduced to gorillas until they were about 2 years of age. As the PHR classification includes individuals that may have been mother-reared for almost 2 years, it was not possible to differentiate between infants that spent more time with their mother and those that spent more time with human caretakers. Segregation of the PHR category differs from previous studies that opted to allocate each PHR specimen to either the MR or the HR category.

Gorillas imported from the wild have produced a significant number of offspring in the captive population, and there have been suggestions that WB specimens have enjoyed greater reproductive success than those born in captivity (regardless of rearing experience). However, the type and extent of rearing experienced by virtually all wild- caught gorillas is either unknown or poorly documented. In the absence of specific information, the SSP® assumes that most WB individuals were imported at 1–2 years of age, which would place them in the PHR category. However, to test the hypothesis that some social experience in the wild, presumably within a natural social group, might have significant socialization effects in later life, we placed all wild-born specimens in the rearing category of WB. Because the WB category included a potentially wide range of rearing experiences, we limited analyses of this category to comparisons against all rearing experiences in captivity (i.e., zoo-born).

Since definitions for rearing may be recorded differently outside North America, and accurate historical records were difficult to acquire for individuals that originated outside the SSP®, we excluded all ZB imports from the analyses. Prior studies included ZB individuals from outside North America [Beck and Power, 1988; Meder, 1993].

Analyses of the relationship between the rearing type and reproductive success was limited to sexually mature, ZB individuals (see Table 1). Definitions of "sexually

TABLE 1A. Birth origins and reproductive success

Birth origin	Total in studbook	Adults (age 6+)	Reproductively successful adults	Total RY	Total infants	Inf/RY	%RYU
Males							
Captive born	202	106	22	279.575	87	0.307	0.307
Wild born	122	115	61	1408.255	314	0.241	0.241
Total	324	221	83	1687.83	401	0.259	0.259
Females							
Captive born	206	109	68	837.61	197	0.235	0.536
Wild born	135	120	77	1875.71	253	0.135	0.181
Total	341	229	145	2713.32	450	0.166	0.324

TABLE 1B. Rearing type and reproductive success of captive born gorillas

Males							
Hand reared	70	55	6	90.12	34	0.389	0.389
Mother reared	77	41	13	165.513	45	0.262	0.262
Partially hand reared	21	10	3	23.942	8	0.339	0.339
Total	168	106	22	279.575	87		
Females							
Hand reared	70	45	24	306.77	61	0.199	0.290
Mother reared	77	40	29	335.42	90	0.268	0.808
Partially hand reared	33	22	15	195.42	46	0.235	0.405
Total	180	107	68	837.61	197	0.235	

mature'' for both genders were based on the earliest ages of first reproduction in the North American regional studbook [Wharton, 1995]: 6 years of age (age class 6–7 years) for males and females. Although the studbook contains one record of a male siring an offspring during age class 4–5, the studbook keeper and other husbandry experts consider this datum to be suspect (perhaps a data entry error), as older males were also present at the time of conception. Reproductive success for males was defined as siring an offspring; for females it was a live birth.

A potential bias in evidence of reproductive success is the lack of opportunity to reproduce. This can occur as a result of limited access to potential mates, infertility, or age (e.g., not old enough to have conceived or given birth). Of these potential sources of bias, only age is readily compensated for. For this study, it was assumed that all other individuals were fertile and had access to competent mates for their entire reproductive life. Of course this is an oversimplification, as mate access is governed by the SSP® recommendations and the location of individuals at any point in time. However, the SSP® makes every effort to maintain all mature females in groups containing mature males; while some mature males are maintained without access to mature females (e.g., in bachelor groups), most mature males are eventually housed with mature females. One sterile male (studbook ID 1161) was excluded from all analyses because he had little, if any, opportunity to reproduce before he was sterilized.

To adjust reproductive success for opportunity with respect to age [see Beck and Power, 1988], the number of infants per individual per reproductive year was calculated by dividing the number of live births by the number of years since maturity. The number of reproductive years for each individual was calculated by subtracting the years prior to sexual maturity from the individual's age as of 25 February 1999. For males, the traditional measure of the number of infants divided by the number of reproductive years is an appropriate estimate of used reproductive opportunity.

When the number of infants per year of reproductive opportunity [Beck and Power, 1988] is used as a measure of female reproductive success, females that conceive their first infant before the presumed age of maturity (6 years of age) have used opportunity that exceeds reproductive opportunity. Therefore, many of these individuals have contributed infants to the total, but contributed few years of reproductive opportunity. Mathematically, this problem is further confounded when reproductive opportunity is adjusted to account for time attributable to lactational amenorrhea. Thus, we created a new variable: the ''proportion of used reproductive opportunity'' (RYU). This measure is defined as the time a female allocates to reproduction (i.e., gestation, the subsequent period of lactational amenorrhea when not cycling, and the interim to first postpartum estrus) relative to the amount of time she was reproductively mature. For this study, the numerator of this ratio is referred to as ''reproductive opportunity used'' and the denominator as ''reproductive opportunity'' (as it is measured in years).

To calculate reproductive opportunity used by each female, we summed the number of years devoted to gestation, lactational amenorrhea, and the interim between lactational amenorrhea and first postpartum estrus behavior for each infant born. Gorilla gestation is approximately 0.7 years, and the interim between lactational amenorrhea and first postpartum estrus behavior is approximately 0.2 years [Dixson, 1981]. The median lactational amenorrhea is about 2.4

years for mothers rearing their infants, and near zero for those whose infants are hand-reared [Sievert et al., 1991]. The mean reproductive opportunity used for each MR mother was 3.1 years; for each HR mother it was 0.9 years. Each unknown rearing was assigned the minimum (0.9 years) reproductive opportunity used.

The length of lactational amenorrhea for PHR is more difficult to determine because that category consists of infants who stay with the mother for as little as 3 days to as much as 2 years. Unlike earlier studies [Beck and Power, 1988] (Roth, unpublished results), we had sufficient data to leave the data on hand-rearing vs. mother-rearing unpooled with other data, such as the PHR data. In an earlier study (Roth, unpublished results) the reproductive opportunity used for each PHR mother under varied assumptions were used in separate comparisons for a sensitivity analysis of used reproductive opportunity between the different rearing types. The effects were found not to influence the effects of this rearing type on the overall patterns of effects, so we chose to use an average value for rearing time in the consideration of this variable.

Chi-squared tests were used to analyze the proportions of reproductively successful individuals. Analysis of variance (ANOVA) was used to compare the number of infants per reproductive year and percent of used reproductive opportunity. The multivariate ANOVA (MANOVA) and post-hoc Tukey's honest significant difference (HSD) tests were used to analyze the effects of dam rearing type on offspring rearing. Throughout the analysis, we used a significance tolerance of 0.05; the minimum in any cell was $n = 5$, to maintain the validity of the tests used. All statistical analyses were conducted using the Statistica 99® software package [1984–2001].

RESULTS

The regional studbook database contains information on 710 gorillas. Of the 697 individuals born in or imported to North America, 257 (135 females and 122 males) were WB and 440 (206 females, 202 males, and 32 unknown sex) were ZB (Table 1A). ZB individuals now comprise 63% of the historical North American population. In our analysis of reproductive success and birth origin, there were 257 wild-caught adults (135 females, 121 males, and one sterile male excluded from the analysis) and 349 ZB adults (163 females, 162 males, and 24 of unknown sex). In the analysis of reproductive success due to rearing type, we excluded unknown sex gorillas and those of unknown rearing type.

The proportional frequency of hand-rearing and partial hand-rearing has not declined significantly since the early 1970s (Fig. 1). However, from 1996 through 1998 the frequency of hand-rearing and partial hand-rearing was lower than at any time since 1970 (Fig. 1).

Comparison of Birth Origins

If the reproductive success of ZB and WB individuals is the same, the proportion of reproductively successful females in the populations should be equivalent to the respective proportions of WB and ZB in the total adult female population.

Extrapolating from Table 1A, of 229 adult females, 52.4% were WB and 47.6% CB. Of the 145 reproductively successful (RS) adult females, 53.1% were WB

and 46.9% CB; these proportions are not significantly different ($X^2 = 0.02$; $P = 0.8946$). These proportions were different for males: Of 221 adult males, 52% were WB and 48% CB; of the 84 RS males, 73.5% were WB and 26.5% CB ($X^2 = 11.85$; $P = 0.0006$), due to a very skewed distribution of reproductive opportunity (years) between WB and ZB adults (females: 31% CB, 69% WB; males: 17% CB, 83% WB). CB females had higher reproductive success than their WB counterparts in terms of infants per reproductive year (0.23 inf/RY CB vs. 0.13 inf/RY WB: $F = 24.04$, $P \ll 0.0001$); males had a similar pattern, but this was not significant (0.31 inf/RY CB vs. 0.24 inf/RY WB; $F = 1.55$; $P = 0.215$).

Comparison of Rearing Types

Of 107 adult CB females, 68 were RS females (Table 1B), although there was a slight tendency for HR females to be less successful (42% of females were HR; 35.3% of HR were successful), and MR females to be more successful (37.4% of females were MR; 42.6% of MR were successful ($X^2 = 3.31$, $P = 0.0687$)). Moreover, neither HR nor MR females differed from PHR females (20.6% PHR, 22.0% PHR of RS (HR: $X^2 = 1.34$, $P = 0.2472$; MR: $X^2 = 0.13$, $P = 0.72$)). Of the 106 adult CB males, only 22 were RS (Table 1B), but proportionally, MR males showed greater reproductive success than HR males. 51.9% of males were HR, of which 10.9% were RS; 38.7% of males were MR, of which 31.7% were RS; ($X^2 = 11.7$, $P = 0.0006$). The proportion of PHR in RS males did not significantly differ from HR and MR males (9.4% PHR, 13.6% PHR of RS (HR: $X^2 = 2.59$, $P = 0.1079$; MR: $X^2 = 0.01$, $P = 0.9169$)).

MR females have had more reproductive opportunity than HR females. RS MR females ($n = 29$) produced 90 infants during 335.42 years of reproductive opportunity, whereas RS HR females ($n = 24$) produced 61 infants during 306.77 years of reproductive opportunity. MR males have also had more opportunity to reproduce than HR males. The RS MR males ($n = 13$) sired 45 infants over 165.513 reproductively opportune years, while RS HR males ($n = 6$) sired 34 infants during 90.12 years of reproductive opportunity.

In terms of infants/reproductive year (inf/RY), there was a tendency for HR males (HR 0.389 inf/RY, MR 0.262 inf/RY, PHR 0.339 inf/RY) and MR females (HR 0.199 inf/RY, MR 0.268 inf/RY, PHR 0.235 inf/RY) to be more successful than the other rearing types. However, no rearing type created a statistically significant effect (males: HR vs. MR: $F = 0.6727$, $P = 0.4235$; HR vs. PHR: $F = 0.0398$, $P = 0.8474$; MR vs. PHR: $F = 0.2532$, $P = 0.6226$), (females: HR 0.199 inf/RY, MR 0.268 inf/RY, PHR 0.235 inf/RY (HR vs. MR: $F = 0.8547$, $P = 0.3596$; HR vs. PHR: $F = 0.0437$, $P = 0.8536$; MR vs. PHR: $F = 1.446$, $P = 0.2538$)).

To examine reproductive investment of females, we used our measure of percent used reproductive opportunity, or RYU. MR females had a significantly higher reproductive investment than HR females (0.808 RYU vs. 0.290 RYU, respectively; $F = 7.381$, $P = 0.0089$).

Dam vs. Offspring Rearing

The primary concern in this study was whether the rearing type of females affects the rearing quality of their own offspring. There was a significant effect from the dam's rearing on the rearing type of the offspring (MANOVA: $R = 2.99$, $P = 0.0091$). Of RS HR dams, 53.7% of their infants were also HR, 31.5% were MR,

and 14.8% were PHR. Although this effect on the distribution of infants is not significant, there was a higher number of HR infants being produced by HR dams. Of RS MR dams, 21.3% were HR, 55% were MR, and 23.8% were PHR. There was a significant effect of MR dams producing MR infants (Tukey HSD; $P = 0.043$). Of RS PHR dams, 47.6% of their offspring were HR, 50% were MR, and 2.4% were PHR. WB dams produced offspring that were 42.9% HR, 42.3% MR, and 14.9% PHR.

One institution routinely hand-rears all ZB gorillas, which could bias our analyses of the relationship between a dam's rearing and that of its offspring (i.e., Maple's [1980] "hand-rearing syndrome"). When this institution was removed from the analysis (n = 35 zoo births), the proportions of HR dams were affected, with a distribution of 51.1% HR, 31.9% MR, and 17% PHR. Despite the change in proportions, MR dams were the only group with a significant effect on the rearing type of their infants (MANOVA: $R = 2.53$, $P = 0.0238$).

DISCUSSION

Compared to earlier studies, our analyses found fewer differences between the reproductive success of HR and MR gorillas. While many of the differences reported by earlier studies were still present as trends, most were no longer statistically significant and many were diminished in magnitude.

The proportion of ZB adult individuals of both sexes in the population has increased from 50% to 63% since the 1988 study, allowing us to "unpool" the data and examine more closely the effects of rearing types.

Beck and Power [1988] reported that WB females (68%) had greater reproductive success than ZB females (49%). The implication of these results was that, at least through 1988, socialization in captivity might have a negative effect on reproductive success. In contrast, we found that the reproductive success of WB females (62%) and CB females (64%) did not differ significantly (Table 1A). This may be attributable to our larger sample size, increased reproductive opportunity for individuals in our sample, or continuing changes in hand-rearing protocols.

Although Beck and Power [1988] found no difference in reproductive success between WB males (59%) and ZB males (50%), we found that more WB (53%) than ZB (21%) males were reproductively successful (Table 1A). This difference may be attributable to the longevity of WB males and the genetic management strategy of the AZA SSP® programs. Because one SSP® goal is to increase the population's genetic diversity by breeding founders (WB individuals), it is likely that the high priority placed on breeding WB males has, in the short term, relegated many ZB males to nonbreeding situations. It may be at least 10–15 years before ZB males accumulate enough reproductive opportunity to allow subsequent analyses to accurately assess their reproductive success.

Beck and Power [1988] reported a significant difference between the number of infants per reproductive year for ZB males (0.32) and WB males (0.17). We found a similar, albeit not statistically significant, difference between ZB and WB males (Table 1A). Again, the lack of significance here may be due to a genetic management strategy (see above) that favors the placement of WB over ZB in breeding situations.

Our results indicate that more MR females are reproductively successful than HR females (Table 1B; Fig. 2), which is consistent with Beck and Power [1988]. Beck

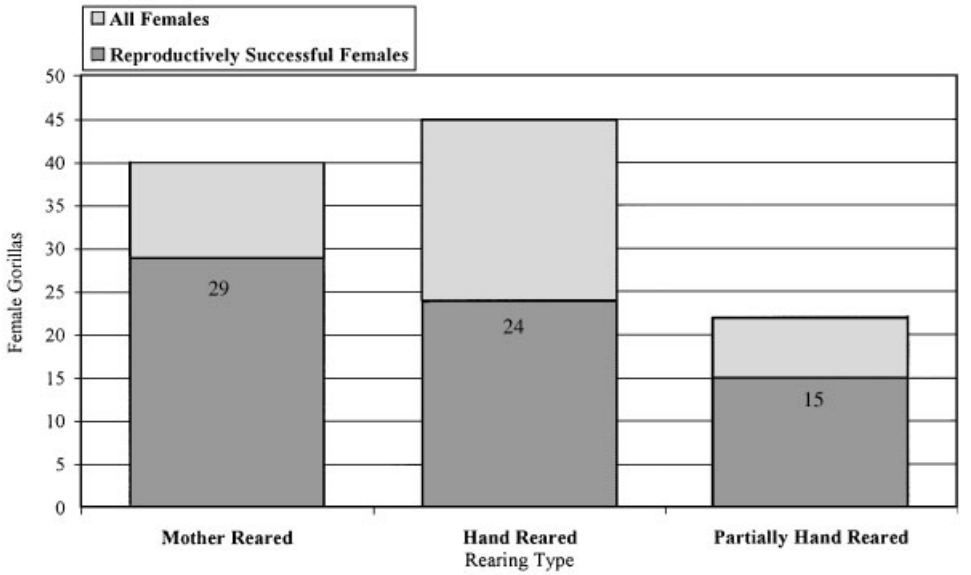

Fig. 2. Number of reproductively successful females and total females by rearing type.

and Power [1988] also found that MR females had a greater number of infants per year of reproductive opportunity (0.30 vs. 0.11); our analyses detected a similar pattern, but it was not statistically significant. However, our analyses show that the proportion of RYU, which we judge to be a more appropriate indicator of maternal success than number of infants born per year of reproductive opportunity, was significantly greater for MR females (45.7%) than HR females (29.4%). For males, rearing type played a significant role in reproductive success, with MR males being more likely to breed than the other rearing types. However, we found that the degree of reproductive success was skewed toward HR males. Although this wasn't a statistically significant result, it was somewhat surprising. One can see from the data that only a few males are having many offspring. The fact that they are hand-reared can be discounted in situations such as artificial insemination, which has been used, albeit rarely, in this SSP® in the last decade. In that instance, the social habits or learning of the male becomes irrelevant, and even his presence is unnecessary for conception to take place. However, hand-rearing may have no negative reproductive effect on male gorillas. The role that partial hand-rearing plays in this study is somewhat vague, due to the vague nature of the category. We suspect most PHR infants were removed from their mother at a fairly young age, probably prior to socialization with conspecifics (3 months at the earliest, according to Fossey, 1982). Therefore, most PHR infants probably spent more of their formative early years with human caretakers than with their mothers and conspecifics. This category represents a compromise between two situations: depriving the infant of early social learning and proper socialization, or leaving the infant with the mother long enough to have that initial bonding. Earlier studies tended either to compare this category to WB infants (Roth, unpublished results), as it was seen to be a partial mother-rearing situation, or to make it a partial-valued category for mother-rearing. This allowed

the researchers to pool or lump the datasets together for analyses. This was not done in the present study, as we had the luxury of sufficiently sized datasets. Because we were unable to determine how long PHR individuals were away from the group, quantification of the degree to which it could be seen as beneficial or detrimental was difficult. Having established the baseline data for the effects of rearing in the two extreme categories, the door is open to more extensive and detailed studies of the effects of PHR. To facilitate future investigations into the impacts and trends of hand-rearing, the PHR status could be subdivided into major physical and social developmental stages, or labeled by the month in which the individual was removed from its mother.

Rearing of Dam vs. Infant-Rearing Needs

As one of the major purposes of an SSP is to create and maintain self-sustaining populations, it is important to know whether the rearing environment and reproductive success are affected by the rearing type of the dam. It is encouraging that while it seemed that rearing type was having an effect on the distribution of rearing types of infants produced (Fig. 3), the only significant effect is that MR dams are more likely to rear their offspring; HR and PHR dams are just as likely to rear, or not rear their offspring.

Impact of Gorilla SSP® Recommendations on Hand-Rearing and Reproductive Success

Despite SSP® recommendations, the frequencies of hand-rearing and partial hand-rearing did not decline substantially from the early 1970s through the early 1990s (Fig. 1). Since 1985, 2 years after the formation of the SSP® (and time enough for SSP® recommendations to begin taking effect), over 40% of all CB individuals that lived over 1 year have been hand-reared. However, it is encouraging that since the publication of the husbandry manual [Ogden and Wharton, 1997] and the

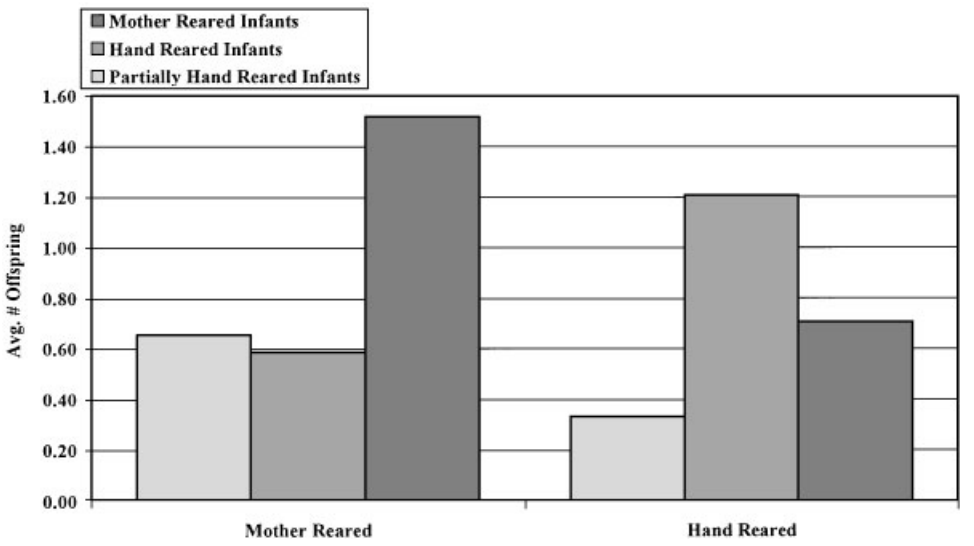

Fig. 3. Rearing type of infants per rearing type of dam.

broader use of protocols to distinguish true maternal neglect from post-partum adjustment, the frequency of hand-rearing has declined substantially.

Other Factors Contributing to Reduction of Reproductive Success or Reproductive Failure

The interaction of hand-rearing with other factors that affect gorilla breeding success may add impetus to its recommended reduction. Abnormal social-sexual behavior, causing reproductive failure in many individuals, is often attributed to hand-rearing. Cases of reproductive failure not due to abnormal social-sexual behavior caused by hand-rearing, such as medical problems and lack of mate access, should be identified and removed from this study.

The variation in breeding success of HR individuals is further affected by factors not associated with rearing, such as the housing environment [Miller-Schroeder and Paterson, 1989; Nadler, 1982; Nadler and Collins, 1984], the lack of mate access [Wharton, 1995], partner incompatibility [Beck, 1982; Harcourt, 1978, 1987; Maple and Hoff, 1982], group instability, stress [Ogden et al., 1989, as cited in Loskutoff et al., 1991], medical problems [Gould, 1983; Reichard et al., 1990; Böer, 1983; Graham et al., 1991; Nadler and Collins, 1991; Loskutoff et al., 1991], and diet [Baer et al., 1989]. In some cases these may caused by not only one factor but by multiple factors. It is further necessary to consider that the situations under which types of rearing occur are variable also. The categories defined herein do not account for the quality of care, level of interaction with human caregivers, contact with peers, or methods of resocialization after non-mother-rearing.

CONCLUSIONS

1. In captivity, female ZB gorillas are as reproductively successful as WB gorillas.
2. Male WB gorillas are more reproductively successful than ZB males, probably due to the breeding status of the older males, with higher representation of WB individuals. There is a positive trend toward an increased reproductive success of CB males.
3. Female MR gorillas are more reproductively successful than both HR and PHR gorillas.
4. MR males are more reproductively successful, but the degree of reproductive success appears to not be affected by rearing type.
5. As mother-rearing positively impacts future reproductive success of gorilla offspring, the gorilla SSP® is justified in placing a strong emphasis on the management protocols that encourage maternal competence before and after the actual birth of an infant.

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Entrenamiento de animales de zoológico para finalidades médicas
Última actualización 27/02/2006@00:00:00 GMT+1

Introducción

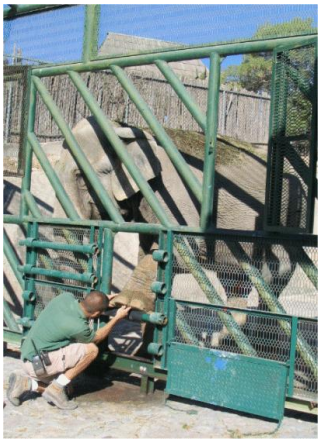
El cuidado que se brinda a los animales que se encuentran dentro de las colecciones zoológicas exige la búsqueda de nuevas y mejores formas para poder contener de una manera mas segura y eficaz a distintas especies que por su tamaño, peso, fuerza o temperamento dificultan su manejo y representan un peligro al intentar realizar algún tipo de procedimiento necesario para garantizar un optimo estado de salud dentro de cautiverio.

Las intervenciones medicas que se realizan dentro de los zoológicos deben realizarse de tal forma en que no se ponga en riesgo la salud o vida del animal y de las personas que realizan estos procedimientos por lo cuál en muchos de los casos es necesario contar con estructuras que favorezcan a la contención física de ciertas especies o bien el utilizar fármacos para sedar o anestesiarlos, en muchos casos estas practicas comunes se dificultan por tratarse de animales salvajes los cuáles no están acostumbrados a ningún tipo de manejo complicando así su padecimiento o en ocasiones haciendo imposible que se puedan tratar o medicar . El entrenamiento de animales en base al condicionamiento operante ha sido de gran ayuda para poder realizar un sin fin de procedimientos médicos con las especies que se encuentran en cautiverio, favoreciendo la aplicación de medicina preventiva, tratamientos y cuidados básicos necesarios que se deben de tener con todos los animales que se encuentren bajo nuestra responsabilidad.

Metodología

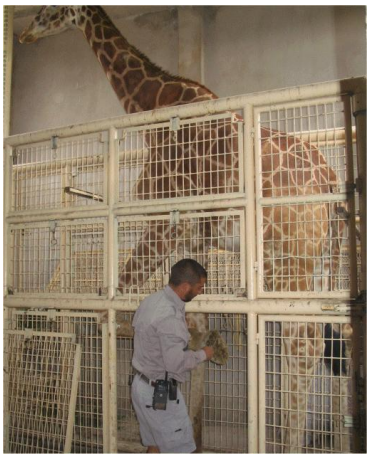
Contacto protegido y Refuerzo positivo

El contacto protegido inicio a principio de los noventas en Estados Unidos por la necesidad de tener opciones para manejar elefantes por dos motivos principales: incrementar la seguridad del operador (en 1991 el departamento de trabajo de los Estados Unidos nombro a la profesión de entrenador de elefantes como una de las mas peligrosas del mundo) y eliminar las agresiones que tienen que padecer los elefantes en un sistema de contacto libre.



Durante la última década, los elefantes han empezado a ser manejados mediante el método exclusivo del condicionamiento operante, sistema conocido como contacto protegido. Por primera vez en 4000 años se pueden manejar elefantes sin la necesidad de utilizar métodos agresivos de control y disciplina físicos.
Africam Safari es un zoológico tipo safari en el cual se implemento un programa de entrenamiento animal desde hace 5 años, adoptando las bases del contacto protegido y el

refuerzo positivo dando así seguridad y la gran ventaja a los animales que participan la opción de decidir y participar de una manera voluntaria y sin repercusión alguna. El programa esta basado en seleccionar especies que de alguna manera necesitan una mayor intervención o bien su manejo rutinario implique riesgos por ser sumamente peligrosos debido a su tamaño, peso, temperamento, etc.



Desde el inicio del programa se establecieron los objetivos y metas a desarrollar con las diferentes especies basados en los antecedentes y complicaciones comunes que se necesitan mejorar o modificar eliminando totalmente el uso de la fuerza, castigo o restricción de la comida para lograr algún comportamiento.
Las sesiones, rutinas y ejercicios estarán enfocados únicamente al apoyo clínico y zootécnico que se requiera eliminando así la confusión de entrenamientos para otras funciones como actos que degradan al animal (circos).

Resultados

Los resultados que se han obtenido después de tres años de aplicar el programa de entrenamiento animal han sido:

1; **Incrementar la seguridad del operador**

Es necesario realizar cuidados rutinarios a los animales que se encuentran en una colección zoológica, por lo tanto siempre existe el riesgo de padecer una agresión o accidente y más aun en caso de intentar realizar alguna intervención que cause cierta incomodidad al animal, con un entrenamiento previo podemos obtener cooperación voluntaria por parte del animal , el tiempo y el grado de intervención que se pueda lograr depende de factores múltiples como la naturaleza de la especie, sexo, edad , antecedentes, instalaciones, estructura social, padecimientos, habilidad del entrenador y cualquier distracción que pueda afectar o modificar un comportamiento durante una sesión de entrenamiento.

2; Incrementa la seguridad del animal

Existen un sin fin de procedimientos clínicos que se pueden desarrollar por medio del entrenamiento, sin la necesidad de contener física o químicamente a los animales, disminuyendo así la probabilidad de que estos sufran alguna lesión e incrementar la frecuencia con la que puedes repetir un tratamiento.

Las especies con las que se han trabajado incluyen elefantes, jirafas, osos, chimpancés, hipopótamos, rinocerontes y pequeños primates obteniéndose diferentes beneficios sin compromete la integridad del animal como:

- *Obtención de muestras*
  - -sangre
  - -orina
  - -semen
  - -saliva
  - -lagrima
- *Chequeo corporal completo*
- *Monitoreo de frecuencias*
- *Verificación de pesos*
- *Mantenimiento y cuidado de uñas, garras, pesuñas.*
- *Aplicación de fármacos por múltiples vías*
- *Realización de pruebas (TB)*
- *Embarques*
- *palpación rectal*
- *Inseminación artificial*

3; Estimulación física y mental

Con el entrenamiento se logra que los animales realicen cierta actividad física y mental al completar sus objetivos estimulándolos así a la realización de trabajos y resolución de sencillos problemas.

4; Investigación

Nos da la posibilidad de poder realizar un gran número de estudios por la facilidad de poder obtener datos precisos, muestras con parámetros y frecuencias especificas así como monitoreos estándares y aplicación de fármacos.

5; Terapia ocupacional

Es sumamente importante brindar opciones a los animales que se encuentran en cautiverio y tratar de lograr enriquecer su comportamiento, una de estas opciones es el entrenamiento.

Conclusión

Al implementar un programa de entrenamiento animal se ha logrado modificar conceptos y formas de manejo antiguo y en muchas ocasiones agresivos para los animales, brindándoles así una mejor calidad de vida dentro de cautiverio. Con la experiencia y tiempo suficiente se pueden llegar a realizar prácticamente cualquier tipo de intervención médica a excepción de aquellas que requieran de una anestesia a pesar de que el animal coopere de forma normal.

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Hand Raising and Diet Supplementation of Calves

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Introduction

Most of the information in this chapter was taken from the "Elephant Hand Raising Notebook ", a compilation of hand raising experiences in survey form. The cases reported in this 1997 survey include calves hand raised from birth on, calves hand raised until they were successfully reintroduced to the dam, mother-raised calves that were supplemented, and calves raised at wildlife rehabilitation facilities. The David Sheldrick Wildlife Trust in Nairobi National Park, Kenya is one of the three reported "elephant orphanages". The "Elephant Hand Raising Notebook includes several articles written by Wildlife Trust Director Daphne Sheldrick detailing her experience in raising more than thirty calves. For more detailed information on individual cases refer to the "Elephant Hand Raising Notebook".

Cases included in the "Elephant Hand Raising Notebook"

Facility and Location	Period of Hand Raising	Facility and Location	Period of Hand Raising
Tel Aviv-Ramat ban Safari, Israel (TARS)	Several days	Cabarceno Wildlife Park, Spain (CWP)	32 hours
Monterrey Zoo, Mexico (MZ)	9 days	African Lion Safari & Game Farm Canada (ALS)	Approx. 10 days
Chester Zoo, UK (CZ)	29 months	Dickerson Park Zoo USA (DPZ)	7 days
Oakland Zoo, USA (OZ)	11 months	Burnet Park Zoo USA (BPZ)	7 days
Kaliningrad Zoo, Russia (KZ)	7 months	St. Louis Zoo USA (SLZ)	4 days
Daphne Sheldrick, Kenya (Sheldrick)	Until weaned	Assam State Zoo Guwahati (ASZ)	Until weaned
Tel Aviv Zoo, Jerusalem Zoo, Tisch Family Zoo Israel (TAZ)	Until weaned	Pinnawela Elephant Orphanage,Sri Lanka (Pinnawela)	Until weaned
Noorder Zoo Netherlands (NZ)	Until weaned	Zurich Zoo Switzerland (ZZ)	Supplemented from 37th day until weaned
Hawthorn Corp. USA (Hawthorn)	Until weaned	Berlin Zoo, Germany (Born in Thailand) (BZ)	Until weaned
S.D.W.A.P. USA (SDWAP)	Until weaned	Busch Gardens USA (BG)	Until weaned

Although over the years many very young elephants have been imported and subsequently bottle fed for some period of time, very few elephants have been hand raised from birth. In the eleven reported cases of calves entirely hand raised from birth only five survived past infancy. Apart from these eleven cases, five others reported successful reintroduction to the dam after a period of up to ten days of bottle feeding the calf. Partially due to the large numbers of females lacking calf experience in captivity we can expect that with increased reproductive success will come an an increased need for hand raising. However, preconditioning of the dam and planning for a gradual, but persistent reintroduction of a rejected calf may result in more mother-raised calves.

Planning for Hand Raising

Planning for any elephant birth should include plans for the possible need to hand raise or supplement the calf's diet. There are many possible scenarios (i.e. aggression from the dam, death or illness of the dam, poor milk production, and a weak or under sized calf etc.) that would necessitate hand raising or supplementing a calf.

Preconditioning for calf acceptance and milking

Planning might include training to desensitize the pregnant female to the presence of a calf and milking. Several facilities have attempted to minimize the fear and aggression a new, inexperienced mother might have towards her calf by exposing her to calf-like stimulus prior to the birth. Artificial elephant calves and other animals (ie. goats, dogs, bovine calves) have been used to desensitize the pregnant female to having smaller, unfamiliar and moving beings around her. Others have played audiotape and videotape recordings of calves to get the female accustomed to the sight and sound of a calf. Desensitizing her to gentle mammary gland and nipple manipulation, as well as, the feel of a warm damp compress may increase her comfort with both the calf's initial attempts to nurse and if necessary milking. However, exercise caution when handling the mammary glands prior to parturition. Excessive handling may reduce the amount of colostrum available to the calf if milk is expressed and may increase the possibility of both mastitis and mammary gland edema.

Supplies

Planning should include the acquisition of supplies at least several months in advance of the anticipated birth date in case the calf is premature or the conception date is wrong. Some supplies like the elephant milk replacer have to be special ordered and may take weeks for the company to mix a batch and ship it to your facility.

Supplies For Hand Raising

- Bovine bottles and nipples
- Milk replacer
- Human breast pump
- Microwave
- Refrigerator
- Cooking thermometer
- Containers and utensils
- Cloth tape measure
- Walk on scale
- Video camera
- Camera
- Record sheets
- Notebooks
- File folder box
- Caretakers for 24hr. coverage
- Nursery in elephant barn
- Shavings
- Straw
- Blankets
- Towels
- Baby wipes

Caretakers

A plan for 24hr. care of the calf should be worked out in advance. Three eight-hour shifts work well. Initially two people should be scheduled per shift. The calf will bond very quickly and closely with its caretakers. Every effort should be made to establish a stable group of people responsible for the calf's care. This group should be large enough to allow for ease of scheduling over a long period of time but small enough that each caretaker is with the calf for most of their workweek. Because of their highly social nature, being able to bond with a human "family group" may help to reduce stress and thereby the likelihood of illness. A small group of caretakers will also increase consistency in care and calf behavior.

Nursery Location

Planning should also include the development of a nursery. It will need to be safe from the adult elephants but allow for visual, auditory, and olfactory contact. Chain link works well as a barrier for the calf but the smaller (1"x1") links are necessary to prevent the calf from putting it's trunk through the fence. Generally, the nursery area should be kept at about 18^{o} C (65^{o} F) but a very young or ill calf many require a warmer ambient temperature. Blankets and heavy bedding may help to offset cold temperatures. The space should

also be hoseable; calves will produce large volumes of urine and feces. A layer of shavings covered by a deep straw bedding works well to insulate the calf and to absorb urine and feces between clean outs. A service area with electricity, water and storage space should be near by.

Record sheet

In addition to standard medical records an infant care sheet should be decided upon. For the purposes of tabulation the sheets should be designed to record a 24hr. period. Basic information includes intake (formula, solids, water) and output (defecation, urination). Other information that could be included are the times the calf lays down and gets up to record sleep time, vital signs, development and behavior.

Reintroduction

As part of the planning process the Elephant Management Committee should develop a plan for a possible attempt at reintroducing the calf to the dam. In five reported cases calves were successfully reintroduced to the dam after a period of up to ten days of bottle feeding the calf. In each of these cases the staff worked around the clock to encourage and facilitate the maternal relationship. The committee should consider their management program, facility, the use of outside consultation and assistance, the temperament of the dam, the potential risks to staff and the calf and the impact of hand raising on the calf and the staff.

Feeding

In the reported cases a wide range of time (2-19 hours) passed before the calves received their first bottle-feeding. Those that went for longer period were trying to get the calf to nurse from the dam. Most often a bovine calf nurser was used with the nipple openings slightly enlarged to allow a steady drip when tipped. A rubber band was placed between the nipple and the bottle rim to allow air to escape. Two facilities (DPZ, SLZ) used an IV line attached to a fluid bag, the end of the IV line was attached to the keepers fingers so the calf could be more easily led to the dams teat.

Milking the Dam

In the majority of reported cases (10 of 16) the dam was milked for some period of time enabling the calf to receive some colostrum and milk. In at least two cases (DPZ, SLZ) the majority of the calves' diet during the short period that they were hand raised was mother's milk. Milking methods varied and included; by hand (similar in technique to that used to milk goats; squeeze the teat at the top with the thumb and fore finger then squeeze with the other three fingers in succession.), manual human breast pump and electric human breast pump. In two cases (SLZ, OZ) human lactation consultants have assisted in facilitating the loan of breast pump equipment as well as providing instruction on its use. In at least two cases (DPZ, SLZ) Oxytocin was used to aid in milk let down and production. Dickerson Park Zoo (DPZ) administered 3ml of Oxytocin intramuscularly approximately 5 minutes before pumping then pumped for between 5-10 minutes. Oxytocin was also administered when the calf began to nurse and it appeared that the milk let down was poor. The amount collected in the first 24hrs. varied widely (300-3,880 ml) partly because in some cases the dam was only milked one time in an attempt to collect colostrum. Of those that continued milking, frequent milking and the use of Oxytocin dramatically increased the amount collected. In one case (DPZ) where the dam was milked every three hours and Oxytocin was given each time the average amount collected per milking was 1080 ml during the first week. Milking has also been used to collect samples from a nursing mother over the course of lactation for the development and modification of formula for a bottle-fed calf.

Milking Procedure with Human Breast Pump and Oxytocin (SLZ)

1) Wash the breasts with warm water.
2) Massage the breasts.
3) Pump the breast 8-10 min. after administering Oxytocin.
4) Rest (stroke, massage + shake breasts).
5) Pump for another 5-7 minutes after 2nd Oxytocin.

6) Rest (stroke, massage, and shake breasts).
7) Pump another 3-5 minutes and finish up.

Milk replacer and supplements

An elephant milk replacer formulated by analyzing the milk of lactating females was used in a number of cases (ALS, OZ, TAZ, NZ, and Hawthorne). In at least two cases (NZ, OZ) additional milk samples were analyzed over time and changes were made to the formula composition accordingly. Several human infant formulas have also been used to bottle feed calves. In North America Grober Company located in Cambridge, Ontario produces the most commonly used elephant milk replacer. Grober produces a replacer for both African and Asian elephants that has been formulated from the analysis of milk collected from lactating females. The Asian formula has 1215 Kcal digestible energy per liter. The African formula has 750 Kcal digestible energy per liter. Enfamil is the most commonly used human infant formula and has 666 Kcal per liter (note not in digestible energy). In most reported cases some kind of dietary supplementation was provided. Bovine colostrum, Colostrix (a colostrum replacer), and lactobacillus were given to protect the gastrointestinal tract. Desiccated coconut and butter fat were added to increase the fat in the diet. Vitamin and mineral supplements were commonly used; mentioned specifically were Vit. E, Vit. B, and calcium. In many cases rice water (cook rice and pour the water off) and glutinous rice broth were used when mixing the formula to help alleviate diarrhea. Rice cereal, milled whole barley or oatmeal, desiccated coconut, and other ground solid foods were added to the bottles of older calves to facilitate the transition to solid foods.

Feeding Schedules

In each of the reported cases the calves were fed "on demand" initially. The keepers began by encouraging/ offering the bottle, but the calf soon developed recognizable behavior indicating a desire to nurse, this usually meant placing the trunk in the nursing position. Sheldrick recommends feeding on demand for at least the first three months, then gradually shifting to an every three hour feeding schedule. In at least one case (OZ) the calf was fed on demand for eleven months. On average the calf nursed every 1-2 hours, although at times he would solicit nursing for comfort and consume little or no formula. When feeding schedules were used the feeding interval for very young calves was 1-3 hours. After three months the nighttime
feedings were gradually eliminated and by nine months the calf was offered as few as four feedings per day.

Feeding Amounts

Calves weighing 100 kg (220 lbs.) should receive between 6,000 and 8,000 Kcal per day and calves weighing 200 kg (440 lbs.) should receive between 16,000 and 20,000 Kcal per day[1]. The Grober Asian formula should be fed at a rate of 5-6.6 liters and 13.2-16.5 liters, respectively to meet this requirement. It is necessary to feed 8-10.7 liters and 21.3-26.7 liters of the African formula per day. At these weights a calf would require 9-12 liter and 24-30 liters of the Enfamil formula per day. Sheldrich recommends that newborns receive at least 8 liters (2gal.) per 24hrs. but states that they can go to as low as 5 liters for a couple of days. Sheldrick states that "over feeding is not possible in elephants calves" and that when allowed to feed at will, as they would if mother raised, they will consume an appropriate amount. Ultimately, the calf should gain between 0.5 kg (1 lbs.) and 1.4 kg (3 lbs.) per day, averaging 0.9 kg (2 lbs.).

RANGE OF REPORTED AMOUNTS BOTTLE FED *

week	liters/day	liters/hour	ml/kg/day
1	5.0-10.7	.208-.446	55.6-87.2
2	8.75-11.6	.364-.483	70.0-91.0
3	11.0-13.2	.458-.550	75.9-128.5
4	11.8-12.0	.490-.500	85.0-98.0

month	liters/day	liters/hour	ml/kg/day
1	5.0-13.2	.208-550	55.6-128.5
2	12.0-18.0	.500-.750	75.9-128.5
3	10.9-20.0	.456-.833	62.9-119.1
4	12.1-24.0	.504-1.00	63.0-130.7
5	14.5-29.0	.606-1.21	70.0-134.0
6	13.7-31.0	.573-1.29	52.9-138.2
7	10.9-24.6	.456-1.02	44.9-118.3
8	12.7-25.8	.531-1.08	56.2-110.8
9	15.0-28.5	.625-1.19	36.8-107.2
10	10.6-28.3	.441-1.18	36.8-107.2
11	12.7-30.6	.531-1.26	43.8-104.1

*(CZ, DPZ, SLZ, KZ, OZ, SDWAP, and Sheldrick)

Solid Foods

Although, hand raised calves experiment with solid foods at an early age they develop normal feeding habits much more slowly than mother raised calves. What is desirable to eat seems to be one more thing calves learn from either their elephant or human families. Hand raised calves often are very interested in tasting foods being eaten by their caretakers. And just like mother-raised calves they use their trunk to smell and try to take food from the mouth of their surrogate mothers. Caretakers might be able generate more interest in appropriate foods by eating or pretending to eat them with the calf. As with mother raised calves weaning and consequently hunger may increase the calf's appetite for solid foods.

Weaning

Very little information has been reported on weaning of the calf. Sheldrick has described generally their process for weaning elephant calves as follows: At 4-6 months they begin to add milled whole barley or oatmeal and desiccated coconut to the formula. They start with 1 TBS. of each and gradually increase the amount until the formula becomes the consistency of porridge. Sheldrick states "the desiccated coconut is a vital ingredient, for this contains the fat that they need. Without it, a calf will begin to show signs of malnutrition during weaning, evident in the development of a pot belly." At nine months Sheldrick believes the calves should be receiving their largest volume of formula at about 28liters/ 24hrs. After this point she begins to decrease, very gradually, the amount of formula. At one year bottles are mixed with half formula and half skim milk, the cereal and coconut continue to be added. At two years Sheldrick gradually replaces the formula and skim milk with water but continues to bottle feed until the calf is five years old. Sheldrick states " that mother raised calves usually nurse until the age of five and that suckling is psychologically important to the calf ". Fowler indicated an age of 15-18 months for weaning to occur.[1]

Behavior

Hand raised calves very quickly become imprinted on their human caretakers. If there is any possibility that the calf might be reintroduced to the dam or introduced to a foster mother in the first couple of weeks, it should spend as much time with them as possible and interaction with people should be minimized. Calves have been successfully returned to their dams after up to ten days of bottle-feeding but in each of these cases the calf was either kept right with the dam or visited frequently including all feedings. Feeding was used as a way to lure the calf to the dam and ultimately transfer the calf to the teat. In one case (NZ) the calf was introduced to a foster mother on day two so the staff continued to bottle-feed the calf but it didn't require round the clock care. In most cases calves that are hand reared require twenty-four hour care and companionship. Being highly social and tactile animals companionship is thought to be very important to

their overall health and well being. Sheldrich states “hand raised calves should never be left alone”, someone from their “keeper family” should be with them at all times.

Newborns

Initially, some calves may struggle with finding a comfortable nursing position, and not nurse well until they do. They seem to need to have their trunks up against something. Sheldrick has had success with hanging a piece of canvas, which the calf then pushes up against to nurse. But Sheldrick cautions that " some calves need more intimate contact with the keeper and will come to rest their trunk at the underarm, face, neck, etc." Once the calf finds a comfortable position it will be reluctant to nurse until it is in that position. Very young calves are also comforted by covering them with a blanket, allowing it to cover their ears so just the front of their face is visible. They may have some instinct to be shadowed or covered by the dam that this fulfills. This will also help to keep them warm. Lighter blankets or sheets can be used in warmer weather.
Newborn elephants often have difficulty lying down, they shuffle around the enclosure until they stop and begin falling asleep standing. At some point they just collapse or tip over. They also may need help getting up. Sheldrich provides large canvas sleeping cushions, others have used deep straw bedding and whole bales for the calves to lean against and slide down.

Companion Animals

A variety of animals have been used as companions to elephant calves, in hand raising situations this is most often in addition to human companionship. Grazing species (goats, sheep, cows) may encourage interest in hay, grass and browse. Animal companions may also encourage play and exercise. Care should be taken that the companion animal is appropriately tested and found to be disease free.

Socializing w/ other elephants and reintroduction

As with many hand raised animals elephants that are hand raised prefer human companionship to that of other elephants. In at least one case (NZ) a calf was introduced to a foster mother on day two. This allowed the calf to socialize normally while still being bottle-fed. It is critical that the calf gets every opportunity to socialize with other elephants. The nursery should be in close proximity to the elephant stalls so the calf can hear, smell and see the other elephants. If possible regular periods of interaction with the other elephants should be planned. The Elephant Management Committee should develop a plan and timetable for integrating the calf into the herd as soon as possible.

Interaction with People/Manners/Training

It can be very difficult to control the movement of very young calves. They may not follow well, a bout of exuberance will send them running off in any direction, and they can be very resistant to attempts to direct or stop them. The environment that they are kept in should be “baby proof” so that they are not in danger if their caretaker “loses control of them”. Although pushing and herding the calf can be effective, grabbing and pulling on the calf seems to trigger an escape instinct and the calf will fight to get away. As they get older they become more reliable followers and respond to their name and simple directional commands. A firm “no” seems to be effective in teaching them what they cannot do. But avoiding problem situations is most practical in calf interactions. Calves exhibit normal butting and charging play behavior at a very early age. Calves should not be allowed to interact with humans in any way that would be unacceptable for an adult elephant. Having many toys available like plastic garbage cans, boat buoys, and hanging objects will make it easy to divert the calf to a toy when a play bout begins. The calf will learn to direct play behavior towards inanimate objects. Although young calves can learn some basic manners, like all infants they are very willful and probably don’t have the maturity for concentrated training until they are at least two years old. In many cases keepers have been able to “capture” simple behaviors like “lie down”, “trunk up”, “move up”, “back up”, etc. by naming and reinforcing the behaviors when they occur.

Play/ Exercise

It is important for normal and healthy development that the calf receives regular exercise. Calves in the wild would be walking miles each day. Even in a captive situation a mother-raised calf would spend more time walking as it followed its mother than a calf raised in a nursery situation. If possible the calf should be allowed to follow the keepers through their cleaning routine. A regular walking routine should be established, possibly before and after business hours. Exercise should also come in the form of play bouts. Healthy calves should regularly have energetic play bouts, which can be solicited with favorite and novel toys.

Physical and Behavioral Development

Physical development of hand raised calves should follow very closely that of mother-raised calves. Monthly body measurements, photographs and videotape of the calf will allow close monitoring of the calf's growth and development. If a hand raised calf is not able to spend an adequate amount of time with other elephants normal behaviors may be absent or slow to develop. The caretakers can encourage some behaviors like dusting, eating solid foods, mud wallowing, swimming, and play behaviors. Further study is needed to determine the effect of hand raising on the calf's communication and social skill once it is integrated into a herd.

Record Keeping and Documentation

Detailed nursery and medical records are essential in monitoring the health and development of the calf. Daily records that allow for the twenty-four hour tabulation of input /output will translate easily into weekly and monthly summaries that make it easier to monitor trends in feeding and stool production. Hand raising also offers a unique opportunity to closely observe and document the behavioral and physical development of an elephant calf. Written, photographic and video documentation of body measurements, vital signs, eruption of molars and tusks, and learning stages of the calf would be a valuable addition to our knowledge of elephants.

Medical Issues in Hand Rearing Elephants

The medical issues involved in the process of hand-rearing elephants are multiple, and the methods for dealing with these issues can be varied. There is little published information available on the subject. Most of the information in this section is derived from our personal experience in raising an elephant calf at the Oakland Zoo from birth to 11 months age, discussions with other zoo veterinarians and staff regarding medical events in hand-reared elephants, and the "Elephant Hand Raising Notebook", including the references cited within the notebook. It is important to plan ahead for the medical aspects of hand-rearing as long as a year ahead of an impending birth. Here is a list of suggested supplies to collect:

Suggested Medical Supplies

- Elephant plasma- 4 to 8 liters minimum for IV use, plus an additional 4 to 8 liters for possible oral use. Can begin collecting 6 months prior to calving date and store at -20^{o} C (-4^{o} F); it can be stored for 12 months if a -70^{o} C (-94^{o} F) freezer is available. Do not use plasma from the dam due to potential for isoantibodies. Donor elephant should be healthy, on-site, and a whole blood PCR test for Herpesvirus should be negative.
- Elephant colostrum- 2 to 10 liters, if available. Bovine colostrum can be substituted in emergencies, same volume.
- Stethoscope
- Large animal thermometer
- Flashlight, penlight, ophthalmoscope
- Intravenous (IV) catheters- 18 gauge, 20 gauge intracaths (eg. Sureflo), 1'' to 3" in length. Other catheterization supplies including heparinized saline, bandage tape, surgical adhesive, suture kit, 2% lidocaine

- IV fluid solutions- Lactated Ringers solution preferred, also NaCl, KCL, 50% dextrose
- Large animal fluid administration sets, standard administration sets, IV fluid bag pump, possibly IVAC unit
- Antibiotics- Ceftiofur (Naxcel), Penicillin GK, Penicillin G Procaine, Amikacin, Gentamycin, Ampicillin, Amoxicillin, Trimethoprim sulfas. Do not advise use of fluoroquinolones.
- Therapeutics for shock- Dexamethasone NaP, Dopram, Epinephrine, Atropine
- Surgical kit- surgical instrument packs, suture material,(2-0 to 0; absorbable, slowly absorbable, and non-absorbable)
- Radiology- portable unit ok for distal extremities, 300 MA or greater for thorax, abdomen, pelvis. On-site preferred, or plan for potential transport to other facility
- Bandaging and casting material
- Antiseptics- Betadyne, Nolvasan, hydrogen peroxide, tincture of iodine
- Vitamin injections- B, C, E and Bo-Se
- Banamine injectable
- Stanolozol (Winstrol), prednisone
- Blood collection kit- vacutainer system, and standard syringes, serum (clot) tubes and EDTA tubes, access to STAT lab, on-site preferred
- Blood culture bottles
- Calf formula and bottles (see above section)
- Heat sources- heating blanket, heat lamps, floor heaters
- Tetanus toxoid, tetanus antitoxin
- Oxygen administration system- portable to elephant location. Anesthesia machine or oxygen demand valve with tank
- Anesthetics- Isoflurane vaporizer system, ketamine, xylazine, reversal agent for xylazine
- Endotracheal tubes up to size 18 with stylets, mask to fit over trunk
- Anesthesia monitoring equipment- pulse oximeter, EKG, Doppler unit
- Medical records

Medical Protocol for Rejected/Orphaned Elephant less than 24 hours of Age

1. *Assess immediate needs.* Evaluate respiration, heart rate, mucus membrane perfusion. Perform resuscitation procedures or begin oxygen therapy before proceeding with further steps if needed.
2. *If temperature is less than 36^{o} C (97.5^{o} F)*, apply heat lamps and/or heating blankets (36.4^{o} C to 37.2^{o} C is normal)
3. *Draw EDTA and Clot blood tubes for:*
   a. Whole blood glucose. If less than 40 mg/dl infuse 5% to 10% glucose solution, 10 to 20 ml/kg IV bolus. Recheck blood glucose.
   b. CBC (STAT)
   c. Chemistry panel (STAT) including electrolytes, P, Creatinine, T.P., Globulins, Ca, CPK
   d. Zinc sulfate turbidity or glutaraldehyde precipitation test (qualitative IgG test)
   e. SAVE extra serum and freeze
   f. Serum electrophoresis
4. *Consider blood culture* if calf is weak and/or placentitis is present.
5. *Administer elephant colostrum* if available, 2 to 10 liters orally. Give by stomach tube if necessary (may need to complete further assessments or treatments if tubing is necessary as this is stressful). Colostrum should be given when the calf is less than 12 hours old if possible, and no more than 24 hours old. Bovine colostrum can be substituted if necessary.
6. *Weigh*
7. *Assess fluid balance.* Insert IV catheter if fluid therapy or plasma therapy is indicated. If calf has not received colostrum – plasma is preferred fluid. If calf has received colostrum, use LRS and/or plasma.
8. *Perform thorough physical examination.* Assess maturity. Rule out congenital defects.
9. *Save placenta* for examination (culture and sensitivity, histopathology)
10. *Evalulate lab data and PE,* decide upon appropriate antibiotic, plasma, fluid therapy, tetanus prophylaxis, umbilical care, and vitamin E or Bo-Se injection.

This table is adapted from Smith, Large Animal Internal Med 1990

Failure of Passive Transfer (FPT) of Immunoglobulins

There have been no recent definitive studies of the immune development of the elephant neonate. Some guidelines, such as volume of plasma to administer in cases of FPT, have been extrapolated from equine recommendations. Some guidelines to consider are as follows:

- Elephant neonates consume 2 to 10 liters of colostrum, with nursing beginning as early as 30 minutes after birth[1]. Therefore it is recommended to give this amount, and assumed that the window of time for absorption is from birth to 6 to 12 hours of age, possibly up to 24 hours of age, as in the foal. Colostrum can be stored frozen for a period of up to one year at –20^{o} C.
- Elephants have long been thought to have no placental transfer of immunoglobulins, only passive transfer through colostrum after birth. Recent findings suggest that further work is needed in this area.[2]
- More information is needed on testing the immune status of neonatal elephants. Tests that should be performed are: total protein and globulins, serum electrophoresis, and a qualitative immunoglobulin test such as zinc turbidity test. A threshold of 400 mg/dl of IgG is an adequate level for foals but this may not be adequate for elephants. Note that the two African elephant calves born at Oakland Zoo that had not nursed prior to blood draw had IgG levels of greater than 400 mg/dl as determined by the glutaraldehyde precipitation test (a qualitative IgG test). It has been suggested that a neonate should be considered hypogammaglobulinemic if serum concentrations are less than 25% of the adult average for the species. Electrophoresis does not require species-specific reagents and can measure gammaglobulins.[3] Total protein and globulins may not be a reliable indicator of passive transfer, even in foals. Generally, a serum globulin level of less than 4.5 g/dl suggests FPT, and 4.5 to 5.0 suggests partial FPT, but these values are only guidelines, and again in the Oakland calves had values greater than 4.5 even though no nursing had taken place. Quantification of IgG requires radial immuno diffusion (RID), which requires species-specific antiserum. This would have to be developed by a research laboratory at present, but in future perhaps would be available. Finally, although not definitive, these tests should be performed to help attempt assessment of the calf, but also to gather information for future calves.
- Elephant plasma should be collected up to 6 to 12 months prior to expected calving date. The sterile plasma can be stored at –20^{o} C (-4^{o} F) for 6 months, and at –70^{o} C (-94^{o} F) for 12 months. The donor elephant should not be the dam due to potential for isoantibodies should be healthy, and Herpesvirus negative by whole blood PCR tests. The elephant should be tested at each plasma collection. It is preferable to collect from elephants on-site, as resistance to local infectious agents is more likely.
- The volume of elephant plasma to administer IV to the calf is not known, but it is likely that amounts similar to that required for the foal are necessary. Foals are given 40 to 80 ml/kg IV over a 2 to 4 day period. For a 100 kg (220 lbs.) elephant calf, this would total 4 to 8 liters. This amount is too large a bolus for one administration, especially in a calf with normal hydration status. Ten to twenty ml/kg is a reasonable amount to give as one IV bolus over 30 to 60 minutes. The volumes of plasma administered to neonatal calves reported in the “Elephant Hand Raising Notebook” have been lower than recommended amounts, 1.5 liters or less. Elephant plasma can also be given orally during the first 24 hours after birth (first 6 to 12 hours preferred), but the antibody content is lower than colostrum, therefore a larger volume must be given to approach a similar absorption. Colostrum or plasma may have a local protective effect on the gut even if GI absorption is closed.

Diseases and Problems of the Hand-Reared Neonate

Selected conditions that appear to be specific to, or occur more frequently in, hand-reared neonates are discussed here.

1. Diarrhea- Defined as an increase in liquidity or frequency of stool production. Loose stool in a variety of colors may be “normal” for formula-fed infants. Severely odorous stool may be abnormal. The frequency of stool production that is normal for one particular calf is helpful in determining the extent of diarrhea when it occurs.

- In cases of mild diarrhea without any additional clinical signs: either dilute formula 25% to 50% for 1 to 3 days; or discontinue formula and substitute water, electrolyte solution such as pedialyte, rice water or

rice milk; or alternate each formula feed with a feed of electrolyte solution; or change to a different formula.

- In cases of diarrhea accompanied by other clinical signs such as lethargy, weakness, reduced appetite, colic or dehydration, diagnostic evaluation as well as treatment is necessary. Diagnostics include- CBC, Chemistry panel (note that blood collection is stressful for elephant calves, so the necessity for this action should be based on history, and severity of clinical signs); Fecal culture for Salmonella, +/- other potential pathogens such as E Coli, Pseudomonas, Clostridium perfringens, and Campylobacter; fecal cytology smear; fecal flotation for parasites, +/- exam for giardia; TPR, and body weight SID to BID; +/- Herpes serology test; and +/- blood culture. Treatment options include diet changes as above, with emphasis on electrolyte oral fluids; IV fluid therapy; antibiotic therapy; Kaopectate orally; anthelmintic when appropriate.

2. Constipation
   - Has been reported in mother reared and hand reared calves.[4]
   - Can occur in particular following a stressful event or abrupt diet change.
   - Signs include listlessness, anorexia, abdominal contractions with no defecation (straining), absence of defecation, and rubbing hindquarters against walls.
   - Treatments: enema (may be necessary to be given daily); consider antibiotics, corticosteroids, and vitamin B12 if the calf is weak; consider use of oral cathartics such as mineral oil, but these should be used with caution in very young animals, as they could cause further abdominal discomfort and/or diarrhea.

3. Metabolic Bone Disease/Rickets- Rickets has occurred in young growing elephants fed a diet with (what appears to be) an imbalanced calcium:phosphorus ratio.[1] Unfortunately there may not be enough information on the calcium:phosphorus content of normal maternal elephant milk to know what the recommended amount should be. Readers should see the analyses in the "Elephant Hand Raising Notebook", and any new information, prior to evaluating a particular formula for a calf. Access to sunlight may also be important in the prevention of this disease, as a source of vitamin D necessary for calcium absorption from the gut. Chronic intestinal malabsorption was suspected as a causative factor in one case of metabolic bone disease in a hand-reared calf at the San Diego Wild Animal Park (Oosterhuis, personal communication 1996).[4] Diagnostic evaluation may include evaluating serum calcium and phosphorus levels, radiology, and formula (repeat) analysis. Treatment would involve correcting the dietary imbalance, possibly injection(s) of vitamin D, access to sunlight, and care with regard to body weight and type of exercise (or any activity that could lead to pathologic fracture). It is recommended that the calf be exposed to 30-60min. of sunlight per day depending on the weather. It is also recommended that x-rays of the distal limbs be taken to evaluate bone density at approximately 6 and 8 months of age.

4. Herpesvirus Infection - Approximately twenty cases of the disease have occurred; eighteen of these cases have been in young Asian elephants. Of the cases that have occurred it is not known how many were hand raised calves with the exception of the Oakland Zoo African calf no.1. The disease is acute to peracute, and often rapidly fatal. Recently four young elephants have been treated with the oral antiherpes medication Famcyclovir, and of these cases three have survived. (Montali, R., personal communication 1999). A whole blood PCR test is available upon special request from Dr. Richmond or Dr. Montali. (National Zoo, Washington D.C.) Results from this test may not be received for a number of days. Treatment may therefore need to be initiated based only on history and clinical signs. Symptoms include lethargy, weakness, reduction in appetite, diarrhea or lack of stool production, cyanosis of the tongue tip, swelling around the face, trunk and front limbs, elevated heart rate, collapse, and sudden death. Not all of these symptoms have been seen in each case of herpesvirus infection, and in older animals the symptoms have appeared to be less specific. It is advised that Famcyclovir be kept on hand at the zoo when hand-rearing an elephant calf. Acyclovir (Zovirex) does come in an injectable as well as an oral form, but this has not yet been used in an elephant, and also the cost may be prohibitive. It is recommended that hand reared calves be trained to allow a physical examination especially of the oral cavity. This is particularly important in situations where herpesvirus has been known to occur on the premises or where there has been cross species contact in the herd.

5. Sunburn- Elephants are susceptible to sunburn, especially on the head. Ensure that adequate shade is available during outdoor time. Sunscreen has been used on calves, however effectiveness is uncertain and there could be some potential for allergy, so covering the calf with sheets, and keeping in the shade are better options. Treat sunburn with a soothing cream such as Vitamin E cream and restricted access to sunlight until healed.

6. Skin Dryness- This has been noted in hand-raised calves. Cause is unknown. The dryness can cause a marked pruritis resulting in the calf rubbing itself raw on doors, walls, etc. Treat with a mixture of lanolin and mineral oil (1-lb lanolin added to 1-gallon mineral oil). Apply to the entire calf's skin once to three times weekly after gently bathing the calf with warm water. It may be advisable to test the calf for allergy to the mixture by applying a small amount to the skin the first time it is used.

7. Umbilical infection- The umbilicus can be very open at birth, and umbilical infections have been reported in elephants, including one fatality.[6] Serious infection may be more likely in a calf that is immune-compromised by FPT, stress, etc. Diagnostic evaluation: Aerobic and anaerobic culture and sensitivity. Treatment: Cleansing and antiseptic flush with dilute Betadyne or Nolvasan q 12 to 24 hours; gentle curettage if necessary; +/- topical antibiotic flush, eg. Penicillin GK or dilute Gentocin q 12 to 24 hours; +/- systemic antibiotics (may be critical in cases of FPT). Broad-spectrum therapy is advised, for example ampicillin + amikacin (with adequate hydration), or Ceftiofur (Naxcel) IM.

8. Trauma- An infant that has been rejected may have received traumatic wounds from the dam or other elephants. The wounds can be external, such as abrasions, lacerations, bruising, puncture wounds, etc.; or internal, such as fractures, trauma to internal organs. Diagnostic evaluations include physical examination (repeat frequently), aerobic and anaerobic culture and sensitivity of any infected wounds, radiology. An x-ray generator of 300 MA or greater will be necessary for all but the distal extremities. Anesthesia may be required to x-ray a calf that is not depressed or weak. Treatment may include minor surgery, major surgery, wound care +/- bandaging q 12 to 24 hours, antibiotic therapy, and analgesics depending upon the location and extent of the trauma.

<u>Fluid Therapy</u>

- Can be a critical therapy in the treatment of many different conditions.
- Adult elephant fluid requirement is approximately 30 to 50 ml/kg/day.[1] The infant requirement is likely to be higher. For example the Oakland zoo calf had an average milk consumption of 108 to 138 ml/kg/day (up to 11 months of age). Active disease and fluid losses can increase fluid requirement to 2 to 4 times maintenance.
- Subcutaneous fluid administration is not a good option for therapy due to limited SQ space. Fluid is of course well absorbed by the oral route, and this should be used whenever possible, although clear fluids such as electrolye solutions should not completely replace milk for too long due to caloric reduction.
- Intravenous fluid therapy: a good tool when dehydration is present, especially if the calf is anorexic. It is difficult to maintain an IV catheter in an infant for continuous infusion. One option is to give fluid by intermittent IV bolus. No IV bolus should exceed 40 to 90 ml/kg, 20 ml/kg being preferred; and the fluids should be given as slow as possible (over 30 to 60 minutes). Anesthesia should be considered if the calf is extremely stressed by restraint for IV fluid administration.
- IV catheters: 18 gauge or 20-gauge intracath, placed in medial saphenous vein or ear veins. It may be difficult to thread an over-the-needle catheter through the skin on the hindlimb. Butterfly catheters can also be used but are difficult to keep in place, even for short periods. Use 2% lidocaine for catheter placement. Suture or apply surgical adhesive to help keep the catheter in place.
- Fluid type: Lactated Ringers is suitable for most cases. Do not add KCl if fluid is given as a rapid IV bolus. May add glucose to make a 2.5% or 5% solution if blood glucose is reduced.

Vaccinations

1. Tetanus toxoid- vaccination for Clostridium tetani. Has been given to adults, sub-adults and neonates at multiple institutions. Give 1 ml IM. First dose at 3 months age, second at 4 months. Consider an initial dose as early as the first day if calf has not received colostrum.
2. Tetanus antitoxin has been administered in adults, and could be considered particularly for use in a neonate with lesions likely to become contaminated with clostridium. However note that fatal serum hepatitis has occurred following administration of tetanus antitoxin to horses.
3. Discuss vaccination for other clostridial diseases with veterinarian. Deaths of elephants have been reported due to C. septicum, C.botulinum and C. perfringens (enterotoxemia), however vaccination has not yet been routinely recommended.
4. Discuss rabies vaccination with veterinarian. One death has been reported[5]. Vaccination of elephants for rabies is rare in zoos, and has not yet been routinely recommended. Calf should be greater than 3 months of age if vaccinated.
5. Discuss encephalomyocarditis virus vaccination in endemic areas with veterinarian. An experimental vaccine has been tested in zoos, however with varying results.
6. Any vaccination could result in anaphylaxis, an acute and potentially fatal systemic reaction. Elephants should be observed for one hour following vaccine administration. Treatment for anaphylaxis would be approximately 0.1 to 0.2 ml of 1:1,000 epinephrine per 100 lbs. body weight IM or SQ, or 0.25 to 0.5 mls of 1:10,000 dilution of epinephrine per 100 lbs. IV. These doses are extrapolated from equine recommendations.

Normal Vitals

No published normal values for neonates. See "Elephant Hand-Raising Notebook" for some examples.

- Temperature: Adults- 36 to 37^{o} C (97.5 to 99^{o} F) is normal. 38^{o} C (100^{o} F) or higher is elevated. Notebook: Oakland Zoo (OZ) calf no.1 temp. was between 36^{o} C and 37^{o} C taken over several months. Kaliningrad Zoo calf temp. was between 36.8^{o} C and 37^{o} C.
- Heart Rate: Adult average (unexcited) is 25 to 35 BPM. Notebook: OZ calf no.1 HR was 100 to 128 BPM during the first week.
- Respiratory rate: Adult, calm is 4 to 6 breaths/min. Adult, excited is 15 or more breaths/min. Notebook: OZ calf no. 1 rate was 22 breaths/min during the first week.

Normal Hematologic and Serum Chemistry Values

Refer to: *Normal hematologic values for young African Elephants with variations for sex and age*, Allen JL etal. Journal of Zoo Animal Medicine Vol. 16(3), p.98-101, 1985.
Blood gas values in juvenile Elephants, Heard DJ et al. Journal of the American Veterinary Medical Association, vol. 189 (9), p.1071-1074, 1986.
"Elephant Hand Raising Notebook", Kinzley, C., Oakland Zoo.
ISIS normals are available, however only for adults, separated by males, females, Africans, Asians.

Antibiotic Therapy

- Can be critical in neonates, especially in cases of FPT.
- No pharmacokinetic studies have been done comparing juvenile to adult elephants.
- Few studies have included captive African elephants, and the doses could vary.
- The number of elephants in the studies have been limited in number.
- Generally, however, the dosage ranges have correlated well with equine dose ranges, with the exception of Amikacin.
- The author prefers the use of ceftiofur, ampicillin, amoxicillin, or penicillin G; Amikacin or Gentocin in more severe infections, when hydration is maintained and if possible serum levels are measured. Do not use fluoroquinolones in growing animals. Avoid LA tetracycline due to the potential for muscle irritation or perivascular sloughing.

- Intramuscular or intravenous routes of administration are preferred to oral, due to the potential for iatrogenic diarrhea. Repeated IV doses in a calf would be difficult due to stress however, unless the calf was moribund.
- Table one offers approximate antibiotic doses. These should be used only as guidelines for use in infant elephants. See reference for further details.

Table 1. Antibiotic Therapy in Elephants (adults). Adapted from "Antibiotic Therapy in Elephants" in *Zoo and Wild Animal Medicine CT 4* by Fowler/Miller.[3]

A. Based on pharmacokinetic studies		**B. Based on doses reported only**	
Drug	Dose	Drug	Dose
Penicillin G	4545 IU/kg q 24 to 96 hrs IM; or 2272 IU/kg q 48 hrs IM	Ceftiofur (Naxcel)	2.2 to 4.4 mg/kg IM q 24 hrs IM; or 1.1 mg/kg q 24 hrs IM; or 1-2 mg/kg q 12 to 24 hrs IM. Do not use IV.
Amoxicillin	11 mg/kg IM q 24 hrs	Trimethoprim-sulfamethoxazole (TMZ-SMZ)	18.1 to 21.1 mg/kg q 12 to 24 hrs. Could cause diarrhea.
Ampicillin	8 mg/kg PO q8 to 12 hrs. Dose may be low for some organisms.**		
TMZ-SMZ	22 mg/kg IV or PO q12 hrs, for Asians. Do not use metabolic scaling. Safety of IV use in horses questioned.	Sulfadimethoxine/ormeto prim (Primor)	16.2 to 18.5 mg/kg q 12 h for one day, then 9.25 mg/kg q12 h; or 23.1 to 26.4 mg/kg q 12 h for one day, then 13.2 mg/kg q 12 hr.
Amikacin *	6 to 8 mg/kg IM q24 hrs. Potentially toxic.*	Amikacin*	4.4 to 4.7 mg/kg IV q 18 to 24 hrs.***
Gentamycin*	4.4 mg/kg IV or IM q 24 hrs. Potentially toxic.*		
Metronidazole	15 mg/kg/day as a rectal suppository		

* Aminoglycosides: potential for nephrotoxicity and ototoxicity. Use only when hydration is adequate. When possible, peak and trough serum levels should be measured. Note that this published gentamycin dose appears high and may result in high peak concentrations.

** Refer to the chapter Antibiotic Therapy in Elephants, *Zoo and Wild Animal Medicine,CT4,* by Fowler/Miller

*** The intravenous amikacin dose is based on the authors' experience.

[1] Fowler, ME: Zoo and Wild Animal Medicine. Philadelphia: W.B. Saunders, 1986.

[2] "Analysis of African Elephant Mature Milk in Early Lactation and Formulation of an Elephant Calf Milk Replacer", by J. Parrott, presented at the AAZV Conference, 1996.

[3] Fowler ME and Miller RE: Zoo and Wild Animal Medicine CT 4, Antibiotic Therapy in Elephants p.533. Philadelphia: W.B. Saunders, 1999.

[4] "The Elephant Hand Raising Notebook", compiled by Colleen Kinzley, Curator, Oakland Zoo, California USA, 1997.

[5] Mikota, MK: Medical Management of the Elephant. Michigan: Indira Publishing House, 1994.

CHAPTER TWO

The Changing Role of Hand Rearing in Zoo-Based Primate Breeding Programs

Ingrid Porton and Kelli Niebruegge

1. THE HISTORY OF HAND-REARING PRIMATES IN ZOOS

The husbandry of nonhuman primates in zoos and laboratories has improved significantly over the past 50 years, with concomitant improvements in the ability of captive primates to breed and successfully rear their own offspring. Nevertheless, there will always be a need for zoos to hand raise some infant primates. In the 1950s and 1960s nurseries devoted to hand rearing infant mammals became a prominent feature in zoos (Ogden and Kasielke, 2001). Reproductive success among the majority of exotic mammals was comparatively low relative to current conditions, and management strategies designed to increase the probability of infant survival were prioritized. For many species there was a zero risk policy and a mother was given little time to become comfortable and adjust her own behavior to that of the newborn infant. At the first indication of infant distress, managers rushed in to remove the neonate from its mother. Some zoos developed a policy of automatically hand rearing high-profile primates, especially the great apes.

The welfare of high-risk infants was not the only consideration when these nurseries were built. Humans caring for and playing with infants in view of the public was a recipe for an instantly successful exhibit. The popularity of nurseries as a zoo exhibit was evident in the number that were built (Ogden and Kasielke, 2001). Slow to mature and so much like human infants, nonhuman primate infants were particularly attractive exhibits. It was not unusual for zoos to prolong a young primate's stay in the nursery well past the age it could have been introduced to a social group. Indeed, an empty nursery was itself a motivation to remove an infant from its mother. In some cases, primates were purposefully hand reared so they could be tamed and used for shows or educational presentations (Taylor, 1978). That the interbirth interval of primates such as gorillas (*Gorilla gorilla gorilla*) was decreased was seen as an added benefit of hand rearing (Taylor, 1978).

The practice of hand rearing primates caused two problems. First, female primates that were raised by humans had no chance to learn parenting skills from their mothers. And second, zoo managers had no opportunity to see that first-time mothers can develop from awkward, rough, and seemingly dangerous caretakers to proficient parents. Thus, the hand rearing cycle continued.

A review of the early nursery literature from the zoo community reveals the focus of caring for the infant was almost exclusively on the physical aspects of hand rearing such as formulas, weight gain curves, and medical issues (e.g., Frueh, 1968; Kirchshofer *et al.*, 1968; Breznock *et al.*, 1979). Indeed, the primary emphasis when hand rearing an infant primate was to keep it alive. The overriding importance placed on a sterile, sanitary environment often translated into a sterile social environment for the infant. For some youngsters, socialization into an adult group was delayed until the individuals were fully capable of defending themselves, which placed them well into adolescence. Unfortunately, too many of these hand-reared primates exhibited stereotypic behaviors and were socially and/or sexually incompetent.

The zoo literature reveals a shifting attitude during the 1970s and 1980s. Increasingly, published articles drew attention to the social needs of all infants and particularly primates (Ott and Joslin, 1981; Miller, 1982; Collier, 1983). Forward-thinking professionals advocated the

investigation of alternative hand-rearing methods that allowed early socialization opportunities with peers and reintegration into adult groups at younger ages. Authors were clearly influenced by the findings of Harlow and colleagues (1971), who experimentally demonstrated the adverse and long-term negative consequences of social isolation upon primates.

Several influential papers helped change the ways in which nonhuman primates are hand reared in zoos. One change was an increased emphasis on encouraging and facilitating maternal rearing. Particularly valuable was the implementation of a 72-hr postpartum observation protocol for apes (Rosenthal, 1989) based on information that human neonates can survive for over 72 hr without nursing. As many ape infants were removed from their mothers precisely because nursing had not been observed in the first day, the protocol provided zoo managers with the confidence to leave infants with nonabusive mothers despite the absence of nursing. This approach was validated by earlier observations that chimpanzee (*Pan troglodytes*) mother/infant pairs sometimes need several days to synchronize their behaviors to facilitate nursing (Rogers and Davenport, 1969). Other methods to keep infant primates with their mothers included maternal skills training programs for apes (Joines, 1977; Keiter and Pichette, 1977; Schildkraut, 1982), distracting new mothers to allow nursing, or tranquilizing mothers to give the infant and dam more time to become accustomed to nursing (Ott and Joslin, 1981).

If infants could not be raised by their mothers, fostering them to an available lactating female was another approach advocated to avoid hand rearing. Examples of this technique were the successful fostering of rejected callitrichid infants in laboratories and the Los Angeles Zoo Marmoset Colony (Collier *et al.*, 1981). However, because zoos typically house fewer individuals per species than, for example, primate laboratories, fostering is more difficult to achieve.

Other important changes in philosophy included the actual methods used to hand rear infant primates. Maple (1980) challenged the idea that extensive human contact with great ape infants was detrimental to their social and psychological development. A concern held by many nursery personnel was that frequent and prolonged interactions with an infant would result in imprinted individuals unable to function appropriately

with conspecifics. Maple (1980) suggested that it was better for caretakers to more closely mimic the amount of social contact infant apes receive from their mothers and, if limited staff prevented realization of the goal, he recommended that volunteers be used.

Peer rearing of infants was recommended as one method to facilitate early and safe exposure to conspecifics. Bringing the infant(s) to the adult facility to gain familiarity with the sight, sound, and smell of adults was viewed as a component of the socialization process. Some (e.g., Meyer and Wilcox, 1982) advocated that infants be moved from the nursery into the adult facility and then into the adult group as soon as possible.

Although these approaches were promoted in the early 1980s, it took time for zoo managers to become comfortable with the added risks associated with these methods. For these procedures to become the norm rather than the exception, they first needed to produce a credible record of positive results. A significant development that advanced best-methods practices was the emergence within zoos of cooperatively managed breeding programs such as the American Zoo and Aquarium Association's (AZA) Species Survival Plan (SSP®). These programs manage all the individuals housed in participating institutions as one population. The SSP® population is genetically and demographically managed through analysis of studbook records and issuance of yearly breeding recommendations. In addition, SSP® Committees are charged with attending to behavioral and husbandry issues. Many of the primate SSP® programs (e.g., Gorilla, Chimpanzee, Golden Lion Tamarin, *Leontopithecus rosali*) directly addressed the hand-rearing issue and developed goals to eliminate all unnecessary hand rearing. In the instances when hand rearing was required, the objective became early resocialization of infants with conspecifics (Porton, 1992 and 1997). SSP® programs also coordinated interzoo transfers of infants to establish peer groups or facilitate the infant's integration into a more appropriate foster group.

2. RESOCIALIZATION GOALS AND TECHNIQUES

The emphasis that zoo professionals have placed on developing hand-rearing protocols that aim to produce socially and sexually competent adults is driven by two goals. One is to increasingly provide for the well-

being of all the animals housed in AZA zoos. Lacking certain social skills, some hand-reared primates may be peripherilized from their social group, subjected to a higher proportion of aggression, and/or exposed to higher levels of stress or depression. Zoo professionals endeavor to develop hand-rearing protocols that do not produce individuals compromised by abnormal or neurotic behaviors.

The second goal is to reduce the number of individuals that are either nonreproductive or have special housing requirements. Zoos face a space crunch. The number of breeding programs that zoos can manage is limited by space (Earnhardt *et al.*, 2001). A minimum viable population size is calculated for each managed program and that figure is used to determine the total number of programs that can be accommodated in participating zoos. Dysfunctional hand-reared individuals that are reproductively incompetent decrease the ratio of effective population size to actual population size and thereby unnecessarily increase the population size required to reach program goals. These individuals may also need special housing accommodations if they cannot live compatibly and safely in social groups. Transferring such individuals outside of AZA zoos is also limited because more stringent disposition policies prevent sending primates to facilities that do not meet AZA housing and care standards.

To achieve their goal, primate managers have pushed the limits to improve resocialization techniques used in zoos. Although infants removed from their mothers and raised by humans are all termed "hand reared," the amount of time infants are exclusively in human care varies to such a degree that the term has become misleading. In reality, there is a large continuum and in some cases the distinction between mother reared and hand reared is becoming increasingly blurred. New terms should be coined to capture these differences and add clarity to discussions. Several examples can illustrate the point. A Sumatran orangutan (*Pongo pygmaeus abelii*) at the Brookfield Zoo was removed from its mother at 1 week for hand rearing. The Brookfield staff developed a training program for the mother and infant with the purpose of reuniting the pair as soon as the infant could be fed reliably with a bottle. When strong enough, the infant was trained to cling to a wiremesh panel while nursing at the bottle; the mother, meanwhile, was trained to stay at the front of its cage while the infant nursed. Familiarity between mother and

infant was maintained through the training sessions, and at 5 months the infant was returned to its mother (Sodaro and Weber, 2000). Although fed by the keepers, the infant was mother reared from that time on.

Black lemur (*Eulemur macaco macaco*) and black-and-white ruffed lemur (*Varecia variegata*) infants that had to be hand reared at the Saint Louis Zoo were fostered into a family group as young as 6 weeks of age. In the case of the black lemurs, the staff took advantage of the foster mother's tolerance of humans and entered the exhibit with the lemurs to continue feeding formula to the reintegrated infants (Knobbe, 1991). Provisioning formula after reintroducing a litter of three 6-week-old ruffed lemurs to their parents and older sibling was solved by building a creep feeder, which the infants readily entered to obtain their designated diet (I. Porton, unpublished observations).

These days, fewer primate infants are being hand reared in isolation from adult conspecifics. Rather, temporary nursery areas are often set up in the same facility in which the adult group is housed. For example, at the Toledo Zoo, a gorilla infant was carried in a sling whenever possible while the keepers worked in the great ape facility. Periodically the infant was shown to the adult gorillas to encourage interest and interaction (Petiniot *et al.*, 1988). Two 3-month-old chimpanzee females from two different zoos were transferred to the Saint Louis Zoo for peer socialization and eventual integration into an adult group. Whereas previous chimpanzees were raised in the Children's Zoo Nursery, these infants were reared by the keepers and a group of docents in the holding cage next to the adults. The infants were thoroughly familiar with their future family and facility well before the physical introduction was carried out (Knobbe and Porton, 2001). Methods for hand rearing Goeldi's monkey (*Callimico goeldii*) at the Brookfield Zoo were modified in the 1990s. As soon as the infant is removed from its mother, it is housed first in an incubator and later in a wire "howdy" cage that sits directly in the parents' cage (Sodaro, 2000).

3. EVALUATION OF HAND-REARED PRIMATES

Despite the number of primates that have been handreared in zoos, there are surprisingly few population level analyses evaluating the outcome of these procedures. Systematic behavioral research comparing the behav-

ior of hand-reared versus parent-reared individuals is rare, as is studbook-based analysis comparing the reproductive rates of hand-reared versus parent-reared primates. Research using studbook records can be hindered by missing data on rearing history, insufficient information on reproductive opportunities, and small sample size. Small sample size also restricts more detailed comparisons between hand-rearing methods and subsequent adult social behavior.

The species for which there is the most information on the consequences of hand rearing is the western lowland gorilla. This is due to the large proportion of gorillas that has been hand reared in zoos, the popularity of gorillas, and the desire by managers to understand the causes of reproductive and parental deficiencies. The first investigation found that mother-reared female gorillas were significantly more likely to copulate and raise their offspring than hand-reared females (Beck and Power, 1988). No statistical difference was evident in the copulatory behavior of hand-reared versus parent-reared males but the sample size was small. A study of the international studbook data revealed similar results for females and also showed that hand-reared males were less successful reproductively than their parent-reared counterparts (Meder, 1993). An updated analysis of the Gorilla SSP® population again confirmed that mother-reared male and female gorillas were more successful reproductively than hand-reared individuals (Ryan *et al.*, 2002). Hand-reared gorillas are more likely than mother-reared gorillas to exhibit solitary play, self-directed behaviors, regurgitation and reingestion, and inappropriate aggressive behavior towards same-age or adult conspecifics (Meder, 1989; Olson and Gold, 1985; Gold, 1992).

In a study of copulatory behavior in zoo-born male chimpanzees, 54% of those that were hand reared with peers showed appropriate copulatory behavior versus just 30% of the males that were raised in isolation from conspecifics (King and Mellen, 1994). Thus, hand rearing of male chimpanzees without access to peers produces adults that are very likely to be sexually incompetent.

In a study of captive golden lion tamarins, parent rearing significantly increased offspring survival rates to both 7 days and 16 months of age (Rettberg-Beck and Ballou, 1988). Of 101 tamarins that were hand reared, 32 lived to breeding age. Of these, 15 were allowed to breed, 13

with a parent-reared mate and two with each other. Eight of the ten males and two of the five females bred. The pair comprised of two hand-reared individuals did not produce young but did copulate. Overall, hand-reared tamarins were less reproductively successful than their parent-reared conspecifics, but the results were not statistically significant. Unexpectedly, infants reared without a sibling were more successful breeders than peer-reared infants (Rettberg-Beck and Ballou, 1988).

In another chapter in this volume, we used studbook and survey data to show that parent-reared black-and-white ruffed lemurs, red ruffed lemurs (*Varecia rubra*), and black lemurs were more successful reproductively than their hand-reared counterparts. Nevertheless, over 60% of the male and female hand-reared ruffed lemurs and female black lemurs were reproductively competent.

None of the above studies focused on the effect of methods used to resocialize hand-reared infants on adult reproductive performance. It is likely, however, that the greater emphasis placed on resocializing primate infants at a younger age has contributed to the improved reproductive success observed in hand-reared zoo primates.

4. SUMMARY

Over the past 50 years, zoo managers have displayed many changes in their attitude towards hand rearing of nonhuman primates and in their choice of methods when hand-rearing is necessary. Today most zoos hand rear primates only when it is absolutely necessary. Resocializing infants at a young age is a priority, and many innovative management strategies to accomplish this goal have proven successful. There are numerous opportunities for research that will help guide further improvements including retrospective research using studbook data. Such research would greatly benefit from better management records that could provide the needed data with which to evaluate resocialization techniques. Research aimed at understanding the impact of hand rearing on social behaviors other than reproduction is also encouraged, for the primary goal of zoo management must be the overall welfare of each animal.

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'Stereotypic Animal Behaviour – Fundamentals and Applications for Welfare'

Deprived Environments: Developmental insights from Primatology
Melinda NOVAK, Jerrold MEYER, Corinne LUTZ and Stefan TIEFENBACHER

For primates, being deprived of maternal care has major effects. Some accounts of maternal loss come from primates hand-reared in zoos, but most data stem from the research of Harlow and colleagues several decades ago. Here, work on social deprivation included the raising of rhesus infants for the first months of life without mothers or peers: these unfortunate animals grew up to spend spent much of their time in stereotypic behaviour. Some early forms seemed to mimic the mother-infant interactions these infants could not experience, e.g.self-clasping and digit-sucking apparently reflecting the loss of physical contact and diminished opportunities to suckle. However, frustrated motivations were not the whole story.
As the monkeys matured, these behaviours were replaced by new abnormalities such as somersaults, head bobs and sometimes injurious behaviours like self-biting (disturbing activities which, paradoxically, may actually help these animals cope with acute stress).
Furthermore, they showed additional changes including poor abilities to extinguish learnt responses (cf. the perseveration described in the previous chapter), heightened fearfulness, and long-lasting disturbances of forebrain serotinergic and dopaminergic function. Early social deprivation is not the only cause of primate abnormal behaviour: isolating or otherwise stressing normally-reared animals can also induce it. However, it is clear that maternal separation has particularly profound and long-lasting effects. Two contributed boxes build on these findings to discuss findings on the appallingly deprived 'orphan' children discovered in Romania in the early 1990s, and the possible role of maternal deprivation elsewhere, such as in the stereotypic behaviours of farm animals.

Knut: A polar bear story

The death of Knut, the world's most famous polar bear, has reopened the debate on the ethical minefield of man's relationship with wild animals. So should polar bears be kept in zoos, asks Tom de Castella.

Knut was born in Berlin Zoo in December 2006. Rejected by his mother, he was put in an incubator and brought up by humans.

His abandonment, cute looks and close relationship with the charismatic zookeeper Thomas Doerflein, turned him into a huge star. He became an environmental symbol, acting as a mascot for the German government's campaign against climate change and being superimposed into a photograph with Leonardo DiCaprio for Vanity Fair's Green Issue in May 2007.

But news of his premature death at the weekend has spurred on those who question both the way Knut was treated and the very fact polar bears are in zoos at all.

While polar bears can live to 30 years old, Knut was only four years and three months when he died. A post-mortem examination suggested the cause of death was brain damage, but already there **have been accusations from animal rights groups**.

From the word go, Knut's life was controversial. Shortly after his birth, the **German media reported** that an animal rights campaigner was calling for him to be put down rather than brought up by humans. It prompted a huge groundswell of sympathy for the bear, which never went away.

For Andrew Linzey, director of the Oxford Centre for Animal Ethics, it is a tragic tale from start to finish.

"Frankly, it would have been better for Knut not to have existed at all than live such a miserable life."

Those who questioned the implications of Knut's hand-rearing have suggested he suffered inevitable behavioural problems as a result both of his treatment and the crowds at the zoo.

But Linzey, author of Why Animal Suffering Matters, believes the issue is not whether the zoo was right to hand rear Knut. Once the cub was born, the management had a duty to hand rear him because a zoo is an artificial, "controlled environment".

The fundamental problem is wild animals being kept in captivity at all, he argues. "Zoos impose unnatural lives on most of their captives. People just see a cuddly bear and they want to gawk at him, but what they should see is an animal deprived of its natural life, exhibited for entertainment and profit."

And profit became a big part of Knut's short life. In 2007 alone Berlin Zoo made an estimated five million euros through increased ticket and merchandising sales. Hundreds of fluffy white toys were sold every day across the city, newspapers offered Knut figurines for 148 Euros and in 2008 a movie, Knut and His Friends, opened in cinemas across Germany.

Knut's life was about celebrity rather than natural history, says Ian Redmond, a consultant to the Born Free Foundation's polar bear project in Canada.

"It does seem to highlight the dichotomy of people who love this one polar bear in particular and those who care about polar bears right across the species."

He sees little point in keeping large powerful animals in captivity. Not only do they lead "unfulfilled lives", but bears bred in zoos cannot be reintroduced to the wild as they lose the skills necessary to survive.

And those creatures bred in zoos become less and less like the wild animals we admire from natural history programmes, majestically leaping from ice floe to ice floe.

"As you breed in zoos down the generations you're getting further and further away from polar bear behaviour in the wild," argues Redmond. "You might be breeding out the traits that allow it to survive in the wild. What's the point? If you want cute cuddly bears for merchandising then that's a commodity."

In Knut's case critics suggested he had developed odd behavioural traits and had come to find the presence of the crowds necessary.

In recent years all but one British zoo has stopped keeping polar bears, a decision Redmond urges Berlin to follow.

But at the Highland Wildlife Park near Aviemore, Britain's only zoo to have polar bears, they are going in the opposite direction. The park has an elderly female and a young male, and when the former dies there are plans to bring in a young female so that mating can begin.

Douglas Richardson, the zoo's animal collection manager, says they have learnt lessons from the past. In the 1980s polar bears became "the poster child" for anti-zoo movement after being kept in cramped concrete pits whose only attempt at recreating the bear's eco-system was white paint.

"I came up with a design that gives the animals between five and six acres of fenced off rolling landscape in the middle of the Highlands."

Richardson said that that much of the criticism of Berlin Zoo - such as over their merchandising policy - was unjustified.

"The European Zoo community pumps the money it earns from merchandise back into conservation in the field. I guarantee that when we have cubs the giftshop here will be full of fluffy polar bear toys and that money will be going to conservation. You have to take advantage of the situation. The money is not going to line someone's pockets."

The wildlife broadcaster Chris Packham acknowledges that a polar bear in captivity loses the ability to relate to bears in the wild. And he believes that if wild polar bears die out there is no point keeping some alive in zoos.

But he argues that zoos have a crucial advocacy role for animals in the wild. And if a zoo is treating the bear well - as he believes Berlin Zoo was with Knut - then keeping some in captivity is a price worth paying.

"We don't need many polar bears in captivity. But sacrificing those animals is justified as they become ambassadors for their species, striking awe into the hearts of humans. We don't want bears and tigers to go extinct."

The immediacy of zoo animals will always wow children and adults in a way that television documentaries cannot, he says.

"I can still remember aged 12 going to the zoo and seeing a tiger for the first time. I could barely speak I was so in awe of the animal."

That has benefits not just for raising awareness about wild polar bears but for dramatising the issue of climate change. Many people might find it hard to visualise abstract notions such as a two degree temperature rise in 50 years' time. But the polar bear losing the ice it relies on for hunting seals, is a story that we can all understand, he says.

"The long-term prognosis is tough for polar bears. So I'd argue that if Knut attracted a million people to see him and they were impressed by what they saw that is the most important role that a zoo can play."

RAISING BABIES BY HAND

Sometimes, animal parents aren't up to the job. Then a hand-rearing team steps in.

By Kerry Gildea Beck

Newborns at the Zoo may look cute and cuddly, but many have razor-sharp claws, fierce fangs, and tricky temperaments. And some of the moms may neglect or even kill their babies rather than nurse or care for them. That’s when Zoo experts with some real hands-on experience step in.

Keeper Jillian Fazio tends to a red panda cub *(Mehgan Murphy/NZP)*

Some of the Zoo’s infants must be “pulled,” or taken away from their mother after birth, to survive. A new mother may not always harm a newborn, but often she simply cannot provide what it needs. The specialized staff who care for the Zoo’s babies have paved the way in raising exotic birds from Africa and New Zealand, clouded leopards and red pandas from Asia, and even one prickly little South American porcupine.

Hand-rearing an animal infant is akin to the initial weeks of caring for a human baby. Some days are joyful; others are filled with fear and worry. Feeding

routines can be erratic. There are too many sleepless nights to count.

A prehensile-tailed porcupine snacks on a bit of fruit.*(Mehgan Murphy/NZP)*

Porcupine Problems

Dell Guglielmo, a keeper from the Small Mammal House, knows the drill well. In August 2009, time was running out for a tiny newborn prehensile-tailed porcupine named Clark. Just days after his birth, he seemed weak. Two weeks later, the little guy still refused to eat, and prospects for his survival were bleak. Guglielmo says she and Stacey Tabellario, a keeper now at Asia Trail, worked tirelessly with the Zoo's Department of Animal Health, but weren't seeing any improvement from the little ball of rust colored hair just starting to form quills.

Soon after Clark was born, Guglielmo had realized something wasn't right. These nocturnal animals nurse for very short periods, making it next to impossible to monitor nighttime nursing. But Clark wasn't gaining weight and was growing weaker every day. He was medicated for an intestinal problem, and his keepers needed to get him to eat somehow—and fast. From the start, they knew handling a porcupine was not going to be easy.

“Normally in hand-rearing you’d hold the baby animal in a blanket or cradle it like a mother would hold a human baby, but that’s a real challenge when you’re dealing with a porcupine,” Guglielmo says. “That’s not how they nurse and it’s not natural for them.”

When porcupines nurse, the mother and the baby stand up, facing each other. It almost looks like they’re playing patty-cake before the baby moves underneath to get at the milk. Trying to replicate this routine, Guglielmo brought in a wooden perch that she used to show off porcupines for Zoo visitors. She hoped Clark would sit on the perch so she could feed him formula with a syringe. The perch worked well enough, but he still wasn’t interested in eating. Then a little bit of banana saved the day.

Adult porcupines love banana, and Clark did too. When Guglielmo and the Zoo nutrition staff added some banana to his formula, Clark finally turned the corner. To accommodate his growing teeth, they also designed an extra thick nipple for his bottle. Guglielmo’s life went on hold for almost two months, but she says she’d do it all again in a heartbeat.

Keeper Dell Guglielmo tends a young porcupine. *(Jessie Cohen/NZP)*

“I had no idea how labor-intensive it could be taking care of this guy,” Guglielmo says, feeding Clark, now a healthy two-year-old, a slice of his favorite yellow fruit. “The effort to help him survive involved curators, keepers,

veterinary staff, nutritionists, and even the Zoo police who opened the gates for us in the middle of the night. “Today he’s doing great, and he still loves his bananas.”

Caring for Cats

In the porcupine’s case, the Zoo staff stepped in to save an individual animal that was sick and needed special care, but hand-rearing also is a component of larger efforts to save endangered species around the world. For example, today all of the clouded leopards born in North America are hand-reared.

Clouded leopard mothers often either ignore or hurt their cubs, and in either case cubs can die, explains Kenneth Lang, senior mammal keeper at the Smithsonian Conservation Biology Institute (SCBI) headquarters in Front Royal. Lang is an expert at hand-rearing. Through it, he says, the Zoo can maintain a captive population of these endangered animals who “become ambassadors for their parts of the world where conservation is very badly needed.” Clouded leopard infants have a 47 percent survival rate, which soars to 99 percent if the cats are hand-reared. Over the past 30 years, SCBI has been responsible for more than 70 clouded leopard cubs.

A veterinarian examines a clouded leopard cub. *(Mehgan*

Murphy/NZP)

Clouded leopards are also shy and very easily stressed. But through the handrearing process, barriers come down, and keepers have an easier time managing and breeding the cats. “We can actually sit in the enclosure like a piece of furniture when they interact with each other,” Lang says. “That allows us to head off aggression and at the same time not distract the cubs from interacting with each other.” Strict protocols are in place to ensure an animal does not become too “imprinted” on a human and then is not able to relate to its own species or breed later on. “We feed them, burp them, and put them back to sleep,” Lang says. “We don’t try to make them pets. We’ve done generations of hand-rearing, and we’ve never had a breeding problem with the clouded leopards.”

Acknowledging there is a high “cute factor” in handling baby animals, keepers stress they never handle the cubs for the sake of handling them. “We’re not doing this because we want to or because they’re cute,” says former keeper Jilian Fazio, who has hand-reared a number of clouded leopards, red pandas, and leopard cats. “This is what the species needs to maintain a sustainable captive population. Every animal is so important, and much of what we learn from them is critical to their survival and management in the wild.” Aside from a sniff or two around the enclosure or nest boxes, animal moms rarely notice the babies are removed. The human handlers tend to show more of a reaction and aren’t shy about bragging about the new kids. “When the cubs are first born,

every time we pull them it's emotional," says Jessica Kordell, a member of the clouded leopard team. "Each time it's a different experience, and their personalities are so different. We learn what's special about each one. It's amazing how quickly they learn."

The cubs are very particular about who's taking care of them, and they don't like change. The more experienced members of the staff start the process, and newer members rotate in during the weeks that follow so the animals follow the same routine over a six-to-nine-month period.

Bird Breeding

In some parts of the Zoo, hand-rearing starts long before the baby arrives. "Handrearing starts the day we bring the egg downstairs to the incubator," says Sara Hallager, who has hand-reared about 50 kori bustard chicks at the Bird House since the first one hatched here in 1997. "We treat that egg like it's the new chick."

Kori bustards are the world's heaviest flying birds, with males weighing up to 18 kilograms. They are native to the grasslands of eastern and southern Africa. There are 25 species of bustard, most of which are in decline.

A keeper hand-feeds a kori bustard chick. *(Mehgan*

Murphy/NZP) Hallager and other keepers monitor a kori bustard egg for 21 days, controlling heat and humidity because large fluctuations can be lethal. Around day 23, the egg starts rocking, and a chick, no bigger than 100 grams, breaks out—wet and exhausted. Next the chick is moved to a brooder box, where a feather duster temporarily replicates a mom. Twelve hours later, it's time for a first feeding of crickets along with watermelon for good hydration.

The Association of Zoos and Aquariums has honored the Zoo's work raising koris. Hallager hopes the lessons learned from the koris can be applied to other varieties of large bustards—such as the great Indian bustard, estimated to have a mere 300 remaining in the wild.

"Koris are an indicator species of what's happening in the savanna ecosystem," she says. "The world's largest flying birds can tell a great story of Africa, where illegal hunting and habitat loss are a threat to all species."

In New Zealand, kiwi parents bring new meaning to the term "empty nester." They have nothing at all to do with their chicks. "Kiwi parents don't rear their young," explains keeper Kathy Brader, who handrears kiwis. "Leaving the young with the parents can be quite dangerous because the parents can kill them in about three or four days. In the wild they tend to live in family groups, but the babies move to a different territory from their parents early on. And they're really helpless when they hatch."

Typically an enormous kiwi egg is pulled from beneath the father, who sits on the egg instead of the mother. After the chick hatches, it's placed in a special isolette box padded with soft towels. The little chick snuggles there until it's able to stand and walk, about six days later. Next the kiwi is moved to a brooder box. Getting the right food mix can involve a lot of trial and error, says Brader, noting that one chick she cared for ate much better when a bit of canned dog food with gravy was added to the menu.

A freshly hatched kiwi rests after the effort of breaking its shell. *(Mehgan Murphy/NZP)*

New Zealand's Operation Nest Egg program is one of the most successful efforts in the world to save a species, Brader notes, adding that she hopes people learn the kiwi's story from the work being done here. Even many New Zealanders, she says, tune in to the Zoo's kiwi cam to get a peek at the funky-looking bird.

"Kiwis have been on the planet for 65 million years, around the time the dinosaurs died out," she remarks. "There aren't many animals we can say that about. I think we have an obligation as stewards of this planet to preserve as much as we can. I hope people think not only about the kiwi, but what they can do in their own backyards to preserve the birds they have at home."

When asked how she handles the work and the worry involved in raising these one-of-a-kind birds, Brader sounds a lot like a mom. "I have a

connection to them," she says with a chuckle. "Why do we love the people we love? Why do some people love dogs and others love cats? I love working with all my kiwis. It's just a real privilege. They're in my heart and soul."

—*Freelance writer* KERRY GILDEA BECK *is a volunteeer interpreter at the Amazonia exhibit*

Should humans be able to touch zoo animals?

The controversial Zoo De Lujan in Argentina allows visitors to interact with the animals in their cages.

If you shudder at the thought of encountering lions and tigers and bears -- oh, my! -- then Argentina's Zoo De Lujan is definitely not the place for you.

The controversial zoo allows visitors to enter cages to pet, play with and bottle-feed their animals. Many people have posted videos and photos of their encounters online.

Zoo De Lujan bills itself as being unique and innovative on its website, and adds that their distinct taming process has distinguished the zoo since it was founded in 1994.

"We raise these animals from the day they are born," explained Jorge Semino, the zoo's director, in a Spanish-language video.

Semino added that the zoo keepers help deliver the babies, and then hold them in their hands while the mothers groom them for the first time.

"We incorporate ourselves from the day they are born. They have contact with our hands, listen to our voices - because for several days they don't see, they have their eyes closed - and we share the first moments of life with the mother."

Semino adds that the zoo keepers make sure all the offspring get equal access to their mother's milk to curb the aggression that comes with competing for food. They also interact with dogs who are friendly with humans.

"The baby becomes social with other species," said Semino, adding that constant contact is an important part of the taming process.

The babies are also hand-fed meat so that they learn to distinguish between the food and the zoo keeper's hand, and they interact with a range of other animals -- from turtles to cats to ducks -- to learn not to attack distinct species.

But critics remain unconvinced, and blast the zoo's practices as dangerous and abnormal.

The Born Free Foundation, which started a petition against the zoo, called on authorities to launch an investigation against its keepers.

"The zoo is, in my view, placing the lives of its visitors at great risk by encouraging them to have 'close encounters' with dangerous, potentially lethal, wild animals," said Will Travers, the foundation's CEO.

"Anyone who has any knowledge of big cats will understand that they are wild animals and, as such, as unpredictable."
The foundation referenced previous incidents during which people were attacked by supposedly tame animals.

Other animal rights groups, like Association for the Defence of the Rights of Animals and Association SOS Vida, have also condemned the zoo.

The dangers of wildlife imprinting

Wildlife imprinting is a form of associative learning where an animal rapidly learns to recognize an individual (or object or location) as a parent substitute or companion and associates this as a form of reward or positive experience. The wildlife become dependent or fixated on humans and it is difficult at best or impossible at worst to reverse.

Humans tend to personify animals by giving that animal human traits or emotions. It is why the human race has such a close relationship to pets. In rehabilitating wildlife, in which we plan to release back out in the wild, it is imperative that we not imprint them while they are in captivity. Wildlife that has become imprinted by humans are not only dangerous to humans but to themselves as well. The imprinted animals often become too tame and they lose their self-protecting fear of people causing problems such as attacks on humans, and disturbance or nuisance of wildlife in high populated areas. They also will allow natural predators and humans to get to close to them often causing death or harm. If it becomes fearless of humans and natural predators, this often decreases its probability of survival.

Avoiding imprinting is imperative to an animal that is to be released back into the wild. Taking a hands-off approach is often the best technique. An animal should be left to its own devices as much as possible. Refrain from handling the animal, except when absolutely necessary, and keep the animal from seeing humans and hearing voices by not talking to the animal or standing around the cage for long periods of time. When speaking in the animals presence, keep it to a whisper. Keeping the enclosure or cage covered or blocked so the animal doesn't respond or react to humans is also recommended. The animal that has the least amount of contact with humans is the one that has the best chances of survival when place back into the wild.