Manteniment dels animals en parcs zoològics: legislació i enriquiment

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I. INTRODUCCIÓ

Quins són els aspectes de les recintes dels parcs zoològics que es regulen a nivell legal? Quins mínims han de complir les instal·lacions dels animals? La llei obliga a estimular-los d'alguna manera?

Aquestes són algunes de les preguntes que se'ns varen platenjar alhora de fer el treball i, les quals s'intentaran contestar al llarg d'aquest. A continuació es presenten les diferents parts del treball i l'objectiu d'aquestes.

Disposicions legals

En aquest apartat s'exposen les diferents disposicions de caire legal que regulen el manteniment dels animals en parcs zoològics. Només es citen les parts més importants a destacar de les normatives i, seguidament es presenta un petit cas per tal de poder donar pas a una breu discussió.

Enriquiment i estudi comportamental

Què és l'enriquiment? En què consisteix? Quins tipus existeixen? Aquestes són algunes de les preguntes que s'intenten respondre en aquest bloc. Per tal de poder aprofundir més en el tema en qüestió s'han triat dues espècies (tigre i ós), de les quals també s'ha desenvolupat un petit estudi de comportament en les instal·lacions zoològiques.

Enquestes

Per tal de poder reflectir el coneixement i l'opinió que té la població sobre les disposicions legals existents i vigents i sobre l'enriquiment en general així com què en pensen dels parcs zoològics com a tal, es van realitzar una sèrie d'enquestes, les quals s'analitzen en aquest apartat per tal del poder reflectir una mica millor la realitat social.

Entrevista

En aquest bloc, es pot trobar una entrevista molt breu que es va realitzar per tal de poder tenir més informació sobre els aspectes tractats en el treball que es poden observar en la realitat del dia a dia d'un parc zoològic.

II. DISPOSICIONS LEGALS

En aquest apartat s'esmentaran les diferents disposicions legals que existeixen actualment i que són vigents, les quals regulen aspectes importants del manteniment dels animals en parcs zoològics. Es farà només un breu resum, destacant les parts més importants de cada directiva, ordre o llei. La totalitat d'aquestes es podrà trobar en l'Annex I.

2.1.- Directiva Europea

DIRECTIVA 1999/22/CE DEL CONSELL del 29 de març de 1999 relativa al manteniment d'animals salvatges en parcs zoològics

En la Directiva de la UE només un paràgraf de l'Article 3 contempla el manteniment dels animals en els parcs zoològics.

Article 3. Requisits aplicables als parcs zoològics.

- allotjament dels animals en condicions que persegueixin la satisfacció de les necessitats biològiques o de conservació de cada espècie, entre altres coses proporcionant a les espècies els recintes adequats a cada una d'elles i mantenint un nivell elevat en la cria d'animals, amb un programa avançat d'atenció veterinària preventiva i curativa i de nutrició.

Els altres contemplen la descripció i funcions que ha de dur a terme un parc zoològic com a tal, altres requisits com poden ser el registre d'animals i la prevenció de fugida d'aquests i condicions d'autorització, inspecció, tancament i sancions aplicables als parcs zoològics, així com les autoritats competents que han de dur a terme aquesta feina i per últim, l'aplicació i entrada en vigor de dita Directiva.

2.2.- Llei Espanyola

Adopció de la Directiva 1999/22/CE del 29 de març de 1999 relativa al manteniment d'animals salvatges en parcs zoològics.

El 27 d'octubre del 2003, es va aprovar a Madrid la llei que adoptava la Directiva Europea referent al manteniment d'animals salvatges en parcs zoològics. Com és lògic pensar aquesta llei disposa dels mateixos articles i, el contingut n'és el mateix. Tot i així, referent a l'article 3, el qual ja s'ha esmentat en la Directiva Europea, la manera d'esposar-lo és lleugerament diferent, per la qual cosa es creu que val la pena tornar-lo a citar.

CAPÍTOL II. MESURES DE CONSERVACIÓ.

Article 3. Mesures de benestar animal, profilàctiques i ambientals.

Els parcs zoològics queden obligats al compliment de les mesures de benestar dels animals en captivitat, profilàctiques i ambientals indicades a continuació i, en el seu cas, a les establertes per les comunitats autònomes:

a.- Allotjar els animals en condicions que permetin la satisfacció de les seves necessitats biològiques i de conservació.

b.- Proporcionar a cada una de les espècies un enriquiment ambiental de les seves instal·lacions i recintes, amb l'objectiu de diversificar les pautes de comportament que utilitzen els animals per interaccionar amb el seu entorn, millorar el seu benestar i, amb això, la seva capacitat de supervivència i reproducció.

c- Prevenir la transmissió de plagues i paràsits de procedència exterior als animals del parc zoològic i, d'aquests a les espècies existents fora del parc.

En quan a l'aspecte veterinari que en la Directiva Europea també es contempla en l'article 3, en el cas de la Llei Espanyola, es troba en l'article 4.

Article 4. Programes

c.- Programa avançat d'atenció veterinària, que comprengui:

1.- El desenvolupament de mesures destinades a evitar o reduir l'exposició dels animals del parc zoològic als agents patògens i paràsits, a enfortir la resistència immunològica i a impedir els traumatismes i intoxicacions.

2.- L'assistència clínica dels animals del parc zoològic que estiguin malalts, per mitjà de tractaments veterinaris o quirúrgics adequats, així com la revisió veterinària periòdica dels animals sans.

3.- Un pla de nutrició adequada dels animals.

En la resta d'articles de la Llei, s'hi troben les adaptacions de la Directiva Europea però, cal dir que en la Llei Espanyola s'hi troben Disposicions addicionals, transitòria i finals, que no es reflexen en la Directiva Europea.

2.3.- Llei Catalana

El 23 de desembre de 1991, la Generalitat de Catalunya va fer una llei a través del D.A.R.P. (Departament d'Agricultura, Ramaderia i Pesca), per tal de poder establir les mesures necessàries per al manteniment d'animals salvatges en captivitat. Aquesta llei es va fer sabent que la Comunitat Europea estava elaborant un Decret en aquest mateix sentint però, es va voler establir el més aviat possible un seguit de mesures de seguretat per tal de poder evitar possibles accidents. Així doncs, aquesta llei no estableix quines han de ser les

condicions de manteniment dels animals com a tal, sinó les mesures de seguretat que s'han de tenir en compte, les quals però també influeixen de manera molt notòria en el disseny de les seves instal·lacions. És per aquest motiu doncs, que a continuació es citen les parts més importants en referència en lo dit anteriorment.

Aquests nuclis són susceptibles de mantenir animals salvatges potencialment perillosos per a la integritat física o la seguretat de les persones. Es fa necessari, doncs, establir una normativa que reguli les condicions mínimes de seguretat que han de reunir les instal·lacions on es mantenen aquest tipus d'animals, per tal de prevenir possibles accidents.

A causa de la gran varietat d'espècies animals potencialment perilloses, de les moltes possibles diferències i particularitats individuals quant a mida, historial, estat d'amansiment, sexe, edat i comportament i de les condicions ambientals de l'indret on es poden ubicar les instal·lacions, es fa inviable establir unes normes de caràcter particular i concret per a cada una de les espècies i circumstàncies, les quals no podrien preveure mai tots els diferents supòsits que es podrien donar.

Quan a les normes de seguretat de caràcter general, es tindran en compte com a paràmetres el comportament i la capacitat física normals d'un animal adult de l'espècie de què es tracti, llevat del cas d'instal·lacions dedicades només a cries, en les quals es tindran en compte els paràmetres d'aquestes.

ANNEX. Normes de seguretat de caràcter general per a nuclis zoològics.

Els entorns d'instal·lacions per a animals es dissenyaran i construiran de manera que no permetin la sortida dels espècimens, atenent les característiques normals de cada espècie.

Quan aquests entorns consisteixin en tanques, aquestes seran prou consistents i estaran ben fixades per suportar el pes i la pressió de l'animal.

Quan aquests entorns siguin fossats (secs o d'aigua), es col·locaran barreres adequades per impedir que el públic s'hi acosti de manera perillosa.

Les portes de les instal·lacions seran tan resistents o efectives com la resta de l'entorn, i es dissenyaran per evitar que els animals les desencaixin o bé puguin obrir els mecanismes de seguretat.

Les portes d'instal·lacions d'animals perillosos es bloquejaran quan estiguin tancades.

Quan sigui possible el contacte directe entre un animal perillós i el públic per sobre o a través d'un entorn d'instal·lació, s'instal·larà una barrera de separació prou endarrera per evitar aquest contacte.

En qualsevol instal·lació on hi hagi animals perillosos i la possibilitat de creuar una barrera de separació, hi haurà el nombre convenient de rètols indicadors d'aquesta circumstància.

La resta de Llei, continua contemplant aspectes de seguretat tant per als visitants de les instal·lacions com per als mateixos treballadors, però no s'ha cregut convenient esmentar-les ja que no afecten directament al disseny del recinte propi de l'animal.

2.4.- Discussió

Un cop vistos per sobre els aspectes legals més importants que regulen el manteniment dels animals en parcs zoològics, es proposa el següent cas per tal de poder discutir una mica sobre els aspectes que cobreixen les lleis i les mancances d'aquestes.

Cas: un grup de gent es proposa crear un parc zoològic i, com és lògic pensar, volen complir totes les lleis vigents. Alhora de dissenyar les instal·lacions dels animals sorgeixen moltes preguntes, de les quals se'n destaquen dues:

- com ha de ser un recinte adequat a cada espècie i a les seves necessitats biològiques i de conservació? Què s'ha d'entendre per això?
- quin tipus d'enriquiment ambiental s'ha de dur a terme?

A partir d'aquest punt, es pot encetar una petita discussió sobre les lleis vigents.

Des del nostre punt de vista les lleis actuals haurien de definir una mica millor quines són aquestes necessitats biològiques i de conservació, que tot i que podem deduir, seria millor no haver-ho de fer, ja que la lliure interpretació pot portar sempre a confusions. Com es cita en un moment de la Llei Catalana, tenir en compte els requisits de cada espècie animal és del tot impossible a causa de la gran varietat, però tot i així, no estaria de més definir una mica més els perfils legals. Som conscients que determinar legalment els m^2 que ha de tenir cada recinte, el tipus de vegetació, etc., és del tot inviable, però si que

estaria bé donar unes directrius per tal de poder-ho fer, o bé nombrar unes figures responsables encarregades de poder guiar els parcs zoològics en aquest aspecte. En la Directiva Europea així com en la seva transposició Espanyola, trobem a faltar tots els aspectes de seguretat que s'esmenten en la Llei Catalana, ja que aquests, són d'allò més importants alhora de dissenyar les instal·lacions.

I, referent a l'aspecte de benestar, creiem també que és un tema que queda poc reflectit legalment. En primer lloc s'hauria de definir més què s'entén per benestar animal i quina és la millor manera de dur-lo a terme. Dir tant sols que ha de servir per diversificar les pautes de comportament o que ha de incentivar la reproducció, creiem que és poc. Des del nostre punt de vista, seria interessat que es contemplessin els diferents tipus d'enriquiment i que s'exigís als parcs zoològics, en la mesura del possible, el seu compliment, ja que per nosaltres el benestar animal és tant o més important que portar un registre adequat dels animals. Valorem positivament però, que es parli a nivell legal del benestar, ja que som conscients que és un aspecte relativament nou i, quan es varen fer les lleis, potser encara no era una tema tant important com ho és avui en dia.

En resum, creiem que les lleis actuals estan més orientades a exigir certs "comportaments" per part dels parcs zoològics per tal de poder justificar millor la seva existència i poder donar una millor imatge de cara al públic. És a dir, força als zoològics a realitzar educació, investigació, conservació… i no només exposar animals. I en detriment, oblida una mica que la part més important hauria de ser la referent als mateixos animals i, vetllar pel benestar d'aquests.

III. DISPOSICIONS NO LEGALS

A nivell no legal, existeixen diferents associacions que estableixen les seves pròpies bases per tal de poder "solucionar" els buits legals existents. L'associació amb més pes dintre del món dels parcs zoològics és WAZA (World Association of Zoos and Aquariums) a nivell mundial, EAZA (European

Association of Zoos and Aquariums) a nivell europeu i AIZA (Asociación Ibérica de Zoos y Aquarios) a nivell espanyol. En l'Annex II si pot trobar el document de AIZA referent a les Bases *generals per l'acomodació i cures d'animals en zoològics*, el qual és francament interessant.

EL TIGRE EN LLIBERTAT

Taxonomia

Regne: Animals

Fílum: Cordats

Subfílum: Craniats o Vertebrats

Classe: Mamífers

Subclasse: Euteris

Ordre: Carnívors

Família: Fèlids

Gènere: Panthera

Espècie: Tigris

Subspècies:

Actuals *Panthera Tigris Tigris* (Tigre de Bengala)
Panthera Tigris Corbetti (Tigre d'Indo Xina)
Panthera Tigris Amoyensis (Tigre del Sud de Xina)
Panthera Tigris Altaica (Tigre de Sibèria o Amur)
Panthera Tigris Sumatrae (Tigre de Sumatra)

Extingides *Panthera Tigris Caspio* (Tigre del Caspi)
Panthera Tigris Sondaica (Tigre de Java)
Panthera Tigris Balica (Tigre de Bali)

Filogènia o història evolutiva del tigre

Gràcies a la seva discreció a l'hora d'acorralar la seva presa, gràcies a les seves dents letals, gràcies a les seves esmolades i retràctils urpes... els tigres són una de les branques dels carnívors que estan més, espectacularment, adaptats a la depredació. Però, aquesta capacitat depredadora no només es deu a l'especialització de dents, urpes, esquelet,..., sinó que també és conseqüència de la limitació que tenen en altres camps, com és el de córrer o trepar. Així doncs, el fet de que els tigres, com altres felins, siguin una de les millors màquines de depredar és degut, en gran part, a les característiques més primitives que conserven dels més antics antecessors de l'ordre dels carnívors.

Ara ja fa uns 35 milions d'anys, a l'inici de l'Oligocé, dintre del període Terciari, es va donar lloc a una gran diversificació d'espècies. Va ser llavors quan de l'ordre dels carnívors es van començar a diferenciar grups, un dels quals va ser el dels miàcids. Aquest grup de carnívors primitius va subdividir-se

en dues grans famílies: els aeluroides i la dels arcotoides. Dintre de la família dels arcotoides s'hi poden trobar totes aquelles espècies que tenen semblances amb l'ós i, en la família dels aeluroides hi trobem tots aquelles que tenen alguna semblança amb els felins, hienes, ... Actualment, els felins i les hienes comparteixen algunes similituds, com ara un nombre similar de dents i una estructura també molt semblant. Això doncs, fa pensar que ja fa uns anys aquestes dues espècies compartien el mateix antecessor, l'anomenat *Smilodon* (Parago, Vaissaire, 2003).

Smilodon

El *Smilodon* (veure fig.1) o tigre de les dents d'espasa va desaparèixer durant el Plestocé (Quaternari), mentre que per altra banda apareixia el que actualment es coneix com el gènere *Felis*.

Aquest animal tenia algunes de les característiques dels felins actuals, com per exemple una dentadura dominada per la importància dels seus ullals els quals medien uns 20 cm. Era un animal gros i pesat, d'uns 3 m de llargada, però, tot i així, el que en destacava més eren els seus grans ullals. La punta d'aquests era molt poc esmolada. Pel que fa a la manera de matar les seves preses, existeixen dues hipòtesis: l'una que diu que clavava els seus llargs i potents ullals a la seva víctima gràcies a una força proporcionada pel fet que podia obrir la seva mandíbula més de 90º. Però, recentment s'ha contemplat, i això dóna base a la segona hipòtesi, el fet de què potser el Smilodon arrancava un plec de pell de la seva presa i deixava que es morís dessagnada . L'única cosa que no es podrà saber mai d'aquest animal era de quin color tenia la pell. (Ediciones Este, 1993)

Fig. *Smilodon*

Però, tot i que aquesta suposició dels miàcids i del *Smilodon* sigui una de les més acceptades, no deixa de ser, una presumpció. Les restes, però,

trobades al ranxo La Brea de Califòrnia (veure fig.), als Estats Units és un gran punt a favor de tot aquest raonament.

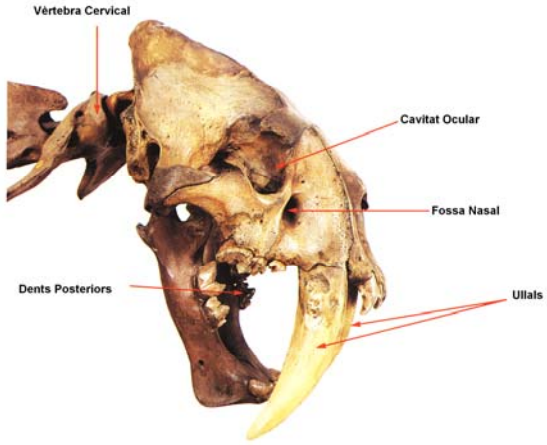


Fig. restes fòssils (crani) de *Smilodon*

Diferents subspècies: trets morfològics característics

Aspectes com el color o la densitat del pèl, el pes i la mida... són trets que no són els mateixos per a cada subspècie de tigre, ja que com que cada subspècie viu en llocs diferents té adaptacions diferents. Per exemple, el fet de que el tigre de Sumatra sigui el més petit de mida és una adaptació que ha anat desenvolupant al llarg dels anys, ja que com que les seves preses són petites

no li és necessari tenir un mida gran si amb una de petita s'adapta millor. Un altre exemple podria ser el del tigre de Sibèria el qual té una gran quantitat de pèl; això és degut a que el clima on viu és un clima fred i per tant s'ha de protegir.

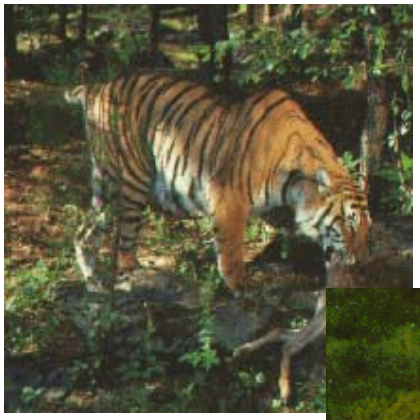
Així, doncs, en aquest apartat es contemplen algunes de les característiques morfològiques que varien en les diferents subspècies del tigre. A continuació s'exposen aquests trets mitjançant les següents graelles:

	Pèl (densitat, color i ratlles)	**Femella (m)**	**Mascle (m)**	**Femella (Kg)**	**Mascle (Kg)**
Bengala	Color ataronjat o òxid marronós. Ventre blanc. Ratlles negres. Orelles negres, però blanques del darrera.	2,4 - 2,65	2,7 - 3,1	100 - 160	180 - 258
Indo Xina	Colors molt foscos, és el tigre més fosc.	2,3 - 2,55	2,55 - 2,85	100 - 130	150 - 195
Sud de Xina	Color ocre rogenc en el llom i un color clar en el ventre.	2,3 - 2,4	2,3 - 2,65	100 - 115	130 - 175
Sibèria o Amur	Pelatge llarg i espès. Color groguenc a l'hivern i rogenc a l'estiu. El ventre i l'interior de les potes de color blanc. Cua de color blanca i negre. Aquest tigre disposa d'una capa de greix molt gruixuda en l'esquena i en el ventre que el protegeix del fred.	2,4 - 2,75	2,7 - 3,3	100 - 167	180 - 306
Sumatra	Ratlles molt juntes. Pèl més llarg en les galtes, però en la resta del cos molt curt, sobretot en la nuca.	2,15 - 2,3	2,2 - 2,55	72 - 110	100 - 140

- Taula representativa dels diferents pelatges, mides i pesos de les diverses subspècies.

	Pèl (densitat, color i ratlles)	**Femella (m)**	**Mascle (m)**	**Femella (Kg)**	**Mascle (Kg)**
Caspi	Ratlles poc amples. Colors més marrons en les potes. El pelatge d'hivern i el pèl del ventre és més llarg. Crinera curta a la nuca.	2,4 - 2,6	2,7 - 2,95	85 - 135	170 - 240
Java	Ratlles molt estretes.	-	2.480	75 - 115	100 - 141
Bali	-	1,9 - 2,1	2,2 - 2,3	65 - 80	90 - 100

- Taula representativa dels diferents pelatges, mides i pesos de les diverses subspècies **extingides**.



Tigre de Bengala

Tigre de l'Indo Xina

Tigre del Sud de la Xina

Tigre de Sibèria o Amur

Tigre de Sumatra

Tigre del Caspi

Hàbitat del tigre i nínxol ecològic. Distribució (poblacions actuals) i ecosistema on viu

Cada subspècie de tigre té una distribució geogràfica diferent i, dintre d'aquesta distribució els tigres poden viure en diferents hàbitats. A continuació aquests dos factors s'exposen mitjançant les graelles següents:

	Distribució geogràfica	Hàbitat natural
Bengala	Principalment es troba a l'Índia, però també es poden trobar en el sud del Nepal, a Bangla Desh, a Butuan o a l'oest de Mianmar.	Boscos de coníferes. Selves i boscos tropicals. Muntanyes, terres altes i esplanades rocoses. Manglars, situats per sobre o per sota el nivell de l'aigua.
Indo Xina	La majoria es poden trobar a Tailàndia, però també n'hi ha al sud de la Xina, a Myanmar, a Cambotja, a Laos, al Vietnam o a la península de Malàisia.	Boscos densos en terrenys muntanyosos, sabanes i selves de Tailàndia. Sabanes.
Sud de Xina	Actualment es troben tots en reserves del sud de la Xina.	Boscos, sabanes i muntanyes.
Sibèria o Amur	Majoritàriament es troben tots a l'est de Rússia, però també hi ha alguns exemplars al nord-est de la Xina i al nord de Corea del Nord.	Boscos
Sumatra	Es troben tots repartits entre les 5 illes de Sumatra (illes d'Indonèsia).	Boscos baixos i de muntanya.

- Taula representativa de les diferents distribucions geogràfiques i dels diversos hàbitats de les diferents subspècies.

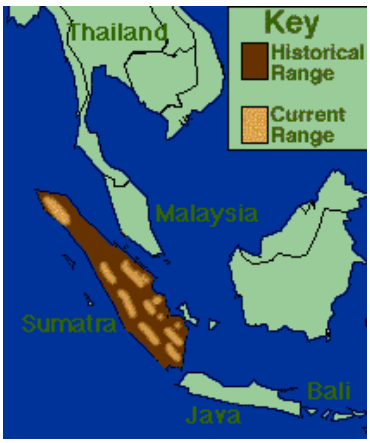
A continuació es mostren les distribucions geogràfiques (històriques i actuals) de les diferents subspècies

Distribució del tigre de Bengala

Distribució del tigre de la Indo Xina

Distribució del tigre del Sud de la Xina

Distribució del tigre de Sibèria o Amur



Distribució del tigre de Sumatra

	Distribució geogràfica	Hàbitat natural
Caspi	Afganistan, Iran, Turquia, Mongòlia, centre d'Àsia i Rússia.	Inespecífic.
Java	Illa de Java (illa d'Indonèsia)	Inespecífic.
Bali	Illa de Bali (illa d'Indonèsia)	Inespecífic.

- Taula representativa de les diferents distribucions geogràfiques de les diferents subspècies **extingides**.

Etologia en llibertat

Com ja se sap, els animals en llibertat s'alimenten, es reprodueixen, es relacionen diferentment de com ho farien en llibertat. En aquest apartat s'explicaran les tres funcions bàsiques del tigre en llibertat: la seva alimentació i les tècniques de caça que utilitza, la relació entre els diferents tigres i les seves tàctiques de marcatge territorial i per últim el seu comportament reproductiu.

1. Nivell tròfic

En aquest punt es contemplarà l'alimentació dels tigres i la manera que tenen ells per a obtenir aquests aliments, la caça.

1.1. Alimentació

Com ja s'ha dit anteriorment els tigres són carnívors, per la qual cosa mengen únicament carn. Les diferents subspècies mengen si fa no fa el mateix però pot haver-hi alguna petita variació.

Tots els tigres es solen alimentar d'ungulats, mamífers que tenen peülles, que pesin entre 50 i 200 Kg. Dintre aquest grup hi entren els cérvols sambar, els axis, els cérvols dels pantans, el cérvol comú, el cérvol rus, els porcs senglars, rinoceronts petits, elefants joves, els búfals d'aigua, ants i alguns cops bestiar domèstic.

Excepcionalment però, el tigre de Sibèria pot menjar peixos i el de Bengala ocells.

En el cas del tigre del sud de la Xina no se sap ben bé el que menjaria en llibertat, ja que tots els exemplars que queden estan o bé en zoològics o en parcs naturals, en llibertat no n'hi ha cap.

1.2. La caça

Perquè el tigre pugui aconseguir totes aquestes preses esmentades anteriorment, primerament les ha de caçar, i ho fa de la següent manera:
El tigre és un animal que caça en solitari i més aviat ho fa de nit que no pas de dia, tot i que hi ha molts tigres que prefereixen fer-ho sota la llum del sol, en aquest cas el seu pelatge els hi és un bon camuflatge. En el cas de que el tigre prefereixi caçar de nit, la gran majoria, quan aquesta arriba comença a buscar la seva presa. Pot caminar fins a uns 10 o 20 Km abans de trobar la seva presa

ideal. Un cop ja la té localitzada la comença a seguir molt silenciosament i arran de terra per tal de que no pugui ser descobert. Un cop el tigre es localitza a uns 10 o 25 m de la seva presa es comença a preparar; s'arronsa i prepara les seves potes del darrera pel gran salt. Quan ja està preparat ataca, sempre per un costat o pel darrera. Si la presa se li escapa pot seguir-la fins a uns 200 m, no gaire més, ja que el tigre no és un velocista, però tot i això no sol atrapar-la. La tàctica que més fan servir per matar la seva presa és la de l'estrangulament, sobretot utilitzada en preses grans. En aquesta tàctica el tigre exerceix la gran pressió de les seves mandíbules sobre la tràquea de la seva víctima fins que aquesta deixa de respirar. Aquest estrangulament se sol fer sense vessar ni una sola gota de sang. Quan ja tenen la presa morta solen portar-la fins a la vora d'algun lloc on hi hagi aigua, per tal de poder beure mentre mengen. Un cop ja estan tips (poden arribar a menjar uns 50 kg de carn de cop) amaguen les restes i se'n van a dormir i, més tard roseguen allò que han deixat abans.

Els tigres solen tenir entre un 10 i un 20% d'èxit en les seves caces.

2. Relacions entre tigres: comportament territorial

El tigre és un individu que a diferència d'altres felins, viu sol. El fet de que no visqui en comunitat fa que hagi de ser per força un animal molt autosuficient, ja que per sobreviure no depèn de ningú més. Un dels factors que és més important per a un tigre i vital per a la seva supervivència, és la possessió d'un territori. En el cas dels mascles aquest territori sol tenir entre uns 60 i 100 Km^2 d'extensió i ha d'haver-hi força aliment i sobretot que estigui rodejat d'altres paratges on hi hagin moltes femelles. En canvi en el cas de les femelles, el seu territori sol tenir uns 20 Km^2 d'extensió i, elles busquen indrets on hi hagi molt d'aliment i sobretot llocs on els hi sigui fàcil de protegir les seves cries. Com ja s'ha dit els territoris dels mascles solen englobar varis espais de femelles, però mai els emplaçaments d'un mascle o una femella es superposen a altres terrenys de tigres del seu mateix sexe. Per norma general, els tigres mascles solen defensar molt més el seu terme que no pas les femelles, tot i

que s'ha donat algun cas de què alguna femella s'ha arribat a enfrontar contra un mascle per defensar la seva demarcació i el seus cadells.

Els tigres utilitzen diferents senyals químiques i visuals per tal de donar a conèixer que un espai és seu i d'aquesta manera evitar possibles enfrontaments. Aquestes marques de territorialitat són molt importants i, se'n poden diferenciar algunes:

2.1. Orina més secrecions de les glàndules anals

Mitjançant una barreja d'orina i sobretot de les secrecions de les glàndules anals, els tigres deixen anar una quantitat de líquid que els serveix per marcar. Aquest líquid s'expulsa molt ràpidament, és com un efecte esprai. Aquesta substància la solen dipositar en arbres, arbustos i roques que delimiten el seu territori.

2.2. Excrements

En certs llocs del seu terme els tigres dipositen les seves femtes. Aquesta és una altra senyal que en aquell indret hi ha un individu.

2.3. Marques dels arbres

Al mateix temps que els tigres s'esmolen les ungles en les escorces dels arbres deixen una empremta visual que també serveix per marcar aquesta territorialitat.

Així doncs, mitjançant aquest tipus de marques, un tigre pot advertir de la seva presència. Aquestes senyals s'han d'anar renovant molt sovint, ja que els tigres sempre estan revisant les fronteres dels territoris veïns per saber si el tigre veí encara hi és o no. Un estudi fet al Parc Nacional del sud del Nepal ha donat a conèixer que si un tigre no marca el seu territori durant unes tres setmanes, els tigres veïns l'ocupen, ja que l'absència d'aquestes marques en aquest període de temps significa per a ells que l'emplaçament està desocupat.

3. Comportament reproductiu

Com ja s'ha dit abans els tigres són animals independents i solitaris, que no viuen en comunitat, però, hi ha certs moments que els tigres conviuen, això només passa en l'aparellament.

La majoria de tigres no són estacionals, ja que aquesta majoria viuen en ecosistemes que durant tot l'any el clima és el mateix i per tant els hi és indiferent tenir els cadells al Gener que al Agost, ja que durant tot l'any hi ha la mateixa abundància d'aliment i les mateixes condicions climatològiques, però, en el cas del tigre de Bengala el seu aparellament es sol produir entre els mesos de Novembre i Abril, durant l'anomenat monzó (època de pluges), ja que així quan les femelles tenen les cries és estiu i, per tant, abunden els aliments i les condicions climatològiques són molt favorables.

L'aparell reproductor de les femelles funciona per ovulació induïda, és a dir, que només ovulen quan ja han estat cobertes. D'aquesta manera asseguren la seva fecundació. L'aparellament comença quan en la femella s'inicia el zel. Aquest zel es caracteritza pel fet de que la femella sent un dolor molt fort en els ovaris, els quals estan madurs però que no poden ovular perquè no hi ha hagut copulació. La durada del zel és d'aproximadament d'uns 4 a 8 dies els quals es van repetint cada 20 dies fins que la femella és fecundada. La femella comença a cridar d'una manera especial, que els mascles reconeixen, i a més a més, també desprèn una olor especial. Els mascles poden arribar a lluitar per aparellar-se. Abans de la copulació hi ha un preludi, en el qual els tigres juguen i lluiten i, fins i tot cacen i s'alimenten junts. Quan arriba el moment de l'acoblament, la femella s'estira al terra, aixecant la part posterior, mentre el tigre es posa sobre la femella i comença a exercir una sèrie de moviments lumbars. El tigre mascle, per tal d'assegurar-se que la femella no

s'escapi, l'agafa molt fortament per la nuca amb les seves mandíbules. Com ja s'havia comentat anteriorment, els penis del mascle està recobert per una sèrie de punxes molt fines que causen dolor a la vagina de la femella. Aquest dolor activa un procés hormonal molt complex pel qual al cap de 24 o 30 hores després de la copulació la femella ovularà. Els tigres es poden arribar a aparellar uns 200 cops en dos o tres dies. Quan a la femella li deixen de fer mal els ovaris, símptoma que ja ha ovulat, se li acaba el zel i comença la gestació. Un cop la femella ja ha quedat coberta el tigre tendeix a anar a buscar a una altra femella, per tal d'assegurar-se la descendència., així doncs, la femella

fecundada es queda sola. La gestació sol durar entre uns 90 i 114 dies. Després d'aquest període la femella dóna a llum els seus cadells, que solen ser entre 2 i 4. Les cries al néixer pesen entre uns 800 i 1.610 g. Neixen totalment cegues i no hi comencen a veure fins al cap d'uns 5 dies i, al cap d'uns 10 o 15 dies ja comencen a caminar. Pel que fa a la lactància, els cadells poden començar a menjar carn a partir del tercer mes, però no solen deixar de mamar fins al cinquè o sisè mes. Durant 2 o 3 anys la femella ha de cuidar d'ella mateixa i dels seus cadells, els ha d'alimentar i els ha de protegir de possibles perills. Dels cadells que tingui, només en sobreviuran aproximadament la meitat. Un cop els seus cadells s'emancipin, el sistema hormonal i reproductor de la femella es tornarà a posar en marxa i tornarà a tenir el zel. Un cop les seves cries hagin abandonat la mare s'hauran d'espavilar per trobar el seu territori propi i de caçar i alimentar-se pel seu compte. Així doncs, aquests tigres que una vegada havien estat cadells es faran grans i, entre els 4 i 5 anys en el cas del mascle i, entre els 3 i 4 en el cas de la femella, també es voldran aparellar, arribaran a la seva maduresa sexual i, d'aquesta manera continuarà el cicle de la vida (Parago, Vaissaire, 2003; Nelson, Corto, 1998).

Casos extrems de comportament reproductiu

Aparellar-se amb tranquil·litat pels tigres no és tan fàcil com sembla, ja que hi ha hagut alguns casos que demostren que el fet de reproduir-se, intentar donar vida, molts cops passa primer per la mort.

Com ja s'ha dit anteriorment, s'han donat diversos casos de tigres mascles que s'han arribat a matar per aparellar-se amb una femella. Però això no és tot. Alguna vegada, s'han donat casos en que alguna femella en zel ha arribat a matar la seva mare, també en zel, per poder aparellar-se, o fins i tot, tigres mascles que han matat totes les cries d'una femella per tal de poder-se aparellar amb ella, ja que com hem dit, una femella no s'aparella mentre té cries.

EL TIGRE EN CAPTIVITAT

ETOLOGIA EN CAPTIVITAT DEL TIGRE EL ZOO DE BARCELONA

En les instal·lacions del Zoo de Barcelona hi ha moltíssims animals i d'espècies molt diferents. Actualment en el Zoo de Barcelona hi ha tres tigres: un mascle, una femella i una cria molt recent que va néixer el passat mes de Maig del 2003. Tot seguit, s'exposa una petita investigació del tigre mascle, ja que aquests últims mesos la femella i la cria no s'han exposat al públic perquè la cria tenia unes petites ferides que havien de ser curades. Així doncs, tot seguit, es poden llegir unes quantes dades del tigre mascle i, següentment, una petita investigació etològica sobre l'animal en qüestió.

1. Aspectes generals sobre el tigre del Zoo de Barcelona

En aquest primer apartat sobre el tigre del Zoo de Barcelona s'hi exposen dades personals d'aquest, és a dir, el tipus d'alimentació que té, les necessitats veterinàries que requereix... i, seguidament, també es fa un breu esment al tipus d'instal·lacions on viu (exterior i interior).

1.1. Informació sobre el tigre (alimentació, atencions veterinàries...)

El tigre del Zoo de Barcelona és un tigre de Sumatra i té l'edat d'uns 10 anys (nascut el Gener del 1993). Aquest tigre (veure fig.23 i annex 3) es passa tot el dia en les instal·lacions de l'exterior, on la gent el pot veure i contemplar i, a partir de les 6 de la tarda, s'entra per donar-li menjar i perquè vagi a dormir fins el dia següent. Pel que fa a la seva alimentació, se li donen uns 7 Kg de carn de cavall amb os, a diari, menys el diumenge, que és el seu dia de dejú.

Pel que fa a la seva relació amb al cuidador, es veu que és bastant bona, ja que el sol reconèixer per la seva olor però, tot i així, per motius de seguretat, sempre mantenen contacte entre barrots. Pel que fa a la seva salut, no ha tingut mai cap malaltia important. Porta les dues vacunes obligatòries (trivalent felina i leucèmia felina). Anualment també se'l tracta contra els paràsits (cucs) i, bastant sovint, el sotmeten a diferents tipus d'anàlisi. Per qüestions legals i de seguretat, aquest tigre també està identificat mitjançant el microxip.

1.2. Instal·lacions

Pel que fa a les instal·lacions on està, s'ha de dir que una de elles, la interior, no s'ha pogut veure però que, tot i així, es té una noció bàsica de com és.

1.2.1. Instal·lació exterior

Aquesta instal·lació és la que el públic pot veure i en la que el tigre només s'hi passa unes 8 hores. Aquest recinte és funcional, és a dir, que quan va ser construït, ara farà uns 40 anys, no es van tenir massa en compte propers projectes d'enriquiment per tant, la instal·lació en si, podria ser bastant millor i deixa força que desitjar. Malgrat això, aquesta instal·lació disposa de diferents elements enriquidors pel tigre, com ara un fossar que, a part d'element de protecció és un lloc on hi pot nedar, bastant vegetació, com per exemple un petit bosc de bambú, un tronc on pot estirar-s'hi i esmolar-s'hi les ungles... En aquests últims dies s'hi va construir un petit tancat per tal de poder mostrar el tigre petit al públic i garantir-ne també la seva seguretat. Aquesta instal·lació es netejada setmanalment, però durant la tardor la neteja és més constant degut a la caiguda del fullatge de la vegetació. (Mapa, veure annex 1 i fotografies, veure annex 2).

1.2.2. Instal·lació interior

Aquesta és un compartiment rectangular on el tigre hi passa la resta d'hores, on hi menja i on hi dorm. La neteja i desinfecció d'aquest recinte és diària.

2. ETOGRAMA DEL TIGRE DEL ZOO DE BARCELONA

En aquest segon apartat s'hi exposa un petit etograma (comportament) que té el tigre mascle del Zoo de Barcelona en diferents hores del dia.

2.1. Introducció

Com ja s'ha dit anteriorment, al Zoo de Barcelona hi ha tres tigres, però en el últims mesos només ha estat mostrat al públic un d'ells, el tigre mascle. Per aquest motiu, l'etograma següent, només contempla el comportament del tigre mascle.

2.2. Hipòtesis plantejades

La hipòtesi bàsica que va ser plantejada abans de començar les observacions va ser que, molt possiblement, el tigre mascle del Zoo de Barcelona tindria un comportament monòton i poc actiu. Les bases d'aquesta hipòtesi, es van basar en els fets següents:

El tigre per si sol és un animal poc actiu, sobretot en les hores diürnes, per la qual cosa es passa la majoria del temps ajagut, rentant-se...

Una falta d'enriquiment que no estimula els instints i sentits sol generar avorriment i monotonia en els animals en captivitat.

El fet d'estar sol en un recinte, quan s'està acostumat a estar acompanyat, pot provocar més avorriment en l'individu.

Per aquest tres motius, la hipòtesi realitzada des d'un bon principi va ser que el tigre en qüestió es passaria la major part del dia ajagut o be realitzant diferents circuits, establerts per ell mateix degut a l'avorriment, per tot el recinte.

2.3. Material i mètodes

El material utilitzat per duu a terme aquesta petita investigació, no ha estat un material gaire específic, ja que les condicions i els mètodes tampoc no ho requerien. El material que va ser utilitzat és el següent:

- Carnet especial per poder tenir accés al Zoo de Barcelona i poder realitzar l'etograma (prèviament pagat).
- Bloc de notes.
- Bolígraf.
- Camera digital de fotos.
- Rellotge.

Referent als mètodes utilitzats per establir l'etograma, principalment, va ser l'observació durant set dies de les diferents activitats i moviments del tigre en qüestió les quals van ser apuntades per poder-les recordar i estudiar. Però, per tal d'aclarir dubtes i millorar l'etograma, també es van establir entrevistes amb el Conservador del tigre del Zoo de Barcelona (Conrad Enseñat) el qual va aclarir molt bé diferents apartats i qüestions.

2.4. Resultats

El resultats obtinguts de les diferents observacions, es plasmen en la graella següent en la qual s'hi relaciona les hores d'exposició al públic, amb les diferents activitats del tigre.

Hores	Activitats i moviments
10 - 11	Dorm en una de les coves del recinte. Fa alguns estiraments i també molts badalls.
11 - 12	Segueix fent el mateix d'abans, però no està del tot adormit, ja que canvia molt sovint de posició i, de tant en tant, aixeca el cap per controlar la situació. Es pot afirmar que no dorm, simplement descansa.
12 - 13	Continua descansant a la mateixa cova.
13 - 14	Continua descansant a la mateixa cova.
14 - 15	Aproximadament a aquesta hora s'aixeca i, la primera cosa que fa és explorar el recinte per veure si tot està en ordre. Un cop ho a comprovat realitza diferents recorreguts (circuits) tan per terra com per l'aigua, però sobretot destaquen aquests últims. De tant en tant para de fer el recorregut que estigui fent

	per llepar-se una mica, però no gaire, tot i que algun dia s'arriba a rentar a fons.
15 - 16	A partir d'aquesta hora és quan sol mostrar més activitat. Continua fent el mateixos recorreguts que abans, de tant en tant es purga amb unes plantes que estan entre el terra i l'aigua. Durant aquesta hora també sol excretat i, sempre ho fa en els nivells més alts del recinte i no tapa les seves deposicions. Mestre realitza els diferents recorregut, aprofita per marcar diferents llocs mitjançant, l'excreció anomenada anteriorment, però també les secrecions de les glàndules anals i l'orina.
16 - 17	Ja cap al final del dia no sembla realitzar tants circuits, ja que es sol dedicar molt a marcar, sobretot al recinte del cadell (ni el cadell ni la mare hi són). Després de marcar varis cops i, sobretot de excretat es sol rentar a fons. Una de les seves activitats habituals també és la de donar varies voltes dintre de les coves i, al sortir-ne rascar-se les ungles al tronc que té en el recinte.
17 - 18	Cap a aquesta hora es comença a impacientar molt més i, comença a donar voltes a la seva porta d'entrada. Es pot assegurar que sap que aproximadament en aquella hora ha d'entrar per menjar. Uns moments abans d'obrir-se la porta el tigre rugeix bastant fort i s'inquieta molt més, tot seguit entra amb bastant afany. Aquest comportament sol canviar una mica els diumenges en els quals no està tant nerviós ni s'impacienta tant per entrar, gairebé es pot afirmar que sap que el diumenge és el seu dia de dejú.

- Taula 5: s'hi exposa un petit seguiment fet al tigre del Zoo de Barcelona durant una setmana. Les seves activitats es relacionen amb diferents hores del dia. Les activitats que s'hi anoten són les que realitza **habitualment**, però com és lògic poden variar o, fins i tot pot ser que en un dia en concret no les realitzi. És un etograma **aproximat**.

2.5. Conclusions i altres anotacions

Després d'una llarga observació i de fer les anotacions necessàries, es va poder comprovar que les hipòtesis plantejades des d'un bon principi eren certes, és a dir, que el tigre porta una vida bastant monòtona i avorrida la qual només es veu mínimament alterada per la presència del recinte que s'ha construït pel cadell, fet que no li permet realitzar els recorreguts habituals, però, que per altre banda és un factor espontani d'enriquiment ocupacional, ja que com que la presència de tots aquells ferros no li és habitual, es passa algunes estones del dia investigant i marcant el recinte de la cria. Cal dir també que

aquest etograma realitzat al tigre en qüestió és bastant aproximat, ja que per motius aliens no es van poder fer totes les observacions que es volien fer.

Per últim, afegir que des d'un principi la intenció era la de fer un etograma del grup de tigres (mascle, femella i cadell), però per raons de seguretat i de salut, això no ha estat possible. Com ja s'ha dit, la intenció era l'observació del comportament dels tres tigres, ja que de ben segur, el fet de ser tres i de haver-hi una cria, hagués canviat molt el comportament del mascle respecte l'etograma anterior. A part de l'etograma exposat anteriorment, també es van fer algunes anotacions que s'exposen a continuació:

- Cada cop que fa les seves necessitats, sempre a les plataformes superiors, no les cobreix mai i, des de la tanca del públic se'n pot sentir la forta olor. Per tant, es pot arribar a la conclusió que segurament no tapa els seus excrements perquè també li serveixen per marcar.
- No mostra cap tipus d'interès per la gent, però sí que reacciona davant dels canvis meteorològics.
- Tampoc no mostra cap interès pels lleons que hi ha al seu costat (recinte veí).
- Pel que fa al comportament de la gent s'ha de dir que és molt lamentable, ja que a part de no tenir cap consideració ni pels animals ni per les instal·lacions, mostren una gran ira quan els animals no se'ls hi posen bé per les fotos o no són gaire visibles perquè estan amagats o descansant en algun lloc. Sincerament, és bastant llastimós sentir insults o, fins i tot, amenaces envers l'animal perquè no es mou o per que no fa cap tipus d'espectacle.

3. NECESSITATS BÀSIQUES I ESPECÍFIQUES DELS TIGRES EN CAPTIVITAT

Com és lògic, els animals que estan en zoològics necessiten unes cures i unes atencions necessàries pel seu benestar i seguretat. Cada animal té unes necessitats específiques de la seva espècie i, el tigre no és menys. Tot seguit

s'exposen alguns dels requisits necessaris per tenir un gran felí, com ara el tigre, en un zoològic tenint en compte el seu comportament en llibertat.

3.1. Estructura del recinte

Primerament ha de tenir un recinte que tingui elements similars als que tindria en llibertat, com per exemple algun tronc per esmolar-se les ungles. Pel que fa a qüestions de seguretat en el cas d'una instal·lació a l'aire lliure, hi ha d'haver uns barrots d'uns 3 m d'alçada que no permetin que el tigre salti a la zona dels visitants o bé, un fossar d'uns 7.6 m d'ample i d'uns 4.6 m de profunditat. Si el tigre està en una gàbia, normalment hi solen estar a les nits, aquesta ha de mesurar uns 6 m d'ample, uns 4.6 m de llarg, és a dir, un total d'uns 28 m^2 per individu. Per cada individu més que s'hi afegeixi, la gàbia s'haurà d'augmentar un 50%.

3.2. Temperatura

Aquest tipus d'animal tolera molt bé les temperatures extremes però, tot i així, han de tenir algun lloc on hi hagi ombra, sobretot durant l'estiu. Pel que fa a la temperatura interior, on s'allotgen a la nit, s'ha d'evitar que superi els 30ºC.

3.3. Llum

Evidentment, els hi és molt més bona la llum natural, tot i que, la llum dels fluorescents tampoc no els hi és dolenta del tot.

3.4. Ventilació i humitat

Sempre es recomana que les instal·lacions estiguin situades en llocs oberts, ja que d'aquesta manera l'aire es renova per si mateix. Però si no és així s'han d'instal·lar sistemes de ventilació, un per a cada gàbia. Per anar bé la humitat s'ha de mantenir entre un 30 i un 70%.

3.5. Aigua

Han de tenir aigua disponible en tot moment i, per a aquests grans felins, els hi és millor que els abeuradors siguin d'obra. En el cas dels tigres, per exemple, els hi és bo poder disposar d'una piscina o fossar on poder-se

banyar, ja que aquests són grans amants de l'aigua. El fossar de protecció pot ser el mateix que utilitzi el tigre per banyar-se.

3.6. Higiene

Els abeuradors s'han de netejar i desinfectar a diari, al igual que els solars. En el cas dels terres d'arena i de vegetació, aquests s'han de mantenir nets i ben cuidats.

3.7. Alimentació

La carn que se'ls hi dóna ha de complir les necessitats vitamíniques i minerals del tigre, fet que satisfan les carns de cavall o boví. Per altre banda, també s'ha de tenir cura de la procedència de les carns per tal d'assegurar-se que han estat ben tractades i que no tenen cap malaltia potencialment perillosa.

Per tal d'evitar l'obesitat va bé que facin un o dos dies de dejú en els quals se'ls hi poden donar ossos per aconseguir una bona higiene bucal i un bon to muscular.

3.8. Atencions veterinàries

Per anar bé se'ls hi haurien de fer exàmens periòdics, al menys dos cops a l'any, dels excrements, per comprovar que no tinguin paràsits (cucs).

Pel que fa a la vacunació, aquesta ha de ser anual i se'ls hi ha d'administrar les vacunes següents:

- Trivalent felina
  - Panleucopènia (*Panleucopènia infecciosa felina*).
  - Rinitis per calicivirus (*Calicivirossis*).
  - Rinitis per herpervirus (*Rinotraqueitis vírica del felí*).
- Leucèmia felina
  - Virus de la leucèmia felina.

Es aconsellable que en les diferents analítiques que se li puguin realitzar es tingui en compte el factor de la malaltia de la tuberculosi, ja que aquesta sol ser freqüent en aquests animals.

Respecte a la identificació, aquests han d'estar identificats **obligatòriament**, ja sigui mitjançant tatuatges o bé microxips.

3.9. Grups socials

Es poden exhibir sols o amb parella, però mai dos mascles junts. Si la mare arriba a tenir cries, tan la mare com els cadells s'han d'apartar i, no es poden introduir fins al cap de 2 o 3 mesos. El mascle sol acceptar bé les cries ja que aquestes són seves.

4. ENRIQUIMENT

4.1. Què és l'enriquiment

En la majoria dels casos els animals que estan en captivitat presenten avorriment o estrès el qual es pot manifestar, per exemple, amb l'automutilació, la coprofàgia (menjar-se els seus excrements), realitzar diversos circuits... Per tal de lluitar contra això, últimament, s'estan portant a terme diversos projectes d'enriquiment els quals tenen com a objectiu principal aconseguir que l'animal no segueixi cap d'aquestes conductes. Alguns dels altres objectius que té l'enriquiment són, per exemple: augmentar la reproductivitat de l'animal, ja que un animal com més a gust se sent amb el seu entorn, més fàcil li és reproduir-se o, evitar-ne l'agressivitat, ja que l'enriquiment els fa consumir part de l'energia que desprendrien si estiguessin en llibertat i així no l'acumulen i no hi ha tan risc que la transformin en odi. Així doncs, l'enriquiment o alimentació neuronal, es podria definir com a l'activitat que proporciona una estimulació suficient a l'animal per tal d'estimular-li la ment, encoratjar les seves conductes típiques de l'espècie i de donar-li eleccions, possibilitats per triar. Cal dir també, que a llarg termini s'espera que l'enriquiment sigui un factor que faciliti el creixement de poblacions d'animals que s'estan extingint i, la seva reintroducció.

4.2. Diferents tipus d'enriquiment

Per tal que l'animal no mostri aquest avorriment o estrès esmentats, se l'hi poden aplicar diversos tipus d'enriquiment el qual, com és evident, haurà de

variar una mica segons les necessitats de cada espècie. Alguns tipus d'enriquiment poden ser per exemple:

4.2.1. Estructural

Per tal que l'animal se senti tan a gust com sigui possible en el seu recinte, s'ha d'intentar que aquest habitatge s'assembli al màxim al lloc d'on prové, és a dir, que si l'animal procedeix dels boscos, s'haurien de posar alguns arbres, roques,... per tal de simular aquest tipus d'ambient.

S'ha comprovat que aspectes del disseny de la gàbia com pot ser la mida i la complexitat influeixen a l'aparició o no de comportaments estereotípics. Tot i així, hi ha estudis (2) que indiquen que a aquest felí no li afecta especialment la mida de la gàbia, ja que a l'augmenta'ls-hi la mida d'aquesta, si que augmenten el nivell de moviments, però només utilitzen el 50% del recinte (sobretot els límits de la gàbia).

L'existència de plataformes i espais elevats on poder-s'hi pujar (per exemple branques d'arbres), sembla que té un aspecte positiu sobre la seva conducta.

També se'ls hi pot proporcionar diferents objectes que cridin la seva atenció i estiguin entretinguts:

- Boomer Ball:

Es tracta d'una pilota "indestructible" que manté l'animal distret. Es pot deixar solta dins el recinte o també es pot penjar d'una cadena.

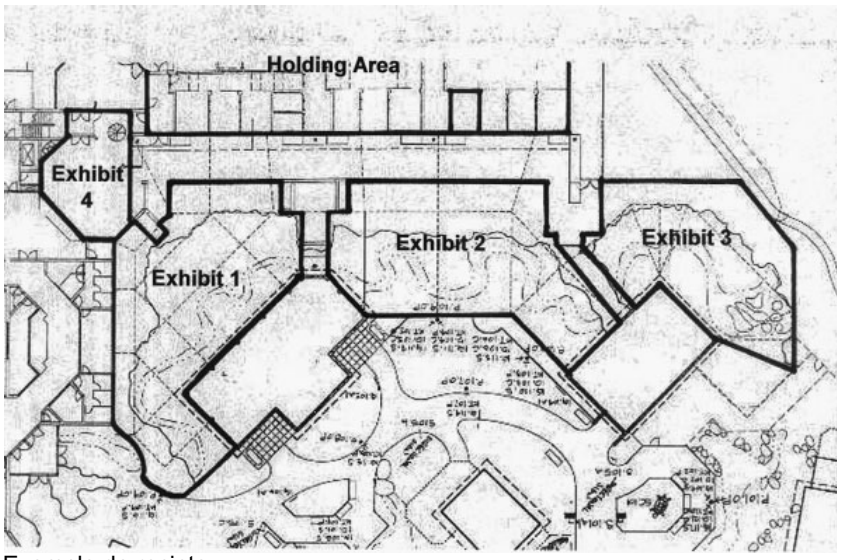
- El zoo de Sant Diego, ha elaborat una variant de la "Bommer Ball", de manera que no sigui un objecte estàtic i l'animal pugui clavar les seves ungles i dents en ell. Per aconseguir-ho, van fabricar sacs d'arpillera farcits de fulles de ficus, branques o altra vegetació d'arbres de la zona. Mentre l'arpillera permet que els tigres clavin les dents i les urpes, i la vegetació proporciona el pes i el volum. Tot

això, es connecta amb una cadena a una barra per tal de que pugui lliscar i moure's: així es simula el moviment com si fos una presa a la que hagués de caçar.

4.2.2. Ocupacional

Els animals que viuen en llibertat cada dia solen canviar d'entorn i quan ho fan sempre investiguen i inspeccionen aquell lloc nou. Els projectes d'enriquiment proposen que el que sí es podria fer són petits canvis en les instal·lacions, com per exemple, moure elements, incloure'n o fins i tot eliminar-ne, ja que d'aquesta manera s'incita a l'animal a investigar i manipular aquell entorn que per a ell és nou.

En un ambient natural, moderats nivells estrès són produïts per estímuls associats amb depredadors, relacions socials amb el grup, obtenció de menjar... S'han identificat 2 tipus d'estrès: el tens i l'energètic. Aquest últim resulta de situacions com l'exercici moderat, l'alimentació, o les interaccions socials. Un dels objectius de l'enriquiment ambiental és l'adequada estimulació que aconsegueixi un òptim nivell d'estrès durant les estones d'activitat de l'animal. Per tal de tenir en compte aquests fets en captivitat, s'ha descrit un mètode: "Activity-based exhibits". Aquest mètode consisteix en que diverses espècies animals ocupin una mateixa gàbia de manera simultània o seriadament. Els animals són traslladats d'en recinte a un altre en un mateix dia, o d'un dia per l'altre.



Exemple de recinte

Durant el transcurs d'aquests canvis, els animals es troben una gran varietat d'estímuls ambientals, incloent variacions físiques del recinte i estímuls d'animals previs. Tot això però requereix un sistema estructural complex de rampes i portes. A més, els animals han de ser entrenats a moure's per aquestes àrees, proporcionant un estímul afegit.

Un estudi sobre l'eficàcia d'aquest mètode (4) indica que augmenta els nivells d'activitat i la utilització de l'espai. A més també s'ha vist que incrementa l'aparició de conductes naturals, com per exemple el marcatge amb orina.

4.2.3. Alimentari

L'alimentació dels animals és el factor que dóna un ventall més ampli per a l'enriquiment, ja que aquest recurs es pot fer servir de moltes maneres.

L'enriquiment alimentari està designat per poder oferir als animals l'oportunitat d'utilitzar les estratègies naturals per tal d'obtenir l'aliment, tal com ho farien en llibertat. En els zoos tradicionals, els animals són alimentats amb menjars formulats un o dos cops al dia. Mentre que aquests aliments tenen el contingut en nutrients adequat, l'alimentació adequada també hauria d'incloure l'oportunitat per als animals d'utilitzar el seu comportament natural d'alimentació.

S'ha comprovat que alguns simples mètodes d'enriquiment alimentari canvia el comportament d'aquests felins:

- Administrar el menjar dins de boles de gel fa augmentar el temps que estan de peu, augmenta la locomoció, oloren i llepen més; en general fa que estiguin més actius.
- En un estudi (3) s'ha comprovat que l'administració de peix congelat augmenta l'activitat dels tigres en un 35% i redueix les estereotipes en un 27%. La durada d'aquests efectes beneficiosos dura durant una setmana a partir de la retirada de l'enriquiment.
- Una altra opció és la de canviar la localització, la presentació i l'hora de l'administració de l'aliment, per tal que l'animal no estigui acostumat sempre a una rutina.
- Un altre estudi (5) mostra que l'administració de la canal sencera (per exemple de vedell) redueix les estereotípies.

I, per últim, una de les opcions que es pensa que seria una de les més adequades per a l'estimulació de l'animal en qüestió, és l'administració de presa viva, és a dir, el fet d'oferir a l'animal que caci la seva pròpia pressa i que aquesta tingui també oportunitats d'escapar-se. Aquesta opció seria un molt bon recurs perquè els animals desenvolupessin més els seus instints.

S'han realitzat alguns estudis (1) sobre aquests mètodes d'enriquiment alimentari:

- La presentació de peixos vius, augmenta la varietat i freqüència dels comportaments d'alimentació. Aquest mètode, redueix les conductes estereotípiques des d'un 60% a un 30%, mantenint aquesta millora durant els 2 dies després de l'enriquiment.
- La provisió d'ossos també s'ha demostrat que redueix el comportament estereotipat però en menor mesura que el peix viu.

Respecte la freqüència d'administració del menjar, els tigres en llibertat no mengen cada dia, així que per tal de simular el comportament natural, hi ha dies que no mengen o són alimentats amb aliments "light".

4.2.4. Social

En la majoria de llocs, animals de diferents espècies comparteixen el mateix hàbitat, és dir, que en un mateix recinte hi poden haver animals de 5 o 6 espècies diferents. Des dels projectes d'enriquiment es proposa que en una

mateixa instal·lació hi podrien conviure animals d'espècies diferents, però, només conjunts que ja es troben en llibertat. Aquesta opció es vista amb grans expectatives ja que els animals mostrarien interès per a l'altre i per tan un altre tipus de comportament que no fóra el mateix que si estigués sol.

4.2.5. Sensorial

Una de les coses bàsiques que fa qualsevol animal en llibertat és seguir rastres, ja siguin d'aliment o d'altres animals. Un tipus d'enriquiment que es creu que seria força adequat per a l'estimulació de l'animal és, per exemple, deixar un rastre de menjar en el seu recinte, per tal de que l'individu en qüestió hagués d'investigar, tal i com ho faria en llibertat, la font de procedència de l'olor de l'aliment. El mateix es podria fer també amb l'olor d'altres animals.

- Una altre opció d'aquests estímuls sensorials seria l'administració de diferents espècies com ara canyella o comí. En un estudi realitzat (3) van veure que augmentava l'activitat dels animals en un 12% i es reduïen les estereotipies en un 21%.
- Per estimular l'olfacte també es poden impregnar objectes amb orina de zebra, camell, cavall..., perfums o herbes.

L'ÓS EN LLIBERTAT

Taxonomia i distribució de l'os

Es remunta a fa uns 60 milions d'anys quan apareix l'avantpassat de tots els carnívors. Tot i així, els primers ossos que formen part de l'actual família dels Úrsids no es troben fins fa uns 20 milions d'anys, al separar-se dels carnívors donant lloc a la família dels Prociònids (ós rentador, ós menor, coatí, etc.).
D'aquest tronc sorgeix, ja fa 15 milions d'anys, el panda gegant i l'os de rostre curt de Sudamèrica.
L'antiguitat de l'os panda i les seves peculiars característiques han determinat la seva posició taxonòmica. Les demés espècies modernes d'ossos s'originen del *Ursus ruscinensis* espècie que al Pliocè (fa cinc milions d'anys) es va extendre per Euràsia i Amèrica. Els fòssils més antics es van trobar en jaciments de França, Polònia i Hongria.
D'aquest os, a través d'algunes espècies intermediàries com l'*Ursus etruscus* descendeix l'actual os bru, *Ursus arctos.*
Sembla que el seu origen és asiàtic, ja que l'os bru està present a la Xina durant el Pleistocè, fa dos milions d'anys. Des d'aquí es va extendre cap a l'est, però la seva aparició a Europa va ser en èpoques relativament recents: fa uns 250.000 anys.

En termes científics, s'estableix que existeixen vuit espècies d'óssos, presents majoritàriament a l'hemisferi nord del planeta.
Tres d'aquestes espècies (l'os negre asiàtic, l'os de rostre curt de Sud-amèrica i l'os malai) es troben llistades a l'apèndix I1 de la Convenció sobre Comerç Internacional d'Espècies Amenaçades de Flora i Fauna Silvestre (CITES), i dos a l'Apèndix II2 (l'os negre americà i l'os polar).

Fig. 1 Exemplar d'ós negre americà

Ós negre americà o baribal (*Ursus americanus*)
Viu a Amèrica del Nord: EUA, Canadà, i nord de Mèxic.

Existeixen al voltant de 400.000 exemplars. És de color negre i no té gepa.
La seva alimentació, principalment vegetariana, inclou arrels, insectes, fruits secs, carronya i peixos. Els mascles pesen entre 90 i 300 kg i les femelles entre 60 i 180.
El seu comportament és molt similar a l'ós bru: nocturn, àrea de territori d'uns 20 Km^2 (major en mascles que en femelles), i hivernació en semiletargia entre novembre i març.

Os polar (*Ursus maritimus*)

Viu a les zones àrtiques d'Alaska, Canadà, Noruega, Rússia i Grenlàndia. Evolucionant des de l'os bru, és el que té un major pes, fins a 800 Kg. És de color blanc, destacant el negre brillant del musell. Els pèls estan buits, el que facilita l'absorció de calor del sol i la flotabilitat. S'alimenta de foques, peixos, aus, ous, carronya, crancs, bolets, algues, etc. És el major carnívor terrestre.

Fig. 2 una mare i fill d'óssos polars.

Els seus molars són afilats. Els mascles són molt més grans que les femelles. Són diürns. Els mascles hivernen (semiletargia) de novembre a gener i les femelles de novembre a març.
Les femelles acostumen a parir 2 cries, que estan amb la mare fins als dos anys. L'àrea de campeig arriba a superar el miler de Km^2.

Ós de rostre curt de Sudamèrica (*Tremarctos ornatus*)

Habita als boscos andins de Veneçuela, Colòmbia, Equador, Perú i Bolívia. Viu preferentment en boscos, és un animal arborícola encara que s'adapta a zones sense arbres. S'alimenta de fruites, plantes i arrels, i també menja petits mamífers i aus

Fig. 3 Exemplar d'ós de rostre curt

Os malai (*Helarctos malayanus)*

És el més petit, amb un pes adult d'entre 30 i 70 Kg. Viu a Malàisia i Indonèsia, havent-se extingit per l'acció humana a l'Índia i Bangladesh. Habita boscos tropicals, alimentant-se d'aus, termites, ruscs, etc.

Fig. 4 Ós malai

Os panda (*Ailuropoda melanolueca*)

Viu en zones de Xina central. És l'únic que presenta dit polze (oposat als altres quatre dits), el que permet agafar els talls de bambú, dels que s'alimenta casi exclusivament.

Fig. 5 Exemplar d'ós panda

Ós "bezudo" (*Melursus ursinus*)

Fig. 6 ós bezudo

Viu a l'Índia, Nepal, Bangladesh, Butàn i Sri Lanka. És de color negre, amb una taca al pit en forma de U o Y de color blanc. Té un orifici entre els incisius superiors que li permet aspirar insectes, extraient els llavis inferiors en forma de tub al voltant del forat. El soroll que produeix a l'aspiració es pot sentir a un centenar de metres. Pot tancar els orificis nasals a voluntat per protegir-se de formigues i termites, que són el seu principal aliment. També s'alimenta de fruites, ous, mel i altres insectes. Quan té cries les transporta sobre l'esquena.

Os de collar o negre asiàtic (*Ursus thibetanus*)

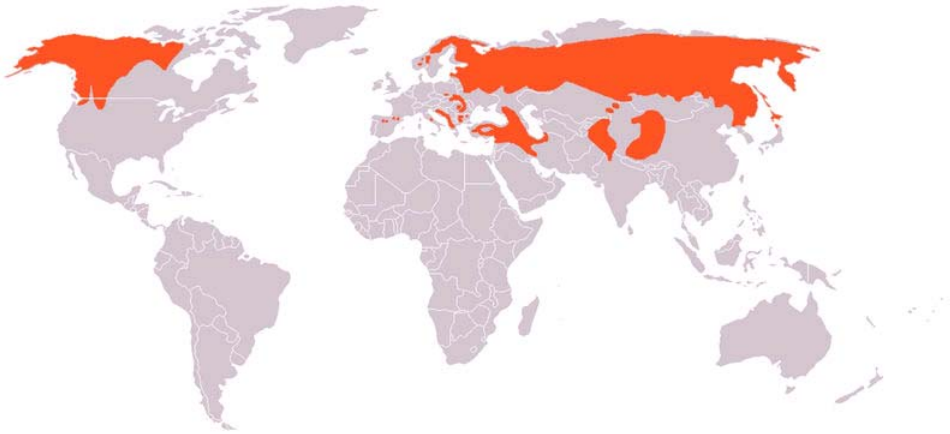
Viu en zones forestals muntanyoses de Xina, Afganistan,
Paquistan, Birmània i nord de l'Índia. S'alimenta d'insectes, fruites i petits vertebrats. Té una taca blanca al pit en forma de V, com un collar.

Fig. 7 ós negre asiàtic

Ós bru (*Ursus arctos*)

L'ós bru és el més extès al món, ja que ocupa pràcticament tot l'hemisferi nord. Tot i així, a causa de la forta pressió de la caça ha estat sotmès a la destrucció dels seus biotips originals i ha desaparegut de gran part dels seus hàbits primitius, sobretot a Europa i Estats Units. Habita principalment zones boscoses, però també pot viure a les extensions obertes de les tundres del nord.

Fig. 8 ós bru



Descripció i Morfologia

Existeixen 11 subspècies:

- *Ursus arctos arctos*
- *Ursus arctos horribilis*
- *Ursus arctos isabellinus*
- *Ursus arctos middendorffi*
- *Ursus arctos piscivorus*
- *Ursus arctos pruinosus*
- *Ursus arctos syriacus*
- *Ursus arctos yesoensis*

3 de les quals ja s'han extingit:

- *Ursus arctos nelsoni*
- *Ursus arctos crowtheri*)
- *Ursus arctos californicus*

La seva longevitat és de 25-30 anys (màxims coneguts de 34 anys en estat silvestre i 47 en captivitat). Tenen una longitud corporal que varia d'1,50-2,95m, depenent de la subspècie, i una altura a la creu de fins a 1,30m. El seu pes també varia, des del 100 fins els 675 kg. El color és molt variable d'un individu a un altre. Pot variar entre el marró molt fosc i el daurat clar, passant per diverses gammes de grisos. Les cries solen presentar un collar blanquinós més o menys ampli al voltant del coll, marca que habitualment desapareix a partir de la primera muda a l'any d'edat. El pelatge es renova una vegada l'any, a l'època estival.

La visió no la té gaire desenvolupada comparada amb altres sentits. A llarga distància reconeixen formes, però no detalls, i detecten molt millor animals o objectes en moviment que immòbils. En algunes situacions desfavorables, poden erguir-se sobre les seves potes posteriors per augmentar el seu camp de visió. La seva oïda

Fig. 9 ós bru a la natura

és extremadament aguda i desenvolupada, igualment que l'olfacte, que és excel·lent i finíssim, tractant-se del seu sentit més desenvolupat i que més ajuda a la seva vida quotidiana. Gràcies a ell, poden detectar a llarga distància moltes de les seves fonts d'aliment, i també l'estat sexual d'altres exemplars durant l'època de zel.

Les seves mandíbules tenen 4 canins punxeguts i robusts com els d'altres carnívors. Tot i així, la presència d'incisius aptes per tallar herba i talls, i de molars amplis i aplanats capaços de triturar aliments d'origen vegetal, fan que la dentadura d'aquest carnívor estigui perfectament adaptada a un regim omnívor.

Dimorfisme sexual: és molt notori en els ossos bruns. Un exemple són els ossos Kodiak: en estat salvatge, els mascles d'aquesta subspècie normalment arriben a un pes de 450Kg, mentre que les femelles acostumen a pesar uns 250Kg. El mateix passa amb els ossos Grizzly: els mascles pesen generalment una mica menys de 400Kg i les femelles al voltant de 200Kg. I això passa amb la resta de les subspècies.

Alimentació

L'os bru és un animal omnívor amb una marcada tendència vegetariana.

L'aport vegetal a la seva dieta supera el 85% del total en totes les estacions de l'any. Només fruits d'arbres i arbusts ja suposen, al llarg de l'any més del 50% de la seva alimentació.

Les seves urpes i extremitats estan molt ben adaptades per l'excavació d'arrels i tubercles.

Encara que la dieta de l'os és molt variada, des del punt de vista estacional, aquesta diversitat disminueix considerablement, dominant en cada període un o dos tipus d'aliments. El que es produeix es un ús seqüencial de diferents recursos que es van reemplaçant al llarg de l'any. Els aliments bàsics són, fonamentalment les herbàcies a la primavera, els fruits carnosos a l'estiu i els fruits secs a la tardor i hivern.

La dentadura de l'os presenta diferencies respecte a la d'altres carnívors, a l'haver-se adaptat a un règim d'alimentació omnívor i predominantment vegetarià. També el sistema digestiu, encara que conservant les característiques bàsiques d'un carnívor, està millor adaptat al consum de

vegetals. Així, l'intestí és de majors dimensions respecte a la mida del cos. A l'augmentar el temps de trànsit dels aliments, pot absorbir-los i digerir-los millor. Per altre banda, la baixa taxa metabòlica de l'os bru, en relació al gran tamany del seu cos, contribueix també amb el baix consum energètic. Els seus principals requeriments energètics es cobreixen principalment mitjançant el consum d'aliments que es distribueixen en petites unitats (herbàcies, petits fruits, insectes) que estan sotmesos a fluctuacions d'abundància estacionals, interanuals i locals.

A part de les adaptacions fisiològiques que hem dit, existeixen altres factors que ajuden a l'espècie a millorar la rendibilitat energètica. Un factor que pot jugar un paper important en l'optimització de la dieta és la memòria individual, que permet identificar i recordar diferents fonts d'aliments.

La buscada i ingestió d'aliment ocupa la major part dels temps actiu d'un os bru i, és un factor que, en bona mesura, determina els seus moviments i us de l'espai. L'alimentació pot ser, a més, un factor limitant per la demografia de les poblacions. El número de cries i la seva possibilitat de supervivència també té a veure amb el grau d'engreixament de les osses gestants. És durant les estacions en les que l'os consumeix fruits (meitat d'estiu i tardor) quan aconsegueix els majors guanys de pes, a base d'acumular grasses que seran posteriorment utilitzades durant la hivernació i inclòs en fases posteriors a aquesta. Aquests guanys poden arribar a suposar augments de fins el 40% en relació a pesos en primavera.

Comportament

Són predominantment crepusculars i nocturns, amb els màxims d'activitat a l'alba i a la posta de sol. Durant gran part del dia romanen inactius en llocs tranquils, amb un període d'activitat mitja anual diària de nou hores. Es tracta d'animals en gran mesura solitaris. Només poden trobar-se varis exemplars junts durant el zel, en casos d'osses amb cries o en el de germans d'una mateixa camada fins que s'independitzen. També poden produir-se, per simple coincidència, concentracions temporals d'uns pocs exemplars en llocs amb abundància d'aliment. No són animals que defensin territoris.

Comportament reproductiu: els ossos arriben a la maduresa sexual entre els 3 i 5 anys. Són polígams i el seu zel té lloc entre maig i juny. Les femelles presenten una ovulació induïda, cosa que incrementa les possibilitats de quedar prenyades.

Cadells d'ós bru

La implantació és diferida, és a dir, l'òvul fecundat flota lliurement per l'úter i no s'implanta fins a la tardor. Només llavors comença la veritable gestació, que dura uns dos mesos. En plena hivernació al mes de gener i dins la seguretat de la ossera, la femella pareix d'una a tres cries, que pesen al voltant d'uns 350g, i els ossets pesen uns 20-25Kg al complir el seu primer any. Viuen amb la mare aproximadament un any i mig. L'interval entre parts és d'almenys dos anys.

Hàbitat

Mescla de bosc amb garrigues i pastures. A Espanya només n'hi ha a les muntanyes Cantàbriques i als Pirineus. La seva superfície d'hàbitat oscil·la entre desenes i mils de km^2 segons els individus. Els mascles necessiten espais superiors que les femelles.

Fig. 11 Ós bru mascle

Quan avança l'hivern i les nevades es fan persistents, el ossos busquen un refugi per protegir-se. Aquest és, amb freqüència una cova no gaire gran o, en ocasions, un forat excavat per ell mateix aprofitant els buits existents sota alguna roca o arbre.

Sembla que el que més els hi importa a l'hora d'escollir el lloc, és la seguretat que els hi pugui proporcionar. Així, les osseres es troben en llocs difícilment accessibles, encara que no necessàriament remots, trobant-se en ocasions molt pròximes a les poblacions humanes.

Prèviament, els ossos s'hauran d'haver alimentat suficientment per augmentar les reserves en forma de grassa corporal, reserves que es localitzen especialment al voltant dels ronyons i que arriben a mesurar quinze cm de

gruix. Això passa com a mecanisme de defensa en èpoques hivernals. Hi ha escassetat de menjar i inclús aigua i, a més, les baixes temperatures requeririen un elevat consum d'aliments només per mantenir la temperatura corporal. Així que per solucionar això els ossos opten per la hivernació.

Els ossos bruns refugiats en osseres dormen enroscats sobre sí mateixos. La seva temperatura corporal descendeix des dels 38ºC habituals fins als 33 o 34ºC. Disminueixen també la freqüència cardíaca des de 40 pulsacions fins a 10 pulsacions per minut, i el ritme respiratori es relantitza de forma similar.

Estan en un somni profund, en el que ni orinen ni defequen, però s'assembla més al son nocturn dels humans que a una veritable hivernació. Dins de les osseres, les condicions són relativament agradables. Al ser bastant reduïdes de tamany i al haver introduït al seu interior fullaraca, molsa i branques per confeccionar el llit, s'aconsegueixen bones condicions que, juntament amb la calor generada pel propi cos de l'animal, fan que la temperatura es mantingui dins d'uns límits tolerables.

Fig. 12 Óssa amb els seus cadells

El temps de permanència a l'ossera acostuma a ser d'un o dos mesos, essent més llarg en climes més freds. Les osses amb cries recent parides romanen a l'interior prop de quatre mesos.

L'ÓS EN CAPTIVITAT

1. ETOGRAMA

- *Estudi realitzat sobre el óssos bruns (Ursus arctos) del Zoo de Barcelona. Entre parèntesi és el nombre de vegades que s'ha comptabilitzat l'activitat, durant tota una jornada, i cada deu minuts s'observaven els animals i es prenien les notes.*

Les claus que s'usen a l'etograma són les següents:

1. Temps mort (1) → l'animal està fora del camp de visió de l'observador.
2. Posició/inactivitat:
    a. Assegut (3) → recolzat sobre les extremitats posteriors amb o sense el recolzament de les anteriors.
    b. Descans (4) → en decúbit, dormint o despert.
    c. Estació (27) → l'animal està alçat sobre les quatre extremitats. Aquesta conducte supedita a totes les altres.
3. Interacció amb l'ambient i/o amb el públic.
    a. Circ (5) → l'animal realitza accions per tal de cridar l'atenció de les persones, respon als estímuls d'aquest, es recolza contra la paret i s'alça.
    b. Xuxeries (6) → forma de circ, l'animal menja xuxeries llançades pel públic, agafant-les al vol o pescant-les a l'aigua.
4. Interacció amb el mobiliari (7) → rasca, mossega, ensuma el terra, troncs i parets.
5. Interacció amb la companya:
    a. Iniciar agressió (8) → davant la presència de la femella, la ossa inicia una conducta d'agressivitat, mostrant les dents, vocalitzant i fins i tot adopta una actitud amenaçadora.
    b. Respondre a una agressió (9) → en resposta a la conducta prèvia (8), l'animal desafia a la companya, mirant-la directament i mostrant també una conducta agressiva.

c. Submissió (10) → com a resposta a una de les conductes anteriors, l'animal refusa l'enfrontament i es sotmet, allunyant-se, baixant el cap i apartant la mirada.

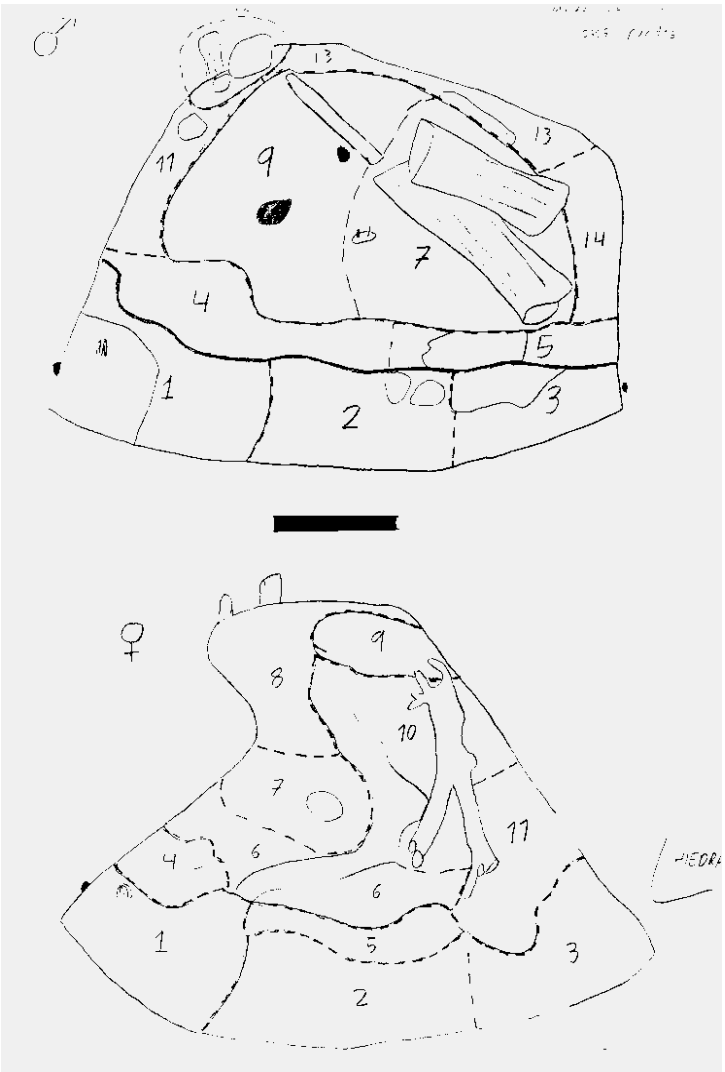
6. Iniciar el joc (24).
7. Respondre al joc (25):
    a. Interacció amb altres gàbies (11) → l'animal introdueix el musell, o les urpes i ensuma, introdueix pedres en els desaigües possiblement amb la finalitat d'explorar la gàbia contigua, tot i que també podria ser com a entreteniment o per mostrar una estereotípia. Seria convenient, marcar-la amb un asterisc quan es tracti de llençar pedres.
8. Ensumar (12) → captar estímuls olfactius alçant el cap i inspirant aire. Aquesta conducta és prioritària sobre la resta.
9. Interacció amb el cuidador (23) → l'animal respon als estímuls que aquest li produeix.
10. Alçat (2) → s'observa en períodes d'inactivitat. No es comptabilitza quan estigui realitzant alguna conducte olfactiva o de circ.
11. Activitat:
    i. Desplaçaments

Fig. 13 ós bru alçat al zoo

    ii. Passeig intranquil (13) → es desplaça per la gàbia a pas lleuger, contínuament i sense cap objectiu aparent, seguint algunes vegades el traçat de manera repetitiva.
    iii. Passeig tranquil (14) → camina pel recinte amb un pas lent i cap a un punt concret.
    iv. Anada/tornada (15) → estereotípia típica; l'animal va i ve sobre un recorregut fix, de pocs passos i de vegades balancejant-se sobre les extremitats anteriors.
    v. Carrera (16) → l'animal surt al trot o galop, en un recorregut generalment curt sense sobrepassar una volta al recinte.
    vi. Escalar (26) → s'enfila pels diferents troncs.

12. Accions reflexes:
    a. Neteja del pèl (17) → l'animal es rasca, llepa, es mossega o es refrega contra el mobiliari.
    b. Beure (18) → ingerir aigua.
    c. Coprofàgia (19) → estereotípia en que ingereix les pròpies femtes.
    d. Menjar (22) → ingestió de pinso o de menjar que deixa el públic.
    e. Mastegar (28) → moviments masticatoris amb la boca oberta.
13. Bany (20) → introduir-se a l'aigua, totalment i sense submergir el cap, excloent les conductes d'entreteniment (pescar objectes, escalar el tronc).
14. Conductes d'entreteniment (21) → inclou perseguir ocells, pescar objectes de la superfície o del fons de l'aigua (bussejar), passejar objectes pel recinte, saltar per atrapar l'heura de la paret o jugar amb el tronc a l'aigua.

Fig. 14 Ós bru nedant



A continuació s'exposa un exemple d'alguna gàbia per a ós.

2. ENRIQUIMENT AMBIENTAL

2.1. Alimentació

- menjar congelat formant blocs de gel.
- aliments dins d'objectes foradats, tals com un tronc foradat o una joguina de plàstic que té un forat que s'anomena kong, a on se'ls l'hi posa cacauets, mel , mantega, melmelada, raïm, menjar de gats, ous bullits, verdures o fruits secs.
- capsa foradada amb escarabats, cucs de la farina o grills i que vagin sortint aleatòriament.
- llistat de telèfon o cables per a què els rosseguin.
- una pilota que reboti.
- oferir rates o peixos vius. Es pot educar per tal que el públic ho accepti.
- oferir rosegadors congelats que els hi pengi la cua.
- se'ls hi pot col·locar en el dormitori carcasses de pollastres o conills.
- amagar menjar entre branques o a l'interior de les roques.

Fig. 15 ós bru llepant mel de les branques

- en les ranures dels troncs també se'ls hi posa menjar.
- per tal de que cavin, es pot enterrar un barril amb menjar al seu interior i que el desenterrin.
- tuberies amb menjar enterrades parcialment.
- oferir melons, cocos, o carabasses com a menjar i com a distracció.
- canyes de blat de moro o de sucre.
- fruites lligades a cordes.
- ossos amb trossos de pell.
- mantega de cacauet congelada, o gelatina congelada.
- aglans, síndries, tomàquets i albergínies.
- mostassa, ketxup, all, salses o pebre vermell.
- pasta elaborada amb farina, aigua, sang, mel i pinso de gos i distribuir-la per la paret del recinte.
- arrels o pinyes.

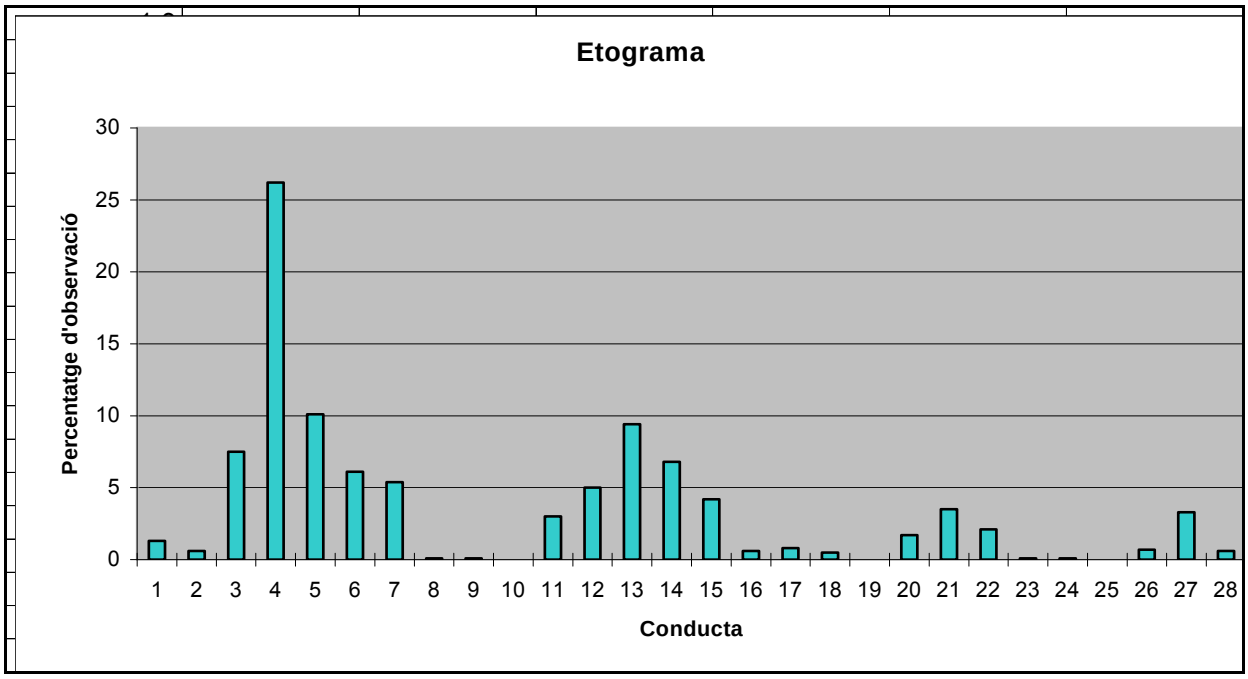
- canyes de bambú amb melmelada congelada amb gust de fruites.

2.2. Altres

- olors de diferents procedències: anís, all en pols, julivert sec, pebres o “maggi” (gallina blanca).
- fulles d’arbres secs, escorça d’arbres.
- pell d’altres animals.
- caixes amb branques de pi i menjar a dins.
- penjar objectes (amb corda o sense).
- sons naturals, vocalitzacions d’altres espècies o música.
- arbusts o arbres decorats.
- palla o branques pel terra i repartides pel recinte.
- dutxes d’aigua.
- canvis d’humitat (mangueres), o canvis a la radiació solar (ombres).
- ruixar la gàbia amb aigua abans que entri l’animal o amb feromones d’altres espècies.
- pilotes de goma recobertes de sang, olors o ossos petits.
- fusta parcialment cremada.
- joguines de plàstic, cons de tràfic, tubs de PVC flexibles.
- taulons superposats.
- cordes amb pesos a l’extrem.
- barrils de cervesa buits.
- repartir pel recinte defecacions d’altres animals o restes de pèl.
- intercanviar i fer rotacions de les gàbies amb altres ossos.
- permetre l’entrada d’altres animals tals com conills o cabres perquè deixin rastre.
- col·locar arbres o llocs verticals perquè es puguin rascar o escalar.
- ninots de neu.

Fig. 16 ós escalant un arbre

** Gràfica de referència per veure la freqüència dels costums descrits anteriorment.*



Aquestes són les conductes menys freqüents (≤0.1): iniciar agressió, o respondre a aquesta, submissió després d'una agressió, coprofàgia, interacció amb el cuidador, iniciar el joc i respondre a aquest.

En canvi, les conductes més freqüents són:

Descans	26.2%
Circ	10.1%
Passeig intranquil	9.4%
Assegut	7.5%
Passeig tranquil	6.8%
Xuxeries	6.1%

3. LES ESTEREOTÍPIES

Una estereotípia és un moviment constant, repetitiu i innecessari, que no porta enlloc (Carlstead et al., 1991a, Mason, 1991), i per tan es considera anormal. Es manifesta, sobretot, en animals salvatges en captivitat perquè indiquen que l'animal pateix una frustració, ja sigui per manca d'exercici, d'instal·lacions inadequades, alimentació i dieta incorrectes i sobretot, al ser animals que estan fora del seu espai natural, es manifesten estereotípies perquè l'ambient i l'entorn és inadequat. Per això cada vegada més, els zoològics i els centres de recuperació de fauna salvatge, donen més importància a l'enriquiment ambiental, ja que és un dels factors que més influencia l'estat d'ànim de l'animal. L'ambient ha de crear estímuls prou interessants a l'animal perquè no s'avorreixi durant el dia. Ha de poder buscar, olorar i satisfer les seves necessitats bàsiques. Això ho entenem si estudiem el comportament en llibertat dels óssos i s'ha de mirar de recrear un espai el màxim de fidel possible, del seu entorn natural.

Fig. 17 ós bru en estat salvatge

Segons un estudi realitzat en el zoo de Zurich, les estereotípies en les ósses femelles estan inversament correlacionades amb la freqüència de descans. En canvi en el mascle, la freqüència d'estereotípies va correlacionada inversament amb les interaccions socials amb les femelles.

Segons Forthman (1992), els recintes dels zoològics són petits i mal dissenyats per les necessitats dels animals, perquè són molt pobres a nivell d'enriquiment ambiental, ja que acostumen a ser de terra de formigó i això comporta que comencin de molt joves a realitzar estereotípies, [Ames, 1993; Carlstead et al., 1991; Forthman et al., 1992; Keulen-Kromhout, 1978; Wechsler, 1991].

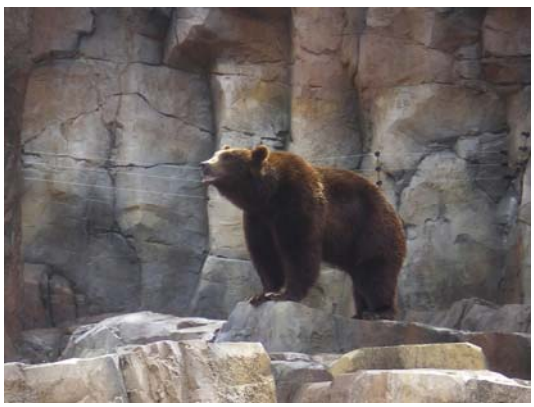


Fig. 18 ós bru al zoològic

Les estereotípies, tal i com s'ha comentat anteriorment, indiquen que l'ambient és subòptim, ja que els animals no poden

recrear el seu comportament natural perquè no troben els estímuls necessaris per a fer-ho. Per això és tant important proporcionar als animals joguines, elements naturals per a què s'estimulin i s'entretinguin, així redirigeixen la seva actitud negativa i la seva frustració cap a aquestes activitats estimulants.

Perquè menjar és una de les activitats més estimulants i a la que els óssos en captivitat dediquen més hores al dia, l'enriquiment en l' alimentació és encara més important. Cal amagar menjar, enginyar situacions a les que l'animal hagi de concentrar les seves energies en recuperar el menjar i així tenen menys temps per mostrar estereotípies, [Ames, 1993; Carlstead et al., 1991; Forthman et al., 1992; Wechsler, 1991.

Fig 19. Imatge de l'entorn de l'ós en llibertat

<u>Un exemple de recinte per a óssos: el zoo de Zurich i l'enriquiment alimentari</u>

L'exposició a l'aire lliure es composa en el zoo de Zurich de tres compartiments de 1210, 630 i 700 m2 rodejats per parets de roca artificial, un fos sec de seguretat, aigua natural corrent i estancs.

Els tres compartiments poden estar connectats per ponts giratoris, com troncs, a través d'una fossa o per una habitació a l'aire lliure que se situaria entre el cau i el lloc d'exposició. El recinte d'exposició està equipat amb un terra natural compost per vegetació (praderes, matolls, arbustos i arbres), zones rocoses, escalada d'arbres

Fig. 20 Exemple d'enriquiment ambiental amb troncs.

morts en posició vertical amb plataformes de descans a diferents nivells, un petit riu i diversos estancs d'aigua.

La majoria del recinte està a un nivell més elevat que els visitants. A més a més dels óssos, hi ha un grup d'espècies tals com ànecs, coatins i gall dindi que fan rotacions del recinte, així impregnen l'estància de feromones seves, i quan canvien d'espècie, la següent olora el rastre que ha deixat l'anterior.

Cada matí, abans de deixar sortir als animals, se'ls hi proporciona un 70-80% dels aliments, que consisteix en peres, pomes, enciam, pastanagues, escarola, pa i pelets. El 20-30% restant, es serveix a la nit.

Durant el dia, els aliments van ser utilitzats per l'enriquiment d'alimentació: tubs de formigó enterrats en el terra i que contenen aliments, branques-bastidors (construccions metàl·liques a on es pot pujar per arrencar les branques fresques més altes, troncs de fusta de 3-10 × 40 cm, con 10 cm de profunditat ple de forats estrets, amb panses), un arbre amb mel (arbre mort a on a la copa hi ha una tassa que conté mel).

En les observacions efectuades pel personal del zoològic, ens determinen que el temps dedicat pels óssos a buscar aliment és major que certs comportaments alternatius ja sigui descans, caminar o interactuar amb els altres óssos. Cal que el temps de descans estigui assegurat perquè s'ha observat que si en dies de mal temps, els óssos no poden descansar, mostren més estereotípies.

El zoo de Zurich assegura que la millora del comportament dels seus óssos són resultat directe de l'enriquiment i la important disminució de les estereotípies, [Forthman et al., 1992, p. 194]. Carlstead et al. [1991]. Així doncs, l'enriquiment ambiental es destina a promoure comportaments naturals per tal de prevenir l'adquisició d'estereotípies.

Thieme y Kolter [1995] prediuen amb la importància dels llocs de descans adequats perquè van trobar certa correlació entre la falta de llocs de descans i l'increment de la locomoció per manifestar les estereotípies.

També és important tenir en compte que si hi ha una femella en zel i el mascle no la pot munta, veurem un increment en les estereotípies d'aquest, perquè indicarà la seva frustració. S'ha vist en aquest estudi que els animals joves que no han fet mai estereotípies, introduïts en un ambient ric no fan estereotípies, ni les aprenen a fer. En canvi animals que abans sí que en feien, se'ls canvia

per un recinte més enriquit, disminueixen el seu grau d'estereotípies però sempre en mantenen certa freqüència.

· Estudi comparatiu del comportament i sobretot de les estereotípies dels óssos europeus en sis zoològics diferents

Amb la finalitat d'avaluar la influència dels paràmetres ambientals en el comportament de l'ós, s'estudien setze óssos de sis zoològics diferents.

S'observa que els animals amb un recinte més gran, es caracteritzen per una alta taxa de joc, comportament social, menjar i explorar el recinte.

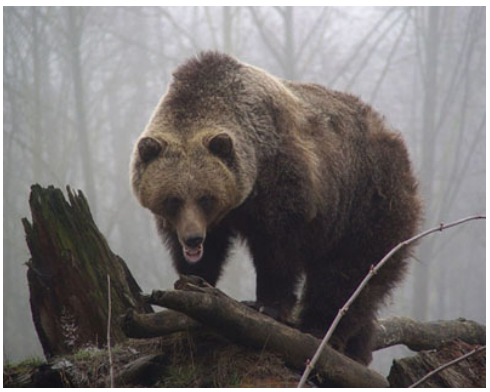


Fig. 21 ós en llibertat

Com que aquests zoològics eren nous, es van estudiar els animals més joves, i es va associar que les estereotípies es presentaven en animals d'edat mitja i si estaven confinats a un recinte inadequat (petit). Incrementaven en aquells zoos que es permet el llançament de menjar i sobretot quan s'acosta l'hora d'arribada del cuidador a repartir el menjar.

Introducció

L'ós bru (*Ursus arctos arctos*) és un animal molt conegut i famós dels zoològics, ja sigui per l'antic folklore dels circs on domaven óssos o ja sigui pels famosos ossets de peluix. El fet és que n'hi sol haver a molts zoos perquè es reprodueix molt bé en captivitat (Tumanov, 1998).

Fig. 22 Recinte d'óssos

Tot i ser una espècie segura en els zoològics, el recinte deixa molt que desitjar perquè la majoria no estan modernitzats i presenten un estanc petit, una vegetació pobre i sense troncs ni roques per poder escalar (Pappas 1993; Poole, 1997; Kolter Smith i Usher, 1998).

Per això en els últims vint anys, s'han portat a terme nombrosos intents de millora del recinte (Bacon, 1992; Shepherdson, 1992; y Mellen MacPhee, 2001).

En termes generals, l'enriquiment de la gàbia es caracteritza per permetre als animals de que puguin demostrar el seu repertori de comportament natural (Mellen i MacPhee, 2001).

Si es compara la captivitat amb la naturalesa, la falta d'estímuls nous, l'espai limitat i la falta de complexitat de l'ambient porta a l'animal a mostrar estereotípies per la frustració que tot això suposa (Carlstead, 1996; Poole, 1998).

Com a conseqüència de tot això, amb l'objectiu general que es busca és proporcionar als animals oportunitats per poder mostrar el màxim del seu comportament en estat salvatge.

Una millora en el repertori del comportament es pot utilitzar com a un indicador de benestar (Healy, 2000).

Per a óssos bruns, l'addició d'una estructura per la qual poder enfilar-se i escalar-la indueix a mostrar més diversitat de comportament.

Fig. 23 Ós jugant amb un arbre

Com que en la natura els óssos es passen la major part del dia buscant menjar, en captivitat s'hauria d'intentar recrear aquesta recerca dels aliments, estimulant-los per tal que simulin les accions que farien en llibertat i redueixen les estereotípies (Fischbacher i Schmid, 1999). Renner et al. (1999) va recomanar l'enriquiment com a una tècnica per resoldre problemes comportamentals en els animals captius.

Fig. 24 ós d'un zoològic dormint. Podem veure cert grau d'enriquiment ambiental (pneumàtic).

Fins fa relativament poc, l'aparició d'estereotípies es considerava com a un indicador d'avorriment, un ambient pobre.

Malgrat tot, també poden aparèixer en ambients enriquits i complexos (Mason, 1991; Fischbacher i Schmid, 1999). Segons Wechsler (1992), és àmpliament acceptat que les estereotípies es realitzen en situacions en les quals hi ha conflictes de motivacions. Moltes estereotípies s'associen a una falta de descans o a un lloc incorrecte on fer-ho i també a l'alimentació. Les estereotípies es manifesten de maneres diferents i estan influenciades per l'edat i sexe (Ames, 2000).

Al 1998, Spendrup i Larsson van estudiar l'ós bru i les estereotípies que realitzava i poder concloure quins són els factors més importants per prevenir-les o reduir-les.

Per fer-ho van observar sis zoològics francesos i belgues (Pescheray, Rodas, Gramat, Le Clos, Vincennes, Han sur Lesse). Es va veure que l'àrea del recinte és un factor clau, com més superfície quadrada té l'animal, menys estereotípies té.

En aquest estudi les superfícies estudiades són molt variables: de 17.000 a 300 m2, qualificant-los com a grans (17.000m2), mitjans (1000 a 800 m2) i petits (600m2 o menys). Les edats dels animals estudiats van ser d'un any fins a trenta-cinc, siguent joves (1-5 anys), mitjos (11-14 anys) i vells (21 anys o més).

Les sessions d'observació van durar tres dies i un mínim de 7 hores per dia.

El comportament que es podia observar era:

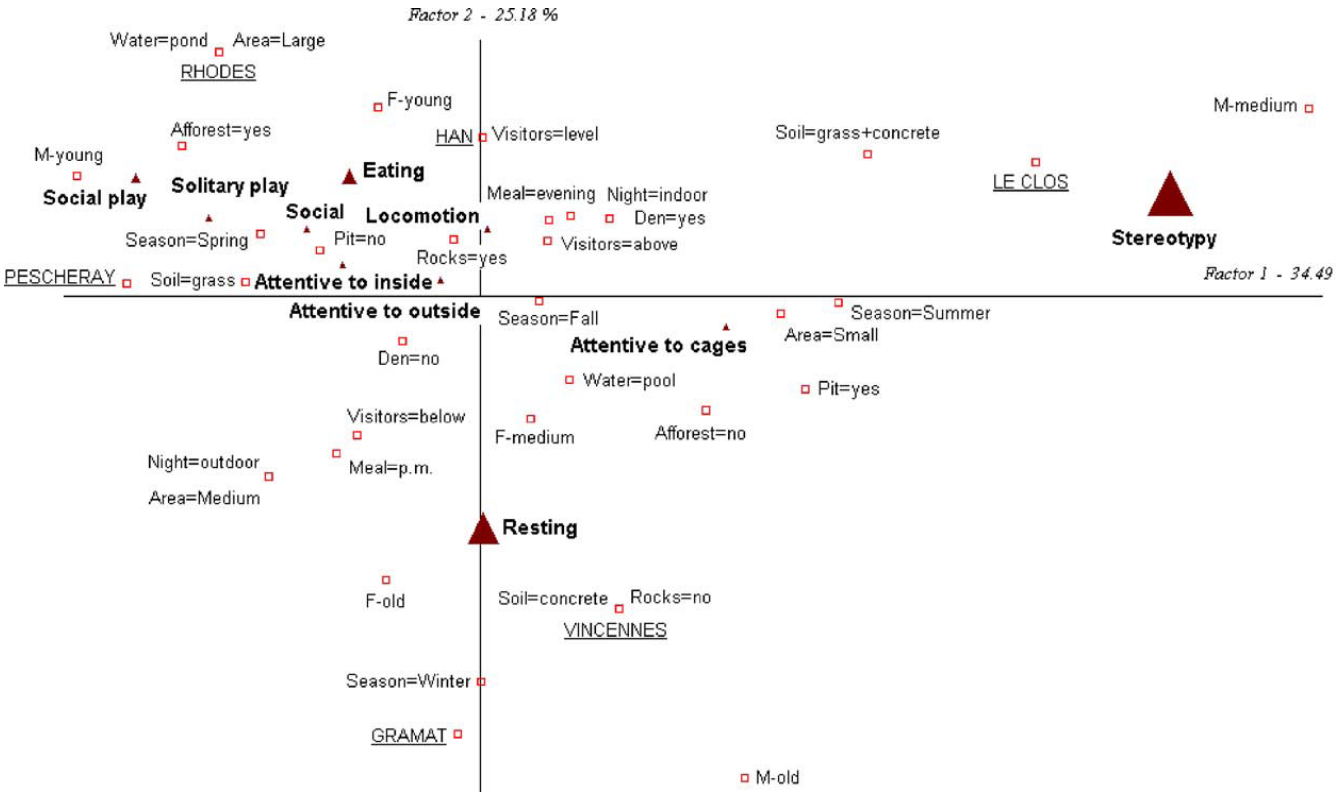
- Atent a les gàbies → l'ós s'apropa a les barres de les baranes, gàbies i esgarrapa.
- Atent a les excavacions → Olora una arbre, roca, rasca el terra o un arbre.
- Atent a fora → l'animal observa o escolta el que hi ha a fora del recinte, els visitants i demana menjar.
- Locomoció → l'animal camina (amb el cap a la línia mitja, vol dir que no el porta alt per veure l'entorn, i tampoc el porta baix per olorar el terra). Corre, escala.
- Alimentació → olora les persones que porten aliments, mossega, llepa el menjar, rasca les fulles o l'escorça dels arbres i caça insectes.

- Social (excepte jugar)→ olora, llepa l'altre ós, olora l'orina i femtes i de vegades estableixen contacte físic.
- Jugar → es persegueixen els uns als altres, mantenint sempre la distància constant. Entaulen una lluita pacífica que es basa en mossegar amb la boca oberta. L'ós solitari sol jugar amb branques, a l'estanc o amb les seves pròpies extremitats.

Fig. 25 Dos óssos joves jugant

- Repòs → l'ós s'asseu, de vegades recolzat en un tronc sense mostrar atenció per a res en concret, amb els ulls oberts o tancats.
- Estereotípia ritme → l'ós camina contínuament d'esquerra a dreta en una línia recta col·locant els peus exactament a la mateixa posició a cada tram.
- Estereotípia circuit → l'ós camina seguint la ruta en un circuit.
- Balanceig → l'animal està davant de la gàbia o la porta i carrega el seu pes en una extremitat i a l'altra alternat el pes de càrrega i balancejant d'un costat a l'altra el cap.

Després de diversos dies d'observació, es va determinar que el zoològic de Le Clos, els animals passaven més d'un 50% fent estereotípies (tal i com es mostra a l'esquema següent).



Les conclusions d'aquest estudi van en funció de l'edat dels animals, per exemple, en els zoos de Han i Pescheray, tenen més percentatge de joc i actituds socials perquè els óssos són més joves, i en canvi, en Granat i Vincennes, al tenir óssos més geriàtrics tenen més percentatge de temps de descans degut a l'increment de l'edat dels animals.

L'actitud de buscar menjar, està molt relacionada amb els recursos oferts de cada zoològic i l'enriquiment de l'entorn (herba més alta durant la primavera simulant la natura o més amagatalls per buscar insectes).

Malgrat tot, s'ha vist que la freqüència de les estereotípies no depèn exclusivament de l'edat dels animals, perquè hi ha més incidència en animals de joves (5 anys) i de mitjana edat, i tampoc el fet de tenir unes bones instal·lacions i un bon equipament és un factor d'èxit segur, ja que també s'han observat moltes estereotípies en Rodas (zoològic molt ben equipat) i evidentment en els zoos més petits i humils (Vincennes).

L'estereotípia més freqüent és la de demanar menjar, i la manifestació més freqüent d'estereotípia és veure l'animal caminant sempre en el mateix lloc del recinte, fent el mateix recorregut. El cap no el porten ni alt, ni baix, sinó que el porten sobre la línia mitja. El recorregut i el lloc triat sempre és el mateix,

perquè és des del qual tant els visitants, com el criador els hi proporcionen menjar.
Aquest tipus d'estereotípia s'intensifica quan arriba l'hora de menjar i els animals saben que apareixerà el cuidador per dóna'ls-hi menjar. En alguns parcs, l'administració de menjar per part del zoo s'ha duplicat per veure si així reduïen les estereotípies, però no ha funcionat. En Pescheray, s'ha reduït aquesta estereotípia en els óssos joves de que han prohibit que els visitants els hi tiressin menjar.
Pel que fa a les estereotípies de l'edat són molt difícils d'eradicar (Koene, 1994a; Wemelsfelder, 1993).

L'enriquiment amb objectes no alimenticis

Fins ara hem parlat molt de les estereotípies d'alimentació, i ara ens centrarem una mica en les estereotípies no alimentàries, que són les que intenten fer un enriquiment ambiental, proporcionar joguines al óssos perquè no passin masses hores inactius i puguin acabar desenvolupant estereotípies.

Per exemple, el fet de proporcionar un flotador durant l'estiu, és molt útil perquè incrementa el nombre d'hores a la bassa i això té dos beneficis: refrescar-se i regular millor la temperatura a l'estiu, i estar més actiu i fer exercici.
Una altra opció és el fet de proporcionar una pilota de plàstic que reboti i la pugui empaitar.
La complexitat del medi del recinte fa incrementar la interacció entre l'animal i el seu ambient i redueix frustracions perquè pot expressar gran part del repertori de comportament que expressaria en estat salvatge.
Cal pensar que moltes vegades si introduïm un objecte nou, els hi crida l'atenció durant una estona i després ja deixen de mostrar-hi interès i els óssos tornen a la passivitat. Un exemple molt clar és el dels aliments: quan han trobat l'aliment i ja se l'han menjat (això pot durar 30 minuts), després tornen a la inactivitat. Malgrat tot, diversos estudis avalen aquesta teoria perquè rebaixen el grau d'inactivitat i avorriment dels óssos, encara que sigui per unes hores.

L'enriquiment estructural

"Enriquiment per a l'ós bru per tal de garantitzar el seu benestar "

En el zoo de Barcelona es va estudiar dos óssos bruns. El que es va observar va ser que el mascle tenia un patró més ampli de moviments respecte la femella i que aquest patró de moviments eren molt similars que els óssos mascles a la natura.

Fig. 26 ós en un zoològic.

També van observar que el fet de canviar-los de gàbia va fer incrementar l'actitud de vigilància i manteniment.

Un dels cinc tipus d'enriquiment ambiental és l'estructural (Bloomsmith, Brent, y Schapiro, 1991). Com a conseqüència molts zoològics han començat a col·laborar amb arquitectes i enginyers per dissenyar explotacions que millorin l'estil de vida dels animals.

Per exemple, un canvi en la forma i tamany del recinte (Van Keulen-Kromhout, 1978; Winhall, 1998), la construcció d'àrees de descans (Cowan, 1997; Poulsen y Precio, 1997) i la introducció d'alguns objectes artificials amb naturals (Acuña, 1993).

El terme POE (postoccupancy evaluation), s'usa en el llenguatje arquitectònic per designar l'optimitat d'un edifici una vegada que la construcció ha estat provada i està en funcionament (Zimring Reizenstein, 1980). Es tracta com si l'edifici estigués en període "de proves" i cadascuna de les persones que l'utilitza pugui exposar si compleix o no els requisits que necessita o si falta alguna cosa. El POE permet plantejar decisions sobre la planificació i el disseny dels ambients i dels recintes (Ross & Lukas, 2003).

Els principals usuaris són els animals (Riddle, Keeling, Alford, & Beck, 1982; Ross & Lukas, 2001). Malgrat tot, també n'hi ha d'altres com els cuidadors, veterinaris, investigadors i visitants. I l'edifici ha de complaure a tots els sectors.

Els subjectes per l'estudi van ser dos óssos bruns del zoo de Barcelona: Bubu (10 anys, femella i nascuda en captivitat) i Keiko (1,5 anys, nascuda en llibertat però criada a mà).

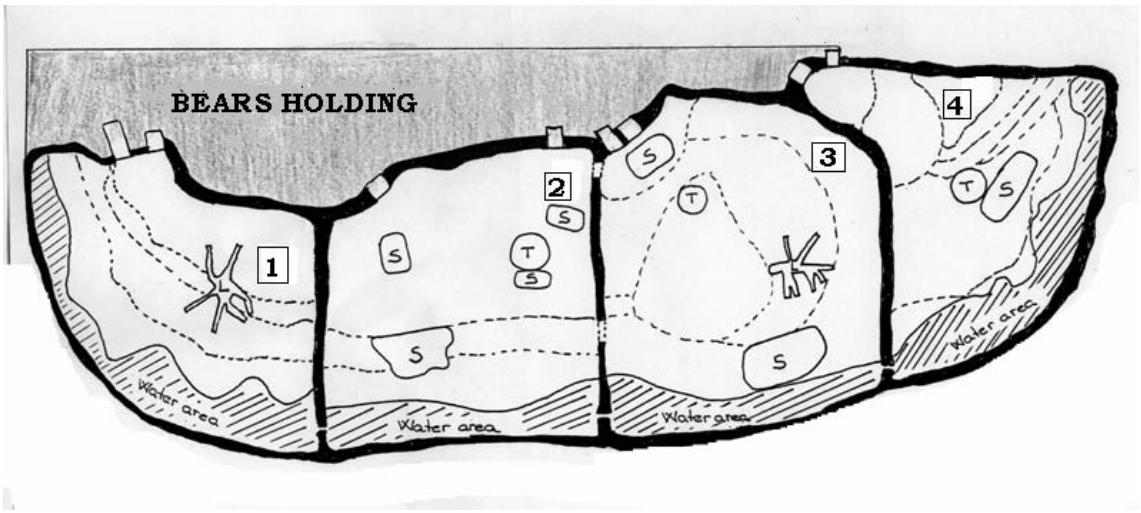
En l'estudi, Bubu vivia amb la seva mare, mentre que Keiko vivia sola en un recinte de 100m2. Conservaven el contacte auditiu i olfactiu perquè vivien en

recintes veïns. Tenien a la seva disposició piscines de formigó, una zona per beure i banyar-se. El mobiliari consistia en pedres grosses i arbres. tenien una zona de 10m2 que quedava fora de l'abast dels visitants i tenien accés lliure al pati de les 9:00 del matí a les 8:00 del vespres tots els dies.

S'alimentaven amb fruites, carn, hortalisses una vegada al dia.

Fig. 27 Dietes dels óssos en un zoo.

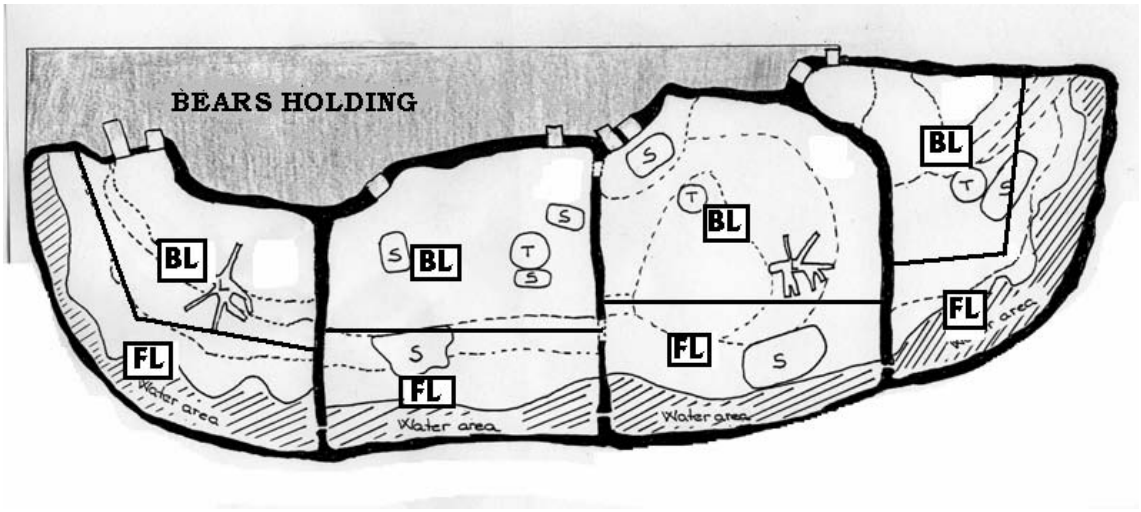
FIGURA 1 plànol del recinte dels óssos. 1 = *Selenarctos thibetanus* recinte; 2 = *Ursus americanus* recinte; 3 = *Ursus arctos arctos* recinte; 4 = *Ursus arctos* e recinte; s = stone; T = tree; L = log;



L'observació es portava a terme de les 10:00 am a les 8:00 pm per diverses persones que havien superat la prova de fiabilitat.

Els recintes es van dividir en dos de similars en quan a la proximitat dels animals als visitants (figura 2).

FIGURA 2 Plànol sobre el recinte dividit en dos quadrants: la part del davant del recinte (FL) i la del darrera (BL). S = stone; T, = tree; L = log; BL = back location; FL = front location; dashed line (- -) = uneven surface.



El POE i la fase d'avaluació van determinar certs canvis al recinte. Es van fusionar els quatre recintes i se'n van construir 2; per tant el tamany del recinte de la Keiko va augmentar fins a 150m2 i el de Bubu fins a 230 m2. A més a més, es van modificar diferents àrees per augmentar el nombre de superfícies diferents. A més a més del ciment, es van condicionar zones per a què hi hagués sorra de la platja, grava i escorça de pi. Noves pedres i nous troncs es van introduir com a mobiliari addicional. Es va afegir una bomba en el sistema d'aigua per tal de que l'aigua de l'estanc fluís i no quedés estancada. També s'ha afegit un dispensador de mel i tubs de PVC fixos.

Bubu va passar més temps a llocs no visibles, manipulació, activitat, vigilància, locomoció i menys temps per explorar, alimentació o interacció social. En canvi, Keiko va passar més temps en la vigilància, manteniment i inactivitat i menys temps en explorar, no visible, locomoció, jugar solitari, alimentació i interacció humana.

Conclusions

Més categories de comportament (joc solitari i estereotípies de comportament) s'observen en l'ós bru mascle que en la femella. Els resultats del POE van ser que els óssos dediquen més temps a la vigilància, manteniment, manipulació i joc solitari. L'increment de tasques de manipulació i exploració es deu al fet

d'incrementar la superfície del recinte (importantíssim en aquesta espècie, Spendrup Larsson 1997), la introducció de nou mobiliari i dels diferents substrats.

El manteniment és un indicador de benestar, ja que contribueix a controlar les funcions fisiològiques.

El joc solitari contribueix al desenvolupament de les capacitats motrius. L'aparició de joc solitari pot explicar-se en mascles joves i el vincle entre el joc i l'aprenentatge.

La interacció humana no és aconsellable perquè tendeix a desequilibrar a l'animal.

Malgrat incrementar l'espai del recinte i aplicar enriquiment estructural, els óssos mascles seguien mostrant un 10% d'estereotípies (indicador de que la fisiologia i benestar de l'animal no és l'adequat), i per tant el Zoo decideix aplicar més programes d'enriquiment (alimentari, professional i sensorial) (Beattie, Walke, y Sheddon, 1996).

Els factors que potser han influït en el fet de que els mascles presentin cert percentatge d'estereotípia pot ser perquè la seva gàbia queda més a prop de la zona dels cuidadors i fan estereotípia alimentària perquè els escolten més. I per últim podríem dir que s'ha realitzat un enriquiment massa homogeni i això fa que no pugui elegir a quin lloc del recinte anar en un moment determinat.

El primer pas a fer és "deshomogeneitzar" i deixar que l'animal pugui triar a quina zona vol anar. Això demostra que hi ha una resposta individual en l'enriquiment ambiental, influenciat pel sexe, edat, origen i condicions de cria, (Hace et al., 2003).

Fig. 28 Podem veure la importància dels arbres en aquesta espècie.

A més a més, en la natura, els óssos tenen la vista bloquejada per nombrosos obstacles que s'hi interposen i llavors aguditzen més l'oïda i l'olfacte. Si

apliquem això al zoo, fem aflorar més instints i més conducta natural a l'animal en captivitat, (Van Keulen-Kromhout, 1978).

Amb tots aquests aspectes citats, es pot concloure que per tenir animals en captivitat i amb un òptim grau de benestar, cal aconseguir l'equilibri entre una correcta exposició entre l'exterior i l'interior de la gàbia, un correcte maneig diari i sobretot una correcta arquitectura que satisfaci el màxim les necessitats dels animals, (Shettel-Neuber, 1988).

4. CONCLUSIONS

- Enriquiment estructural → recinte ben dissenyat tan per l'ós, com per a les persones que l'utilitzaran, recinte gran, espai que garantitzi el descans.
- Enriquiment alimentari → amagar molt de menjar a llocs diferents, i que no siguin els mateixos amagatalls d'un dia per l'altre.
- Enriquiment ambiental → arbres per escalar, estanc per banyar-se, herbes altes i joguines per entretenir-se, llocs on amagar-se, plataformes a diferents nivells.
- Enriquiment sensorial → ruixar amb feromones el recinte per estimular l'olfacte, posar al cd que simuli els sorolls dels boscos on viuen per estimular l'audició, col·locar obstacles a la vista per tal de què desenvolupin més l'oïda i l'olfacte.
- Educar als visitants per a què no tirin menjar (reforcen l'estereotípia de l'aliment).
- Les estereotípies no sempre es manifesten a animals geriàtrics (també a animals joves i mitjans) i també es poden presentar en zoològics amb molt d'enriquiment.
- Sol presentar-se més en mascles que en femelles.

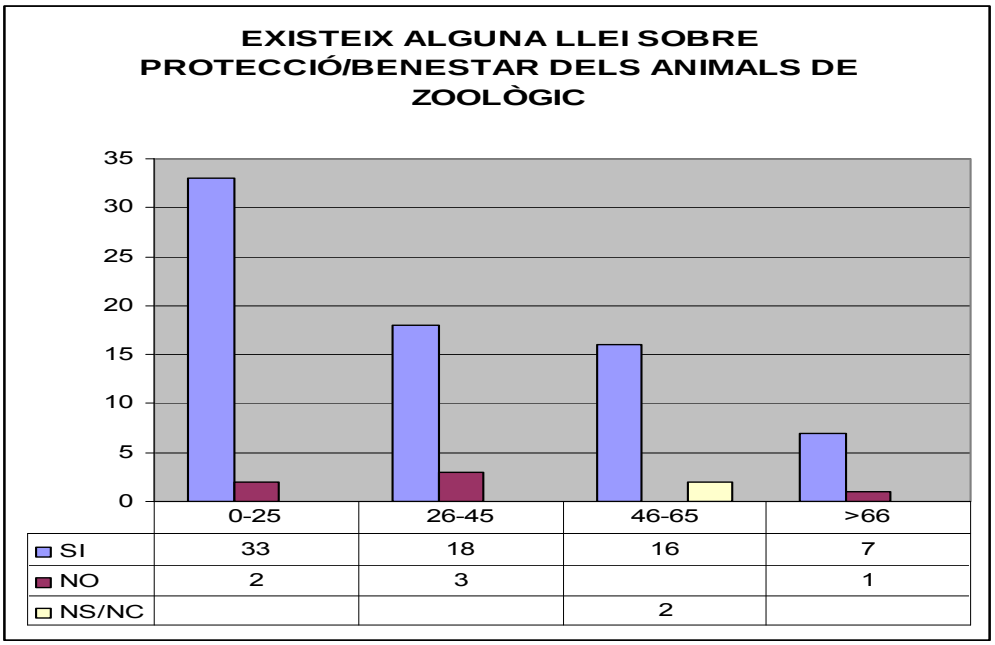
ENQUESTES

Després de tota la recerca en la base legal i teòrica ens quedava indagar a la realitat que és el què hi passa, per la qual cosa vàrem decidir fer una enquesta a la població. El grup escollit ha estat un nombre total de 82 persones a partir de 17 anys. Aquests enquestats els hem dividit en quatre grups de tal manera que queden repartits de la següent forma: joves (fins a 25), adults (26-45), mitjana edat (46-65), majors (>66).

L'enquesta està estructurada amb 10 preguntes que a continuació analitzarem una per una amb els gràfics corresponents.

PREGUNTA 1

Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològics?

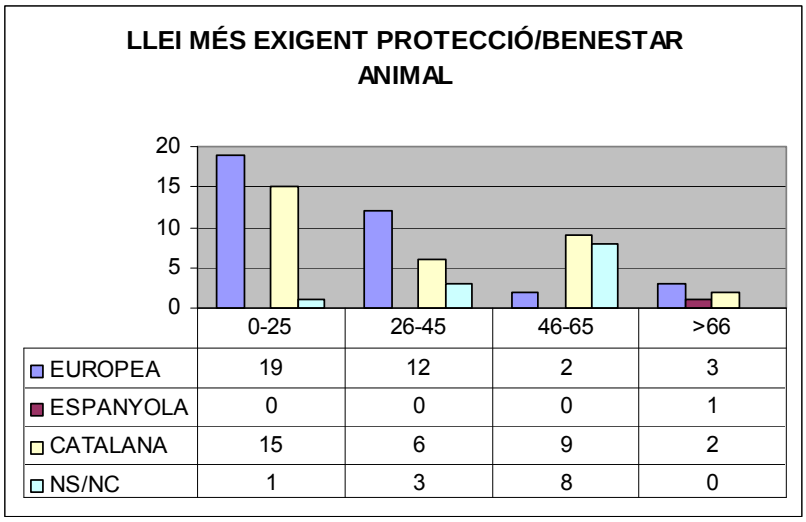


El 90% de la població suposa que existeix alguna llei que regula la protecció/benestar dels animals del zoo. Els valors de les respostes, no i ns/nc (no sé, no contesto) són insignificatius davant el si.

PREGUNTA 2

Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològics?

La majoria de la població opina que la llei europea és més exigent que la catalana i la espanyola. Només podem destacar que en el grup de mitjana edat això no passa però per contrapès la resposta ns/nc també té un pes important.



	0-25	26-45	46-65	>66
EUROPEA	19	12	2	3
ESPANYOLA	0	0	0	1
CATALANA	15	6	9	2
NS/NC	1	3	8	0

Cal valorar el fet que al opinar davant un tema desconegut és fàcil pensar que la llei que mana per sobre totes sigui també la més exigent, tot i que sabem que en molts casos no és així. Pel què fa a la legislació de protecció i benestar, com la resta de legislacions, la llei europea dóna una bona base mínima sobre la qual la llei catalana encara la profunditza més i la fa més exigent.

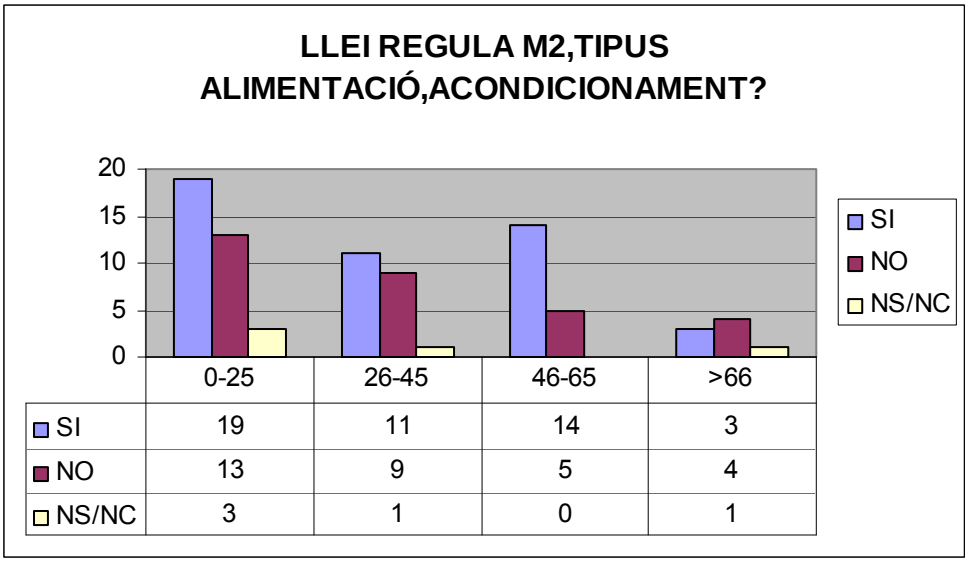
PREGUNTA 3

Creus que les lleis actuals regulen aspectes com els m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte, etc.?

Tot i ser conscients del poc coneixement general de legislació en animals, vàrem voler demanar de manera indirecta el grau d'especificació que creien que estava regulat.

Les directives sortides de la Unió Europea, han estat cada vegada més nombroses i sensibles vers la protecció dels animals. Així en data 29 de març de 1999, va adoptar la Directiva 1999/22/CE relativa al manteniment d'animals salvatges en parcs zoològics a fi d'establir una base comuna als Estats membres que propicien la correcta aplicació de la legislació comunitària en matèria de conservació de la fauna silvestre i que d'altra banda asseguri el compliment pels parcs zoològics del seu important paper en l'educació pública, en la investigació científica i en la conservació de les espècies.

Els resultats obtinguts:



	0-25	26-45	46-65	>66
SI	19	11	14	3
NO	13	9	5	4
NS/NC	3	1	0	1

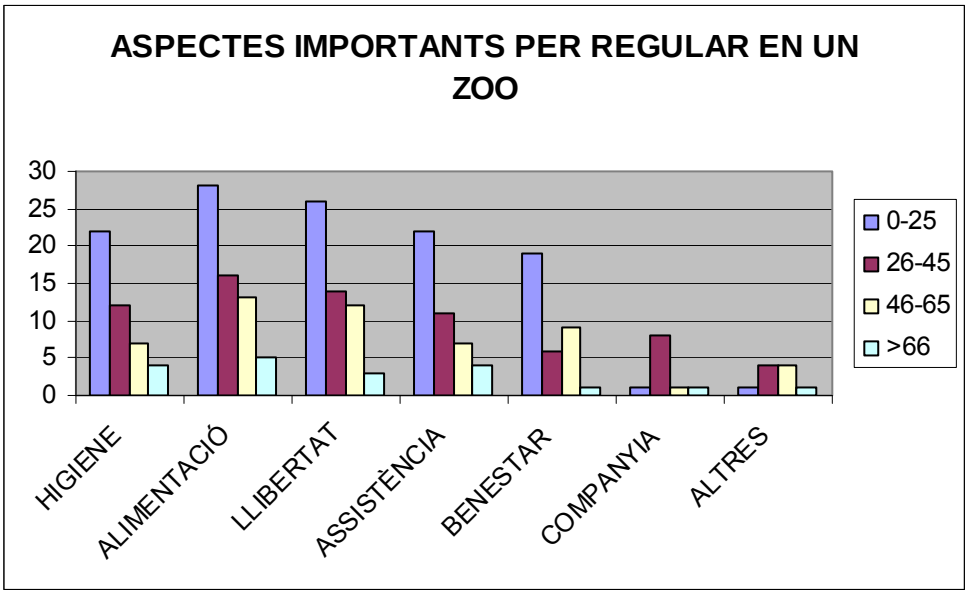
La opinió està bastant repartida ja que a cada grup trobem un valor diferent. En el grup de joves està igualat, mentre q el grup d'adults i majors opinen que no, al contrari dels de mitjana edat en el qual un 30% diuen que si.

PREGUNTA 4

Quins aspectes creus que són importants per regular legalment els animals del zoo?

Aquesta pregunta era oberta, és a dir, vàrem deixar que la gent respongués lliurement el què pensava i d'aquí hem tret els punts més destacats. Així tenim que per ordre d'importància en els tres primers llocs és: l'alimentació, el grau de llibertat, i en tercer lloc considerem que hi ha un empat entre la higiene i assistència veterinària ja que la diferència numèrica es d'una unitat.

Al grup d'altres hi ha incloses totes aquelles respostes molt minoritàries com per exemple: controlar els animals en perill d'extinció o assegurar la seguretat dels ciutadans.



Els zoos compleixen amb una funció important, però que cal ser molt curosos en el seu plantejament. Bàsicament un zoo, ha de complir amb tres funcions: la recerca, l'educació ambiental i el lleure familiar. Un zoo ha de ser un espai agradable per a les famílies on es pugui aprendre a respectar la natura però un zoo ha de ser també un espai on es desenvolupin programes de reintroducció d'espècies amenaçades i on es facin programes en favor de la riquesa natural. Per tant el plantejament del zoo ha de ser diferent. Fa uns anys vàrem passar de les gàbies a les instal·lacions i ara cal passar als hàbitats. Tot això permetrà un projecte que sigui a la mida de la ciutat, que no hipotequi cap projecte

important i que aposti per la defensa de la biodiversitat i no per l'exhibició d'animals. I sobretot és important garantir el caràcter públic del zoo. Per tant a l'hora de regular per llei o norma vers els animals, es necessari que es faci pensant amb ells, tal com demostren les respostes dels nostres enquestats.

PREGUNTA 5

Què entens per benestar animal?

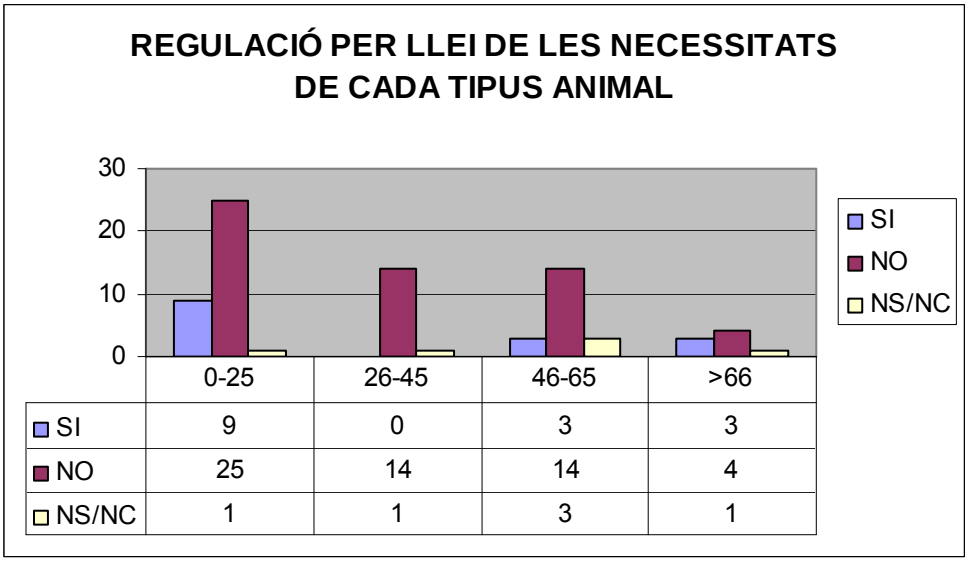
La definició donada per l'enciclopèdia catalana és: *estat de qui se sent bé, en què els sentits estan satisfets; situació en la qual hom troba satisfetes les necessitats de la vida.*

Actualment no existeix una definició de **benestar animal** acceptada per tots els científics. Personalment ens afegim a l'opinió de Colin Whittemare, 1996 : El benestar es pot observar des de dues perspectives. La primera és la percepció humana del benestar de l'animal, i la segona la del propi animal. La primera es provable que sigui variable, oscil·lant segons canviïn els preceptes de la societat, i dependrà de les costums i cultures locals. A més a més es veurà motivada a través d'un desig polític i pot ser reforçada per la legislació. La segona percepció tindrà aspectes en comú amb la primera, però sobre una base diferent. La percepció de l'animal tendirà a relacionar-se amb la seva situació de sanitat i benestar, carència de lesions, adequació en el subministra d'aliment i aigua, absència d'actes inacceptables d'agressió, carència d'estrès i possibilitat de manifestar les conductes necessàries per a crear una vida agradable dins del context ambiental en què es troba el propi animal.

Fent una valoració general de les enquestes tota la població mostrejada té una idea correcta del significat de benestar animal. Segons els resultats, hem pogut veure que les definicions les podríem dividir en dues branques. La primera seria en la vessant del sentit emocional, és a dir, relacionat amb el tracte, estat de salut, la companyia, el cuidat, el maneig, el menjar... mentre que la segona vessant és en el sentit físic: màxima llibertat, hàbitat similar, desenvolupament i funcions vitals realitzades amb normalitat... Així doncs, d'aquesta pregunta ressaltem el fet que les persones diversifiquen en aquesta pregunta ja que qui opta pel sentit físic no pensa amb el emocional, com igual passa a l'inrevés.

PREGUNTA 6

Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal?

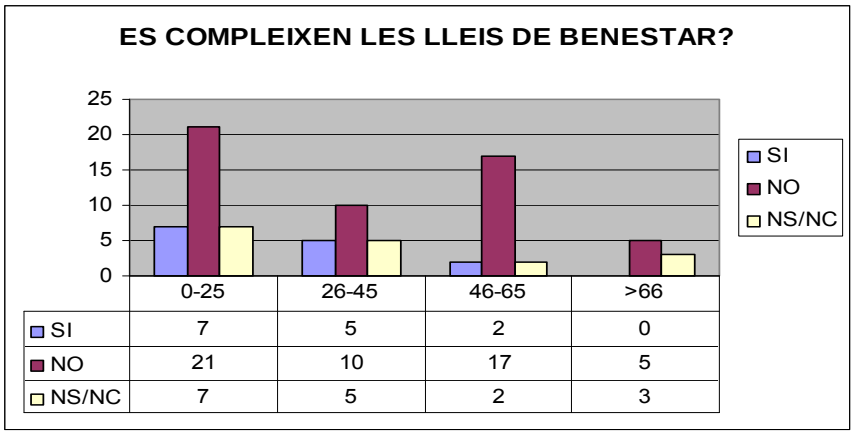


	0-25	26-45	46-65	>66
SI	9	0	3	3
NO	25	14	14	4
NS/NC	1	1	3	1

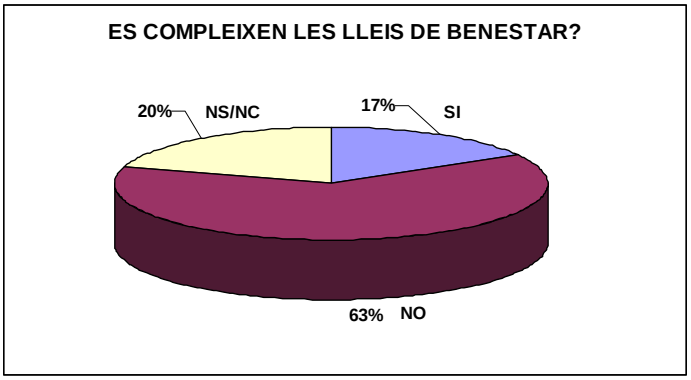
Ressalta clarament el no. La mostra poblacional analitzada considera que existeix una llei però que aquesta es base amb una generalització de les condicions mínimes en què s'han de trobat tots els animals.

PREGUNTA 7

Creus que les lleis de benestar es compleixen?



	0-25	26-45	46-65	>66
SI	7	5	2	0
NO	21	10	17	5
NS/NC	7	5	2	3



El 63% de la població enquestada opina que no.

Segons informes d'organitzacions ecologistes, sembla que els enquestats tenen raó. La Unió Europea ha recordat a Espanya que molts dels seus centres no compleixen la normativa. La seva crítica es centra en la irregularitat de la concessió de llicències i la manca d'inspeccions.

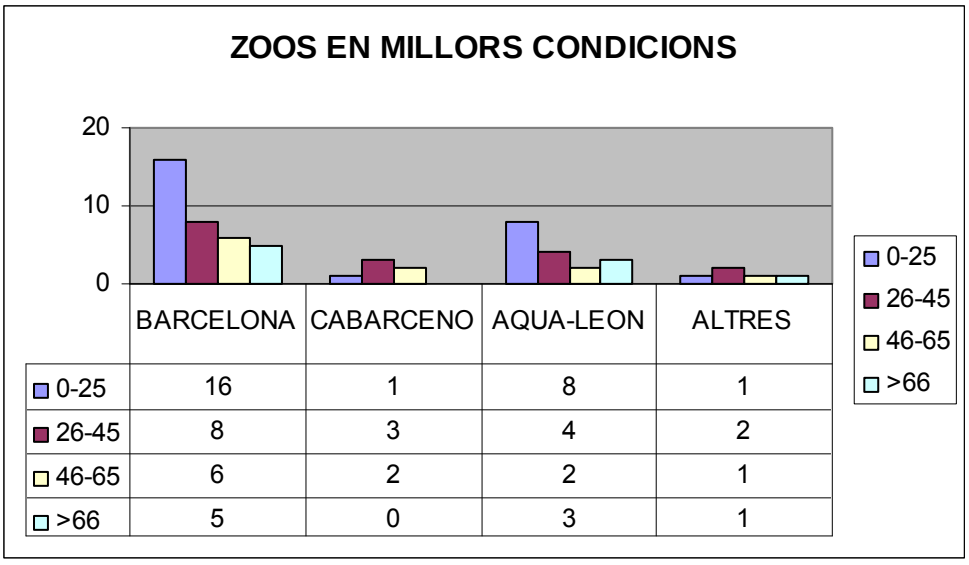
PREGUNTA 8

Dels zoològics o centres similars en els què has estat, en quin creus que els animals estan en millors condicions?

Aquesta pregunta està feta amb doble intenció. La primera d'elles era veure quins zoos eren més ben valorats i per contra, també ens permetia veure la mobilitat de la població per anar a visitar centres a altres zones.

Altre cop en el resum de l'enquesta només hem valorat els tres centres més visitats que són: Barcelona, Cabárceno i per últim en orde decreixent, Aqua-León. En el grup d'altres, destacar el zoo de Berlín, l'Oceanogràfic de València i un zoo de Brasil.

Hem de destacar que el 83% de les persones que han considerat el zoològic de Barcelona com a millor és per la simple raó que no han estat en cap més.

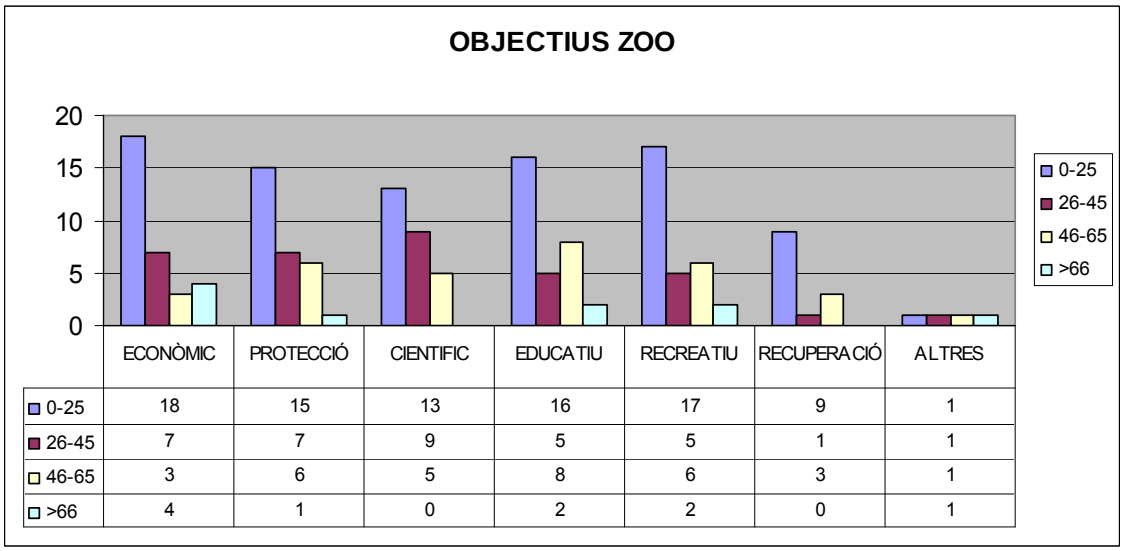


	BARCELONA	CABARCENO	AQUA-LEON	ALTRES
0-25	16	1	8	1
26-45	8	3	4	2
46-65	6	2	2	1
>66	5	0	3	1

També cal tenir en consideració que la resposta de la majoria dels enquestats han vist tant sols un zoo i per tant no poden fer comparacions respecta a qui reuneix millors condicions.

PREGUNTA 9

Quins objectius creus que tenen els centres zoològics i centres similars?



	ECONÒMIC	PROTECCIÓ	CIENTIFIC	EDUCATIU	RECREATIU	RECUPERACIÓ	ALTRES
0-25	18	15	13	16	17	9	1
26-45	7	7	9	5	5	1	1
46-65	3	6	5	8	6	3	1
>66	4	1	0	2	2	0	1

Es tracta també d'una pregunta oberta en la qual per realitzar el gràfic hem valorat les més destacades.

Fent una generalització podem dir que els objectius més valorats són: l'econòmic, l'educatiu i el recreatiu.

Si mirem per grups d'edats, és curiós observar que els dos extrems de la població, joves i majors, creuen que el primer objectiu de l'existència dels zoos és el factor econòmic.

En l'actualitat, els parcs zoològics tenen una funció prioritària com a reserves d'animals i bancs genètics. Per a moltes espècies els zoos són l'última esperança de supervivència mitjançant els programes de reproducció en captivitat d'espècies amenaçades. Alhora realitzen una tasca d'educació i sensibilització social per al respecte de la vida animal i són espais privilegiats per a la recerca biològica.

El 1985 es va crear el Programa europeu per a espècies amenaçades (EEP), amb els objectius de:

· Coordinar la tasca que realitzen tots els zoològics europeus.

· Portar un control informatiu de tots els animals.

· Evitar els majors riscos que corren les espècies en captivitat:

1. La consanguinitat.

2. La pèrdua de variabilitat genètica.
3. La pèrdua de variabilitat conductual.
L'EEP intenta evitar aquests riscos i elaborar documentació científica sobre les espècies en captivitat.
El Zoo de Barcelona participa en 47 programes europeus de cria en captivitat per a espècies amenaçades.

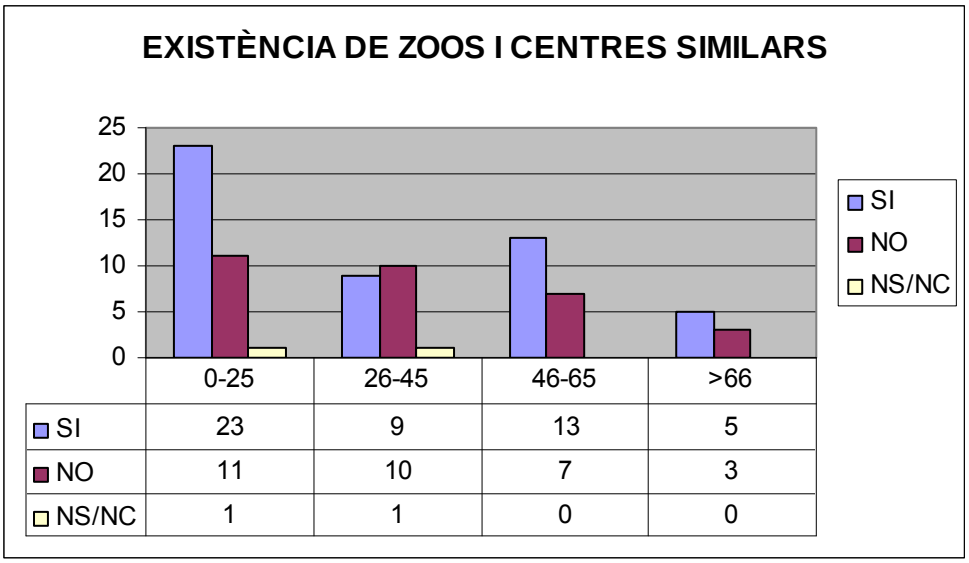
Per què serveixen els programes de reproducció en captivitat?
Per mantenir el màxim de variabilitat genètica i conductual d'espècies amenaçades i realitzar experiències de reintroducció d'animals nascuts en captivitat en hàbitats naturals.

"La supervivència de les espècies dependrà de la cooperació entre les dues parts implicades en la conservació, ex situ i in situ, i del reconeixement de la interdependència dels seus esforços conservacionistes i la necessitat del reforç mutu."

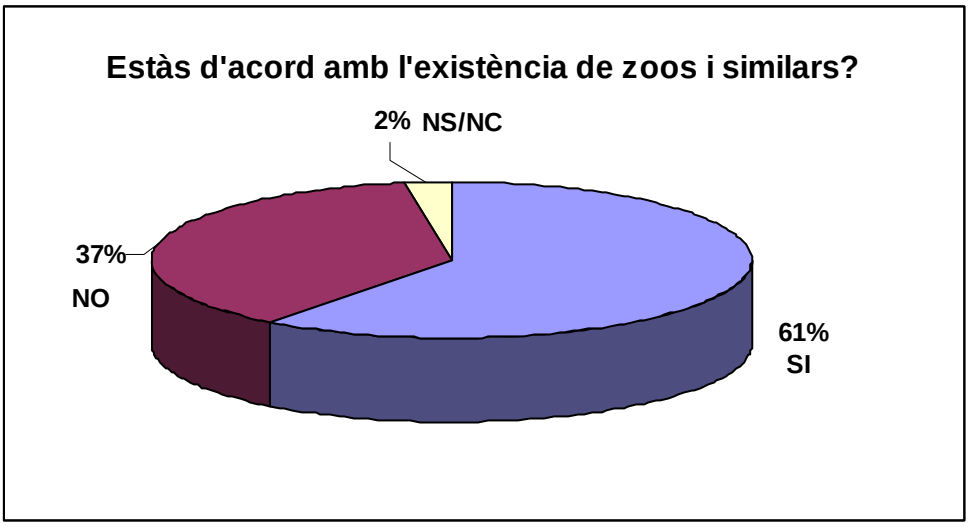
Quines dificultats hi ha per a la reintroducció d'animals?
El procés de reintroducció al seu hàbitat d'animals que prèviament han estat separats del seu medi natural i dels seus grups és llarg i costós i pot ensopegar amb problemes, com ara:
- Desconeixement de la procedència de l'animal.
- No és apropiat introduir animals en determinades àrees per motius genètics (pertanyen a diferents subspècies).
- Existeix el risc d'introduir patògens que afectin les poblacions locals que viuen en llibertat.
- Els programes de reintroducció són cars, ja que requereixen grans inversions econòmiques per a la compra de menjar i per garantir les cures veterinàries i els sous del personal que ha de tenir cura dels animals de la zona del santuari fins que s'aconsegueixi que siguin autosuficients.
- L'èxit depèn en gran mesura d'assegurar el compromís dels governs i els ciutadans que viuen a la zona.

PREGUNTA 10

Estàs d'acord amb l'existència de zoològics i centres similars?



	0-25	26-45	46-65	>66
SI	23	9	13	5
NO	11	10	7	3
NS/NC	1	1	0	0



Encara que resulta majoritària la resposta del SI, la majoria dels enquestats ho fan en condicional. En la major part, les condicions del SI són :

Els zoològics s'han de dedicar a la preservació de les espècies animals

- Els zoològics s'han de dedicar a la investigació dels animals (comportament, reproducció...)
- Els zoològics han d'apropar els animals a les persones d'una forma lúdica, amb activitats, educant

D'altre banda, les respostes del NO, també estan condicionades, ja que reconeixen la necessitat de preservar les espècies, però no en zoològics sinó en reserves, o parcs nacionals, és a dir ho condicionen a la "llibertat".

ENTREVISTA

L'entrevista següent es va realitzar al Conservador de Mamífers del Parc Zoològic de Barcelona Conrad Enseñat.

1.- Quina és la legislació actual que regula el recinte del tigre i què exigeix.

No hi ha legislació específica pel disseny de l'instal.lació del tigre més enllà de la Directiva Europea sobre zoos i la seva trasnsposició a la legislació espanyola.

Nosaltres a més, hem assumit les recomanacions de la Associació Europea EAZA i, per tan, del programa de cria europeu EEP i de l'Associació Ibèrica AIZA.

2.- Quin és el departament del Zoològic que s'encarrega del compliment de la legislació respectiva.

Secretaria Tècnica en la part de legislació i cada departament en seguir les recomanacions de benestar animal de les dues associacions.

3.- Creus que les legislacions actuals haurien de ser més exigents en quan al disseny i manteniment de les instal·lacions zoològiques.

És difícil establir criteris molt precisos perquè en general es refereixen als mínims i són de tipus numèric (superfície, alçades de seguretat, etc.). Cal valorar també la qualitat.

4.- Quin és l'estat actual del programa d'enriquiment del tigre.

Tenim un programa específic pels tigres desenvolupat però, encara està en fase d'implantació i ara com ara es veu una mica parat per les properes obres del Zoo.

5.- Quin és el futur de l'enriquiment en el cas del tigre.

El Zoo té com a projecte de futur la remodelació de les seves instal·lacions incloent-hi la d'aquesta espècie per la qual cosa l'enriquiment està en procés i a l'espera.

6.- Quines són les accions que dur a terme el veterinari en aquest àmbit i, quines creus que s'haurien de millorar/modificar.

Des del punt de vista clínic no hi ha cap acció específica però si en el desenvolupament de les tècniques de maneig de l'espècie i de l'enriquiment a dur a terme.

Conclusions entrevista

Com ja s'ha esmentat en l'apartat de les disposicions legals, no hi ha cap llei que reguli específicament el disseny d'una instal·lació i, moltes entitats, com

és el cas del Zoològic de Barcelona, segueixen les recomanacions d'associacions com WAZA, EAZA o AIZA.

Com a comentat l'entrevistat, a vegades, és molt més important tenir en compte la qualitat de les coses que no pas la quantitat i, en referència als animals, aquest és un aspecte d'allò més important.

Pel que respecte a l'enriquiment, ja s'ha comentat molt en l'apartat en concret, però cal dir, que el Zoològic de Barcelona compta amb unes instal·lacions molt antigues que ha anat adaptant mica en mica. Actualment però, l'entrevistat no ens va poder definir l'enriquiment que es vol dur a terme en el cas del tigre, ja que el Parc Zoològic de Barcelona està pendent a dia d'avui de la seva reubicació i remodelació.

Observacions

Es va intentar entrevistar el veterinari del Parc de Cabárceno (Cantàbria) per tal de poder parlar una mica de l'ós però, no va respondre a les nostres peticions.

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Meredith J. Bashaw,1,2n Mollie A. Bloomsmith,1,2 M.J. Marr,2 and Terry L. Maple1,2

1TECHlab, Zoo Atlanta, Atlanta, Georgia

2School of Psychology, Georgia Institute of Technology, Atlanta, Georgia

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Lyons'*, Robert J. Young', and John M. Deag*

' Scottish National Zoological Park, Murrayfield, Edinburgh, United Kingdom

'Institute of Cell, Animal, and Population Biology, University of Edinburgh, Kings Buildings, Edinburgh, United Kingdom

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Amy L. Skibiel,1_ Heather S. Trevino,1 and Ken Naugher2
1Department of Biological Sciences, Auburn University, Auburn, Alabama
2Montgomery Zoo, Montgomery, Alabama

4. Activity-Based Exhibition of Five Mammalian Species: Evaluation of behavioral Changes

Brent C. White,1n Lisa A. Houser,1 Jodi A. Fuller,1 Steve Taylor,2 and Jennifer L.L. Elliott3
1Psychobiology Program, Centre College, Danville, Kentucky
2Louisville Zoological Garden, Louisville, Kentucky
3Stites & Harbison, PLLC, Lexington, Kentucky

5. Intact Carcasses as Enrichment for Large Felids: Effects on On- and Off-Exhibit Behaviors

M. Elsbeth McPhee*
School of Natural Resources and Environment, University of Michigan, Ann Arbor,
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S. Montaudouin, G. Le Pape
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Ana I. Soriano, Conrad Ensenyat, Susana Serrat,
and Carme Maté
Barcelona Zoo
Barcelona, Spain

3. Feeding Enrichment and Stereotypic Behavior in Spectacled Bears
Mark Fischbacher1* and Hans Schmid2
1Zoo Zürich and ZooLogic Research & Consulting, Zürich, Switzerland
2Nutz- und Zootierethologie, Zoologisches Institut, Universität Zürich, Zürich,
1. Switzerland

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Joanne D. Altman, *Department of Psychology Washburn University*

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Sophie Vickeryn and Georgia Mason; Animal Behaviour Research Group, Department of Zoology, Oxford University, Oxford, United Kingdom

Estándares generales de AIZA para la acomodación y cuidado de animales en zoos

25/6/98

(Asociación Ibérica de Zoos y Acuarios)

Estándares para la acomodación y cuidado de animales en zoos

Introducción

Estos estándares están basados en los conocimientos y práctica actuales para la acomodación y cuidado de animales en zoos.

En este Anexo se aplicarán las siguientes definiciones:

a) **Zoos**. El término se refiere a todos los establecimientos abiertos y gestionados para el público para proporcionar al mismo tiempo entretenimiento educativo, recreativo y cultural a través de la exhibición de animales. Esta definición incluye zoos, safaris, aviarios, delfinarios, acuarios y colecciones especializadas, tales como exhibiciones de mariposas, etc.

b) **Animales.** Este término se refiere a todas las especies del reino animal, incluyendo las clases Mammalia, Reptilia, Amphibia, Avium, Piscis e Invertebrata.

c) **Bienestar.** Este término se refiere al bienestar físico, psíquico y social de los animales, conseguido a través de unas condiciones apropiadas para cada especie, incluidos alojamiento, entorno, dieta, atención médica y contacto social cuando éste sea posible, pero no necesariamente limitado a estos aspectos.

d) **Instalación** significa cualquier acomodación dispuesta para animales en zoos.

e) **Barrera de instalación** significa una barrera para contener a un animal dentro de una instalación.

f) **Barrera de separación** significa una barrera física separada del extremo de una barrera de instalación y diseñada para evitar el acceso del público a esta última.

g) **Animales peligrosos** significa cualquier representante de las especies de la lista del Anexo I que a causa de su disposición individual, ciclo sexual, instintos maternales o por cualquier otra razón, sea mordiendo, arañando, embistiendo, comprimiendo, inyectando veneno o de cualquier otra manera, es probable que hiera gravemente o transmita enfermedades a los seres humanos.

h) **Carnívoros peligrosos** significa todos los miembros del género *Panthera*, *Acinonyx*, *Lyns y Neofelis*, las familias Ursidae y Hyaenidae, los géneros *Canis y Lycaon.*

Estándares

CUIDADO DE LOS ANIMALES - BIENESTAR , SALUD E HIGIENE

Observación rutinaria de los animales

1. El estado y salud de todos los animales del zoo será comprobado diariamente por la persona o personas responsables de su cuidado.

2. Todos los animales que sufren stress, están enfermos o heridos, recibirán una atención inmediata y, si es necesario, tratamiento veterinario.

Acomodación - espacio, ejercicio y grupos

3. Se proporcionará a los animales un ambiente, espacio y mobiliario suficientes para permitir el ejercicio necesario para el bienestar de la especie.

4. Las instalaciones serán de tamaño suficiente y se tratará a los animales de forma que:

    a) se evite que los animales en manadas o grupos estén indebidamente dominados por otros individuos.

    b) se evite el riesgo de conflictos persistentes no resueltos entre miembros del grupo o manada o entre diferentes especies en instalaciones mixtas.

    c) se asegure que la capacidad física de la instalación no se sobrecargue.

    d) se evite una concentración inaceptable de parásitos y otros patógenos.

5. Los animales no serán provocados de forma no natural, cuando esto signifique un perjuicio para su integridad física o psíquica.

6. En instalaciones contiguas, las especies que en ellas se alojen deberán ser especies que no interaccionen de una forma estresante.

7. Se dispondrá, si es necesario, de acomodación separada para animales embarazados y animales con crías para evitar un sufrimiento o stress innecesario.

Acomodación - confort y bienestar

8. La temperatura, ventilación e iluminación de las instalaciones serán las adecuadas al confort y bienestar de cada especie animal en todo momento, y en particular:

a) se tendrán en cuenta las necesidades especiales de los animales recién nacidos y gestantes.

b) los animales importados recién llegados serán totalmente aclimatados teniendo en cuenta que esto sólo puede ser un proceso gradual.

c) las piscinas, fosos o charcas para animales acuáticos serán los adecuados a las especies que en ellos se alojen.

9. En instalaciones exteriores, se proporcionará a los animales un cobijo suficiente, para resguardarse de las inclemencias del tiempo o de una excesiva luz solar.

Equipamiento dentro de las instalaciones

10. Las instalaciones de animales estarán equipadas de acuerdo con las necesidades de la especie en cuestión, con artículos tales como: material para nidos, ramas, madrigueras, cajas nido, charcas. En el caso de animales semi-acuáticos, de materiales como: hierbas, guijarros, etc.

Prevención de stress o daños a los animales

11. Las instalaciones y barreras de instalaciones se mantendrán en un estado tal que no presente probabilidad alguna de lastimar a los animales y en particular:

a) Se reparará o sustituirá sin demora cualquier defecto observado en una barrera de animales o en cualquier dispositivo o equipamiento dentro de la instalación de éstos.

b) Cualquier defecto que pueda causar daño a los animales se rectificará de forma inmediata o, si ello no es posible, se privará a los animales de la posibilidad de cualquier contacto con la fuente del peligro.

c) Cualquier vegetación capaz de dañar a los animales se mantendrá fuera de su alcance.

d) Se utilizará el pastor eléctrico de forma coherente, con el objetivo de preservar la integridad y seguridad de las instalaciones y los animales que albergan.

12. Todas las plantas y equipamiento fijo, incluyendo los aparatos eléctricos, se instalarán de forma que no representen un riesgo para los animales y que su funcionamiento seguro no pueda ser interrumpido por éstos.

13. La basura en las instalaciones de animales se retirará tan regularmente como sea posible para evitar cualquier posibilidad de daños a los animales.

14. Los árboles dentro o cerca de instalaciones de animales se inspeccionarán regularmente y se podarán o cortarán de forma apropiada para evitar el riesgo de que los animales sean dañados por ramas que caigan o para evitar que los animales usen éstos como medio de escape.

15. El personal del zoo tendrá prohibido fumar cuando esté trabajando cerca de los animales o cuando esté preparando alimentos para éstos en espacios cerrados .

16. Los animales sólo serán manejados por o bajo la supervisión del personal autorizado; su manejo se hará con cuidado de forma que se les evite molestias, stress de conducta o daño físico.

17. Cualquier contacto físico directo entre los animales y el público visitante sólo se hará bajo el control del personal del zoo por periodos de tiempo y bajo condiciones adecuadas al bienestar de los animales.

Comida y bebida

18. La comida y bebida suministrada a los animales será del valor nutritivo y cantidad requeridas para cada especie y para cada individuo dentro de cada especie. La cantidad de alimento tendrá en cuenta el estado, tamaño y edad de cada animal, así como circustancias especiales (p.e. días de ayuno o períodos más largos de ayuno o hibernación) y dietas especiales para ciertos animales (p.e. animales gestantes o bajo tratamiento veterinario).

19. Se obtendrá y seguirá el consejo veterinario o de otros especialistas en relación con todos los aspectos de la nutrición.

20. Los suministros de comida y bebida se almacenarán, prepararán y ofrecerán a los animales bajo condiciones higiénicas.

21. La conducta natural de los animales, en particular los aspectos sociales, se tendrá en cuenta al ofrecer comida y bebida. Los receptáculos de comida y bebida, si se usan, se colocarán de modo que sean accesibles a todos los animales mantenidos en una instalación.

22. No se permitirá la alimentación incontrolada por parte de los visitantes. Cuando se permita la alimentación, será sobre una base selectiva sólo con comida apropiada suministrada y aprobada por la dirección.

Higiene y control de enfermedades

23. Se mantendrán niveles adecuados de higiene, tanto respecto a la higiene individual del personal como a la de las instalaciones y salas de tratamiento y en particular:

    a) Se prestará especial atención a la limpieza diaria de las instalaciones de animales y equipamiento en su interior, para reducir el riesgo de

enfermedades, incluyendo, en caso de animales acuáticos, un control regular de la calidad del agua.

b) Se dispondrá fácilmente de agentes de limpieza adecuados, junto con suministro de agua y de los medios para aplicarlos.

c) Se obtendrá y seguirá consejo veterinario especializado respecto a todos los requisitos de higiene y limpieza de las instalaciones u otras áreas, después de la identificación de una enfermedad infecciosa en cualquier animal.

24. El drenaje de todas las instalaciones será capaz de eliminar eficazmente todo exceso de agua.

25. Todos los desaguaderos al aire libre, excepto los de agua superficiales, estarán fuera de las áreas a las que tengan acceso los animales.

26. El material de desecho se retirará y eliminará regularmente.

27. Se establecerá y mantendrá en todo el zoo un programa seguro y efectivo para el control de enfermedades, roedores, insectos y parásitos, y, cuando sea necesario, de los depredadores.

28. Los cuidadores estarán instruidos para informar inmediatamente si contraen o están en contacto con cualquier infección que tengan razones para creer que pueda transmitirse y afectar de forma adversa a la salud de cualquier animal, y la dirección tomará entonces las medidas apropiadas.

29. Los cuidadores estarán instruidos para informar en confianza sobre cualquier otro impedimento que pueda afectar su capacidad para manejar a los animales de una forma segura y competente.

CUIDADOS DE LOS ANIMALES - ASPECTOS VETERINARIOS

30. Se dispondrá de una asistencia veterinaria rutinaria. En el caso de peces e invertebrados, algún otro tipo de especialista que se considere adecuado también es aceptable. Esto es válido para todas las referencias a aspectos veterinarios en peces e invertebrados que aparezcan en este documento.

31. Se establecerá y mantendrá un programa de cuidados veterinarios bajo la supervisión de un veterinario especializado.

32. Se realizarán exámenes rutinarios, incluyendo pruebas de parásitos y se aplicará una medicina preventiva, incluyendo la vacunación, a los intervalos que pueda recomendar un veterinario especializado.

33. Cuando en el zoo exista un servicio veterinario completo, las instalaciones incluirán: una mesa de examen, instrumental quirúrgico básico y una serie de

instrumentos de diagnóstico básico, facilidades para tomar sangre y muestras, prepararlas y despacharlas, y una serie amplia de fármacos.

34. Cuando no se disponga en el zoo de un servicio veterinario completo, se establecerá una sala de tratamiento en las instalaciones para su uso, cuando sea apropiado, para la práctica de exámenes rutinarios de animales en un ambiente limpio, ventilado y bien iluminado.

35. Se dispondrá de una sala o salas para el cuidado de animales estresados, enfermos o heridos. Además, se dispondrá de un lugar adecuado para crianza a mano de animales crías.

36. Se dispondrá, iempre que sea posible, de instalaciones para inmovilizar y administrar una anestesia general y para cuidado de animales que se recuperan de una anestesia.

37. Se dispondrá de acomodos de reserva, lejos de otros animales, para el aislamiento y examen de animales recién llegados.

38. Los animales recién llegados se mantendrán aislados el tiempo que se estime necesario a fin de asegurar una observación y examen adecuado, antes de ser introducidos con otros animales de la colección.

39. Se prestará especial atención a la higiene en los lugares donde se mantenga a los animales aislados o en cuarentena.

40. Las ropas de protección y utensilios usados por el personal en el área de aislamiento se usarán, limpiarán y almacenarán sólo en ese área, siempre que sea posible.

41. Todos los fármacos animales, vacunas y otros productos veterinarios restringidos se mantendrán de forma segura bajo llave, con acceso sólo a personas autorizadas.

42. El personal del zoo no poseerá ni administrará drogas controladas si no es bajo la dirección de un veterinario o un médico (sólo en el caso de primates).

43. El equipo técnico del zoo dispondrá de antídotos para productos veterinarios potencialmente tóxicos utilizados en el zoo.

44. Se eliminará de forma segura todo el equipamiento veterinario contaminado superfluo.

INSTALACIONES POST-MORTEM

45. Los animales muertos se manipularán de forma que se evite el riesgo de cualquier transmisión de infección.

46. La causa de la muerte de cualquier animal que muera en la colección se establecerá cuando sea posible y razonable incluyendo, en la mayoría de los casos, el examen del cadáver por un veterinario o patólogo con preparación y experiencia constatada.

47. Siempre que sea posible, las instalaciones y equipamientos de cualquier sala de autopsias contará con: un sistema eficaz de drenaje, suelos y paredes lavables, una mesa de examen, una selección adecuada de instrumentos post-mortem, instalaciones para tomar y conservar especímenes y una grua o medio adecuado para mover cadáveres de animales grandes (si los hubiese).

48. Después de los exámenes post-mortem realizados en el zoo, los cadáveres y órganos se retirarán rápidamente y se eliminarán de forma segura.

SEGURIDAD

Disposición general

49. Debe aplicarse la legislación local sobre seguridad en cuanto a zoos.

Instalaciones

50. Salvo cuando estén bajo el control de personal autorizado en cualquier otro lugar, los animales del zoo estarán en todo momento dentro de las instalaciones o, en el caso de animales no peligrosos con posibilidad de moverse libremente fuera de la instalación, dentro del perímetro del zoo.

Barreras de instalación

51. Las barreras de instalación se diseñarán, construirán y mantendrán para contener a los animales dentro de las instalaciones deseadas.

Barreras de separación

52. Cuando fuera posible el contacto directo entre los visitantes y animales peligrosos a través o por encima de cualquier barrera de instalación, en la medida en que tal animal fuera capaz de causar lesiones, se instalará una barrera de separación suficientemente atrás como para evitar dicho contacto.

Límites perimetrales

53. El límite perimetral, incluyendo los puntos de acceso, se diseñará, construirá y mantendrá para desanimar la entrada no autorizada y, en la medida en que sea razonablemente factible, como una ayuda al confinamiento de todos los animales dentro del perímetro del zoo.

54. Ninguna barrera perimetral incluirá ninguna sección eléctrica a menos de dos metros del suelo (excepto en los casos en que también sirva como una barrera normal de animales y no pueda ser alcanzada por el público visitante)

Señales de aviso

55. Además de una barrera de separación, en cada instalación donde exista un peligro evidente se instalará un número adecuado de señales de seguridad claramente visibles, incluidas puertas de seguridad.

Salidas

56. Se establecerán suficientes salidas del zoo, tomando en consideración el tamaño del zoo y el número de visitantes previstos en cualquier momento que puedan necesitar abandonarlo rápidamente en caso de emergencia.

57. Las salidas estarán claramente marcadas e indicadas con señales.

58. Toda salida del zoo se mantendrá libre y se podrá abrir fácilmente desde el interior para permitir la salida de personas del zoo. Todas estas puertas podrán ser cerradas y fijadas para evitar la escapada de animales.

Instalaciones con paso de coches

59. Se aplicará este capítulo a las instalaciones con paso de coches a menos que exista una legislación local más estricta.

60. Cuando se mantengan carnívoros o primates peligrosos en instalaciones con paso de coches, la entrada y la salida de tales instalaciones se hará a través de un sistema de doble puerta, con suficiente espacio entre ellas para permitir que las puertas sean cerradas de forma segura, tanto delante como detrás de cualquier vehículo que entre o salga de la instalación.

61. Este sistema de doble puerta estará diseñado, construido y mantenido de tal forma que cuando los animales estén dentro o tengan acceso al espacio de seguridad (pasillo entre ambas puertas), una puerta no pueda ser abierta al menos que la otra esté cerrada en forma segura. Este sistema tendrá posibilidad de ser anulado en caso de emergencia.

62. Tanto la doble puerta de seguridad como el cierre del pasillo a ambos lados, estarán construidos en la misma forma y tipo de material que el cierre periférico principal de la instalación de los animales. Las dobles puertas estarán situadas, para mejorar la visibilidad del pasillo de seguridad, en ángulo recto respecto al cierre perimetral de la instalación de animales. El pasillo de seguridad tendrá una distancia de al menos 25 metros entre ambas puertas.

63. Para otros animales peligrosos, excepto los ungulados o los que pacen (en los que una reja de ganado sea suficiente para contenerlos), se establecerán puertas únicas de entrada/salida, supervisadas en todo momento.

64. Los puntos de acceso entre instalaciones se controlarán para evitar que los animales penetren en instalaciones adyacentes.

65. Los cojinetes a presión electrificados, cuando se usen, se diseñarán e instalarán para asegurar que en caso de fallo, cualquier puerta que controlen se cierre automáticamente o funcione de manera que se asegure que los animales son mantenidos dentro de su instalación.

66. Las puertas que funcionan automáticamente por control remoto dispondrán de un método alternativo de funcionamiento que permita ser abiertas y cerradas manualmente en caso de una interrupción de energía u otra emergencia. En caso de corte del suministro eléctrico, las puertas deberán cerrarse automáticamente.

67. Los operadores de puertas que funcionen mecánicamente tendrán una vista clara y sin obstrucciones de las puertas bajo su control y del área próxima a ellas.

68. Se usará un sistema de carretera de un solo sentido para ayudar al flujo de tráfico y reducir así el riesgo de accidente.

69. Sólo se permitirá parar en los lugares en que la carretera tenga al menos 6 metros de ancho.

70. Cuando se mantengan primates, carnívoros peligrosos o (excepto cuando la instalación esté supervisada por personal competente de forma que se evite cualquier peligro para el público) cualquier otro animal salvaje peligroso:

    a) no se permitirá el acceso de ningún vehículo si no se dispone inmediatamente de un vehículo de rescate capaz de efectuar su recuperación,

    b) se prohibirá en todo momento el acceso de vehículos sin cubierta sólida,

    c) se instalarán avisos, que serán visibles y fáciles de leer, para advertir a los visitantes de que, mientras se hallen en la instalación:

        I. permanezcan en el vehículo en todo momento.

        II. mantengan todas las puertas del vehículo cerradas,

        III. mantengan cerradas las ventanas y techos del vehículo

        IV. hagan sonar el claxon o hagan ráfagas de luz y esperen la llegada de un vehículo de rescate si sufren una avería.

71. Se mantendrá una observación continua sobre toda el área de cada instalación que contenga cualquier animal peligroso.

Retirada de animales de las instalaciones

72. No se permitirá que los animales peligrosos salgan de sus instalaciones habituales con el propósito de que tengan contacto directo con el público excepto si quien gestiona el zoo está convencido de que tales animales, cuando se hallan bajo control, no es probable que causen lesiones, transmitan o puedan contraer enfermedades.

73. Cuando se permita salir a animales peligrosos de sus instalaciones habituales un miembro autorizado y experto del personal acompañará a cada animal.

74. Quienes gestionen el zoo tendrán precaución y prudencia en caso de retirar a un animal no peligroso, puesto que la conducta de todos los animales puede ser menos predecible cuando están fuera de su instalación habitual.

75. Se tomarán precauciones para evitar lesiones a los visitantes cuando los animales se usen para pasear montados a visitantes (poneys, etc).

Escapada de animales de sus instalaciones

76. Quienes gestionen un zoo valorarán si puede surgir algún peligro en caso de que un animal escape de su instalación y tomarán en consideración la posible o probable ruta de escape dentro del zoo y desde éste, si ello fuera a ocurrir.

77. Para caso de escape de animales, deberá disponerse de un plan de emergencia plenamente comprendido y puesto es práctica por todo el personal.

78. Un miembro del personal debe ser fácilmente accesible en todo momento para tomar decisiones referentes a la eutanasia de animales escapados.

79. Cada empleado con tareas asignadas dentro del plan de emergencia realizará prácticas y entrenamiento en forma periódica.

80. Se procurará la existencia de un arma de fuego apropiada para ser usada contra los animales por personal autorizado y entrenado en el caso de que peligre la integridad física de las personas cercanas.

Seguridad del acceso para el público

81. Los edificios, estructuras y áreas a las que el público tenga acceso se mantendrán en condiciones seguras.

82. Los árboles en áreas de acceso al público, se inspeccionarán regularmente y se podarán o talarán de forma apropiada para evitar que los visitantes resulten lesionados.

83. Se dará aviso de todos los bordes en los que pueda caer una persona, incluyendo los de agua, y cuando sea necesario, tales bordes se protegerán con una barrera que impida que los visitante tropiecen.

84. Todo paso elevado sobre una instalación de animales se diseñará, construirá y mantendrá para soportar con seguridad el peso del máximo de adultos que puedan usarlo en cualquier momento. Se mantendrá, emplazará o protegerá de forma que evite cualquier contacto entre animales peligrosos y visitantes.

85. No se permitirá al público visitante penetrar en ningún edificio u otra área de las instalaciones del zoo que pueda presentar un riesgo para su salud y seguridad.

86. Cualquier edificio al que no se permita la entrada de visitantes, en base a lo antes dicho, se mantendrá cerrado y se colocarán carteles de aviso para indicar que el acceso no es seguro para el público y no le está permitido.

87. Se señalarán claramente otras áreas, p.e. por medio de barreras y carteles de aviso similares, o mediante letreros adecuados junto con marcas en la carretera, cuando sea necesario el acceso frecuente para vehículos conducidos por el personal del zoo por carreteras a las que el público no tenga acceso.

Primeros auxilios

88. El zoo contará con un equipo de primeros auxilios fácilmente accesible e instrucciones escritas de primeros auxilios.

89. Cuando se mantengan animales venenosos, se tendrán en el zoo antídotos apropiados y no caducados, que serán mantenidos según las instrucciones del fabricante.

90. Se darán al personal instrucciones escritas sobre los pasos a seguir en caso de un accidente que afecte a cualquier persona mordida por un animal venenoso. Estas instrucciones incluirán:

    a) las acciones inmediatas a tomar respecto al paciente,

    b) la información requerida en un formulario pre-preparado para enviar al hospital, que incluirá:

        I. la naturaleza de la mordedura o picadura y la especie que la ha causado.

        II. la especificación, para fines de referencia cruzada, del antídoto que acompaña al paciente,

        III. el número de teléfono del centro hospitalario de referencia más próximo para casos de mordedura por animales venenosos.

IV. el número de teléfono del zoo.

VARIOS

Seguros contra posibles daños o heridas causado por animales

91. El titular del zoo deberá poseer una póliza de seguros o contar con otro procedimiento legal que permita indemnizarle a él o a cualquier otra persona con un contrato de servicio o actuando en su nombre, en el caso de daños o heridas causadas por cualquiera de los animales, tanto dentro como fuera del zoo, incluido el transporte en vehículo. Cualquier límite máximo de la suma en cuestión que se incluya en los términos del seguro debe ser adecuado y realista.

Registro de la colección

92. Se mantendrán registros detallados mediante un sistema de registro establecido de todos los animales individualmente reconocibles o grupos de animales del zoo.

93. Cuando los animales abandonen el zoo o mueran se mantendrán sus datos en el registro.

94. Es recomendable que los registros se mantengan a través de un sistema informático que permita acceder a dicha información.

95. Los registros suministrarán la siguiente información:

a) la correcta identificación y nombre científico,

b) el origen (es decir, si nació en libertad o en cautividad, incluyendo la identificación de los padres si se conocen, y las localizaciones previas, si existen),

c) las fechas de entrada y salida de la colección, y el destino,

d) la fecha (o fecha estimada) del nacimiento,

e) el sexo de los animales (si se conoce),

f) cualquier marca distintiva, incluyendo marcas de tatuaje o de congelación,

g) datos clínicos incluyendo detalles y fechas de cuando se dieron fármacos, inyecciones y cualquier otra forma de tratamiento y detalles de la salud del animal,

h) la fecha de la muerte y el resultado de cualquier examen post-mortem,

i) cuando ha tenido lugar una escapada o se ha causado daño o lesión por un animal a una persona o propiedades, la razón de tal escapada, daño o lesión y un resumen de las medidas tomadas para evitar la repetición de tales incidentes.

96. Es recomendable que además de los registros individuales, se mantenga una lista anual de todos los animales de la colección, preferiblemente en la forma abajo indicada:

1. Nombres comunes y científicos de las especies.

2. Número total por especies y sexo en la colección a 1 de enero.

3. Composición de grupos de animales y número de animales cuidados como ejemplares individuales.

4. Número de animales, por especie y sexo, llegados a la colección desde el exterior durante el año.

5. Número de nacimientos por especies y sexo durante el año.

6. Número de muertes por especies y sexo durate el año.

7. Número, especies y sexo de animales que salieron a través de ventas, préstamos, etc.

8. Número total por especies y sexo en la colección a 31 de diciembre.

Este registro, dando detalles de los animales machos/hembras/no sexados, se formará en columnas para facilitar su compilación y consulta, p.e.:

NOMBRE COMUN	NOMBRE CIENTIFICO	GRUPO 1.1.89	LLEGADAS	NACIMIENTOS	MUERTES NEONATALES	MUERTES	SALIDAS	GRUPO 31.12.89
Ualabi de Bennett	*Macropus rufogriseus*	5.11.3	…	1.1.8	1.1.0	1.5.0	….	8.13.0

Todos los registros pueden llevarse en idioma local o en inglés (para facilitar la cooperación y el intercambio de información internacional).

97. Las listas de excedentes de un zoo sólo se enviarán a personas responsables que tengan la experiencia e instalaciones apropiadas y estén en posesión de licencia para mantener y gestionar la especie en consideración.

Transporte y movimiento de animales vivos

98. Deberá tenerse o poder disponer del material adecuado para poner en cajas y transportar cualquier animal del zoo dentro del mismo recinto o a otro destino.

99. Cualquier animal que se envíe fuera del zoo deberá ser propiedad del titular del zoo o de personas competentes actuando en su nombre, y deberán tomarse medidas necesarias para asegurar su seguridad y bienestar en todo momento.

100. Todo animal peligroso que se envíe fuera del zoo deberá mantenerse en condiciones seguras en todo momento. Estos animales deberán mantenerse fuera del alcance de cualquier persona que no sea el titular del zoo o personas competentes actuando en su nombre, excepto cuando el titular tenga la seguridad de que no es probable que, estando bajo control, causen heridas o transmitan enfermedades.

Anexo 1 a los estándares generales de EAZA para la acomodación y cuidado de animales en zoos

Lista de animales peligrosos en zoos y acuarios

Prólogo:

- Esta lista sólo se aplica a animales no domésticos mantenidos bajo condiciones de zoos, acuarios o safaris.
- Los animales mencionados pueden causar lesiones a sus cuidadores o al público debido a su fuerza física, armas específicas incluyendo el veneno y conducta.
- Algunos de los animales mencionados sólo son peligrosos durante la estación de apareamiento.
- Los animales no mencionados pueden ser peligrosos en algunos casos, bajo circunstancias excepcionales (incluyendo la crií a mano) y sujetos a un manejo no profesional.
- Los carnívoros peligrosos son los mencionados con un asterisco.

Lista

Mammalia (Mamíferos)

Nombre científico de la clase	Nombre o nombres comunes
Marsupialia	Marsupiales
Macropodidae de las especies *Macropus rufus y M. fuliginosus y M. robustus*	Canguros (machos grandes de canguro gris y rojo y canguros walabis)
Primates	Primates
Pongidae	Simios (adultos)
Hylobatidae	Gibones (adultos)
Cercopithecidae	Langures (machos adultos) Macacos (machos adultos, excepto Macaca de Gibraltar) Papiones (incluyendo mandril y dril, machos adultos) Mangabeys (machos adultos) Cercopitecos -mono africano de cola larga (machos adultos)
Cebidae	Monos lanudos (machos adultos) Monos araña (machos adultos) Monos capuchinos (machos adultos)

	Monos aulladores (machos adultos)
Carnivora	Carnivoros
Ursidae*	Osos*
Ailuropoda melanoleuca	Panda gigante
Canidae* (solo *Canis lupus Canis rufus, Lycaon pictus)*	Perros* (sólo lobos, lobos rojos y lycaon)
Mustelidae *(mellivora spp., Gulo spp.)*	Martas (sólo ratel, tejón africano y glotón)
Hyaenidae (excepto *Proteles sp.),*	Hienas (excepto lobo de crín)
*Crocuta crocuta**	Hiena manchada*
Felidae: todas *Panthera spp.*	Felinos (todas las especies grandes, león*, tigre*, jaguar*, leopardo*, pantera de las nieves*, puma, pantera nebulosa y lince)
Pinnipedia	Pinnípedos
Otariidae	Foca de orejas (sólo machos adultos)
Odobenus spp.	Morsa
Mirounga spp. y Hydrurga leptonyx	Elefante y leopardo marino
Halichoereus grypus	Foca gris (machos adultos)
Cetacea	Cetáceos
Orcimus orca	Orca
Proboscidea	Elefantes
Elephantidae	Todos los elefantes africanos y asiáticos de más de dos años de edad
Perissodactyla	Persisodáctilos
Equidae	Caballos salvajes, asnos y cebras (sementales adultos)
Rhinocerontidae	Rinocerontes
Tapiridae	Tapires (machos adultos)
Artiodactyla	Artiodáctilos
Suidae, Tayassuidae	Jabalíes (adultos)
Hippopotamidae	Hipopótamos (hipopótamo pigmeo y del río)
Camelidae	Camellos (camello del Viejo Mundo, durante el celo, ocasionalmente machos de camello del Nuevo Mundo)
Cervidae	Ciervos
Alces spp.	Alces (todos los subadultos)
Elaphurus davidianus	Ciervos del Padre David, wapití
Cervus spp.	Ciervo rojo, sika (asiatico)
	Sambar y otras especies de ciervos (machos durante el celo)

Ranfiger spp.	Renos (machos durante el celo)
Capreolus spp.	Corzo (machos criados a mano de cualquier especie de ciervo durante el celo)
Giraffidae	Jirafas y okapis
Bovidae	Especies salvajes
Boselaphus tragocamelus	Nilgo (machos)
Taurotragus spp.	Eland (machos)
Hippotragus spp.	Antílope roan y antílope de sable
Oryx spp.	Orix (todas las especies)
Addax nasomaculatus	Adax (machos)
Kobus spp.	Kobos (machos) o antílopes acuáticos
Connochaetes spp.	Ñu (todas las especies)
Bison spp. Bos spp., Bubalus spp. y Syncerus spp.	Bisontes, Búfalos y todas las especies bovinas salvajes
Ovibos spp.	Buey almizclero
Budorcas spp.	Takin -pequeño búfalo de montaña (machos)
Caprinidae	Especies salvajes

Aves (Aves)

Struthioniformes	Ratites
Struthio camelus	Avestruces
Dromaius novaehollandiae	Emús (sólo en época de cría)
Casuarius spp.	Casuarios
Rhea americana, Pterocnemia pennata	Ñandúes (sólo en época de cría)
Ciconiiformes	Cigüeñas y Garzas
Ardea goliath	Garza Goliat (no debe mantenerse en pajareras donde se permita la entrada de público)
Ephippiorhynchus senegalensis *Xenorhynchus asiaticus, Leptopilos spp.*	Jabirú africano, jabirú asiático y marabúes pueden ser ocasionalmente peligrosos (no deben mantenerse en pajareras donde se permita la entrada de público, o detrás de vallas bajas)
Gruiformes	Grullas
Gruidae	Grullas (pueden ser peligrosas en la época de cría)
Falconiformes	Rapaces
	Grandes rapaces algunas pueden ser peligrosas por ej. *Harpia harpyja* y atacar a los

	intrusos durante la época de cría. (No deben mantenerse en pajareras donde se permita la entrada de público) Los individuos domesticados utilizados en cetrería no entran en la categoría de peligrosos
Strigiformes	Grandes Rapaces Nocturnas Algunas de las grandes rapaces nocturnas atacan a los intrusos durante la época de cría (no deben mantenerse en pajareras donde se permita la entrada del público)
Bucerotidae	Calaos
Bucorvus spp.	Calaos terrícolas (No deben mantenerse en pajareras donde se permita la entrada de público)

Reptilia (Reptiles)

Crocodylia	Cocodrilos
Alligatoridae, Crocodylidae y Gavialidae	Caimanes, cocodrilos y gaviales
Sauria	Lagartos
Helodermatidae	Montruo de Gila y lagarto de cuentas
Varanidae, sólo *Varanus komodoensis V. vaius y V. salvator*> 1,50m largo	Varanos monitor
Serpentes	Serpientes
Boidae (>3m)	Serpiente gigante (Boidos de más de 3 m. de largo)
Colubridae, sólo *Dispholidus typus y Thelotornis kirtlandii*	Culebras (sólo las especies venenosas)
Elapidae, Hidrophididae Viperidae, Crotalidae	Serpientes venenosas

Piscis (Peces)

Chondrichtyes	Peces cartilaginosos
Myliobatoidei	Pastinaca
Osteichtyes	Peces óseos
Scorpaenidae: *Synanceja sp. Inimicus sp., Pterois sp.*	Peces escorpiones
Trachimus sp.	Pez araña

Invertebrata (Invertebrados)

Arthropoda	Artrópodos
Orthognata y Scorpiones	Arañas y Escorpiones (sólo ciertas especies)
Mollusca	**Moluscos**
Conidae	Caracolas cono (ciertas especies)
Cephalopoda: *Hapalochlaena maculosa*	Gibia: pulpo

Polígon: Santpedor, Barcelona.
Adreça: carrer Privilegis, 5, 1r 1a.
Titular: Guillermo Alonso Aguilera i M. Pilar Aguilar López.

Polígon: Buenos Aires, Martorell.
Adreça: bloc, 12, 2n 1a.
Titular: M. Margarida Canals Peris.

(91.336.020)

CORRECCIÓ D'ERRADA

al Decret 260/1991, d'11 de novembre, de modificació parcial del Decret 4/1989, d'11 de gener, d'adjudicació de la concessió administrativa per a la construcció, la conservació i l'explotació de l'autopista de peatge Castelldefels-Sitges (DOGC núm. 1529, pàg. 6344, de 13.12.1991).

Havent observat una errada al text del Decret esmentat, tramès al DOGC i publicat al núm. 1529, pàg. 6344, de 13.12.1991, se'n detalla l'oportuna correcció:

A la pàgina 6345, article 4.2, on diu:

"començarà a aplicar-se en el moment d'entrada en servei d'aquesta via. Durant el període d'un any, i per a anys successius, s'atindrà", ha de dir:

"començarà a aplicar-se en el moment d'entrada en servei d'aquesta via durant el període d'un any, i per a anys succesius s'atindrà".

(91.357.075)

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DEPARTAMENT D'AGRICULTURA, RAMADERIA I PESCA

ORDRE

de 23 de desembre de 1991, d'establiment de mesures necessàries per al manteniment d'animals salvatges en captivitat.

El títol 7 de la Llei 3/1988, de 4 de març, de protecció dels animals, relatiu a les agrupacions zoològiques d'animals de la fauna salvatge, especifica que el Departament d'Agricultura, Ramaderia i Pesca establirà, per reglament, les mesures necessàries per a la prevenció de possibles atacs dels animals al públic.

L'article 3.1 de l'Ordre de 28 de novembre de 1988, de creació del registre de nuclis zoològics de Catalunya, inclou dins la secció de nuclis zoològics pròpiament dits tots aquells nuclis que alberguen col·leccions zoològiques d'animals de la fauna salvatge amb finalitats científiques, culturals o recreatives i de reproducció, de recuperació, d'adaptació i/o de conservació d'aquests animals, tals com zoosafaris, parcs o jardins zoològics, reserves zoològiques, circs, col·leccions zoològiques privades, granges cinegètiques i d'altres agrupacions zoològiques.

Aquests nuclis són susceptibles de mantenir animals salvatges potencialment perillosos per a la integritat física o la seguretat de les persones. Es fa necessari, doncs, establir una normativa que reguli les condicions mínimes de seguretat que han de reunir les instal·lacions on es mantenen aquest tipus d'animals, per tal de prevenir possibles accidents.

A causa de la gran varietat d'espècies animals potencialment perilloses, de les moltes possibles diferències i particularitats individuals quant a mida, historial, estat d'amansiment, sexe, edat i comportament i de les condicions ambientals de l'indret on es poden ubicar les instal·lacions, es fa inviable establir unes normes de caràcter particular i concret per a cada una de les espècies i circumstàncies, les quals no podrien preveure mai tots els diferents supòsits que es podrien donar. Així doncs, tenint en compte l'experiència d'altres països europeus i la normativa que sobre això està elaborant la Comunitat Econòmica Europea, s'ha considerat convenient establir, d'una banda, unes normes de seguretat de caràcter general per a totes les espècies i, d'altra banda, crear una comissió tècnica que serà la que realitzarà les inspeccions a tots els nuclis zoològics on es mantinguin animals salvatges.

Quant a les normes de seguretat de caràcter general, es tindran en compte com a paràmetres el comportament i la capacitat física normals d'un animal adult de l'espècie de què es tracti, llevat del cas d'instal·lacions dedicades només a cries, en les quals es tindran en compte els paràmetres d'aquestes.

La comissió tècnica estarà formada per personal de l'Administració de la Generalitat de Catalunya i serà assessorada pel Parc Zoològic de Barcelona, tenint en compte l'experiència, la capacitat i el prestigi d'aquesta institució.

Per tot això, i a proposta de la Direcció General del Medi Natural,

ORDENO:

Article 1

Comissió tècnica d'inspecció de nuclis zoològics amb fauna salvatge

1.1 Es crea la Comissió tècnica d'inspecció de nuclis zoològics amb fauna salvatge, la finalitat de la qual serà inspeccionar i revisar tots aquells nuclis zoològics on es mantinguin animals salvatges.

Aquesta Comissió estudiarà, en cada cas, les mesures concretes que garanteixin que les instal·lacions tenen unes condicions de seguretat adequades i elaborarà un informe detallant, si escau, les mesures correctores que caldrà adoptar. La realització de les mesures correctores imposades serà d'obligat compliment per part del responsable del nucli zoològic.

1.2 La Comissió estarà integrada pels membres següents:

Un representant del Departament de Governació.

Dos representants del Departament d'Agricultura, Ramaderia i Pesca.

El Parc Zoològic de Barcelona i la Facultat de Veterinària de la Universitat Autònoma de Barcelona nomenaran un representant de cada entitat, que actuarà com a assessor de la Comissió.

1.3 La inscripció al registre de nuclis zoològics dels centres que mantinguin animals salvatges estarà condicionada a l'informe favorable de la Comissió tècnica.

Article 2

Normes de seguretat de caràcter general per a nuclis zoològics

2.1 En el desplegament de les seves tasques, la Comissió tècnica es guiarà per les normes de seguretat de caràcter general per a nuclis zoològics i per les específiques per a instal·lacions amb pas de vehicles que figuren a l'annex d'aquesta Ordre.

2.2 En l'aplicació de les mesures de seguretat que s'esmenten a l'annex d'aquesta Ordre, es consideraran com a paràmetres el comportament i la capacitat física normal d'un animal adult de l'espècie de què es tracti, llevat d'instal·lacions dedicades només a cries, en les quals es tindran en compte els paràmetres d'aquestes.

Article 3

Infraccions

Les infraccions comeses contra aquesta Ordre seran sancionades d'acord amb el que preveuen l'article 34 i l'article 42.2.h) de la Llei 3/1988, de 4 de març, de protecció dels animals.

En el cas que no es compleixin les mesures correctores que estableixi la Comissió tècnica d'inspecció, el Departament d'Agricultura, Ramaderia i Pesca podrà procedir al comís dels animals.

DISPOSICIÓ TRANSITÒRIA

Els nuclis zoològics que ja estiguin inscrits en el Registre de nuclis zoològics hauran d'adoptar les mesures correctores especificades a l'informe de la Comissió tècnica per poder continuar inscrits en el Registre esmentat.

A aquest efecte, la Comissió tècnica efectuarà una inspecció de cadascun d'ells, determinarà les mesures correctores que calguin i establirà un termini d'execució congruent amb la transcendència de les correccions.

DISPOSICIÓ FINAL

Aquesta Ordre serà sotmesa a revisió quan es publiqui la Directriu Comunitària que regularà

els estàndards mínims a complir per al manteniment d'animals salvatges.

DISPOSICIÓ ADDICIONAL

Els membres de la Comissió tècnica estaran emparats per una assegurança de responsabilitat civil.

Barcelona, 23 de desembre de 1991

JOAN VALLVÉ I RIBERA
Conseller d'Agricultura, Ramaderia i Pesca

ANNEX

Normes de seguretat de caràcter general per a nuclis zoològics

Tots els animals perillosos es mantindran permanentment dintre de la instal·lació que tinguin assignada, excepte quan estiguin sota el control de personal autoritzat.

Els entorns d'instal·lacions per a animals es dissenyaran i construiran de manera que no permetin la sortida dels espècimens, atenent les característiques normals de cada espècie.

Quan aquests entorns consisteixin en tanques, aquestes seran prou consistents i estaran ben fixades per suportar el pes i la pressió de l'animal.

Quan aquests entorns siguin fossats (secs o d'aigua), es col·locaran barreres adequades per impedir que el públic s'hi acosti de manera perillosa.

Les portes de les instal·lacions seran tan resistents o efectives com la resta de l'entorn, i es dissenyaran per evitar que els animals les desencaixin o bé puguin obrir els mecanismes de seguretat.

Les portes d'instal·lacions d'animals perillosos es bloquejaran quan estiguin tancades.

Quan sigui possible el contacte directe entre un animal perillós i el públic per sobre o a través d'un entorn d'instal·lació, s'instal·larà una barrera de separació prou endarrera per evitar aquest contacte.

En qualsevol instal·lació on hi hagi animals perillosos i la possibilitat de creuar una barrera de separació, hi haurà el nombre convenient de rètols indicadors d'aquesta circumstància.

Qualsevol nucli zoològic tindrà un nombre suficient de sortides perquè el nombre previst de visitants pugui abandonar-lo ràpidament en cas d'emergència. Les sortides estaran clarament indicades amb senyals, i s'hauran de poder obrir fàcilment des de l'interior per personal autoritzat.

Quan s'utilitzin animals per a munta, es prendran les mesures adequades per evitar lesions al públic i als animals.

Per al cas d'escapada d'un animal perillós de la seva instal·lació, es disposarà d'un pla d'emergència i de material de captura suficient. Aquest pla serà explicat al personal afectat i assajat periòdicament.

Els arbres ubicats en zones d'accés del públic s'inspeccionaran periòdicament i es tallaran o podaran quan sigui necessari, per tal d'evitar que a través d'ells puguin sortir els animals o accedir les persones.

Els passos elevats sobre instal·lacions d'animals hauran de poder suportar el pes de totes les persones que hi pugin simultàniament, i es dissenyaran per evitar qualsevol contacte directe entre el públic i animals perillosos.

No es permetrà l'accés del públic a cap lloc del nucli zoològic que comporti un risc no raonable per a la seva salut o seguretat.

Els llocs d'accés vedats al públic se senyalitzaran adequadament.

Es disposarà com a mínim d'un equip de primers auxilis i d'instruccions escrites de primers auxilis.

Quan es posseeixin animals verinosos, es disposarà de sèrums antiverí apropiats per iniciar el tractament.

En cas d'accident per mossegada d'animal verinós, s'enviarà l'accidentat a un centre mèdic amb una dosi de sèrum antiverí i un imprès on constarà:
L'espècie causant de la lesió.
L'especificació del sèrum antiverí tramès.
El número de telèfon del centre de sèrums antiverí més proper.
El número de telèfon del nucli zoològic.

Normes específiques per a instal·lacions amb pas de vehicles

Les entrades i sortides de les instal·lacions amb pas de vehicles destinades a carnívors perillosos tindran doble porta, de manera que les dues portes puguin estar totalment tancades, i hi hagi entre elles qualsevol vehicle que hagi de penetrar a la instal·lació.

En aquestes portes hi haurà un mecanisme que impedeixi obrir-ne una fins que l'altra no estigui totalment tancada, si bé podrà haver-hi un mecanisme alternatiu que permeti obviar aquest requeriment en cas d'emergència.

Per a instal·lacions d'altres animals perillosos, les portes d'entrada i sortida seran úniques i estaran vigilades en tot moment.

També es controlaran permanentment els punts d'accés entre instal·lacions, per evitar que un animal passi a una instal·lació adjacent.

Quan s'usin sistemes elèctrics de tancament de portes es dissenyaran de manera que si aquests fallen les portes es tanquin automàticament o hi hagi un sistema alternatiu de tancament.

El personal que faci funcionar els mecanismes d'obertura i tancament de portes disposarà de visió sense obstacles sobre les portes al seu càrrec i de la zona propera a elles.

La carretera a l'interior de les instal·lacions serà d'un sol sentit de marxa, i només s'hi permetrà parar en els llocs on l'amplada sigui com a mínim de 6 metres.

En cas d'instal·lacions d'animals perillosos, no es permetrà l'accés de cap vehicle si no es disposa al mateix lloc d'un vehicle de rescat que pugui efectuar la seva recuperació. En cap cas no es permetrà l'accés de vehicles sense coberta sòlida.

Existirà una observació permanent de tota l'àrea de les instal·lacions on hi hagi animals perillosos. Com a mínim, un membre del personal de vigilància disposarà en tot moment d'una arma de foc per abatre un animal perillós si aquest pot lesionar o matar una persona.

(91.323.059)

RESOLUCIÓ

de 17 de desembre de 1991, per la qual es disposa el compliment de la Sentència del Tribunal Superior de Justícia de Catalunya dictada en el recurs contenciós administratiu núm. 1097/90.

La Secció 4ª de la Sala Contenciosa Administrativa del Tribunal Superior de Justícia de Catalunya ha dictat Sentència, en data 15 de juliol de 1991, en el recurs contenciós administratiu núm. 1097/1990, interposat per l'Ajuntament de les Franqueses del Vallès contra la Resolució de 24 de juliol de 1986, de la Direcció General de Producció i Indústries Agroalimentàries, dictada en l'expedient 379/1984, desestimatòria del recurs d'alçada plantejat contra la Resolució de 9 de juny de 1986 de la Secció Territorial d'Indústries i Comercialització Agràries de Barcelona per la qual es denega la inscripció de l'escorxador municipal.

La part dispositiva d'aquesta Sentència estableix:

"Decidim: que desestimem el recurs contenciós administratiu interposat pel procurador dels tribunals senyor Ángel Quemada Ruiz en representació de l'Ajuntament de les Franqueses del Vallès contra la Resolució de la Direcció General de Producció i Indústries Agroalimentàries de 24 de juliol de 1986, que desestima el recurs d'alçada interposat contra la Resolució del cap de la Secció d'Indústries i Comercialització Agràries de 9 de juny de 1986, ja que és ajustada a dret, sense costes."

Vist el text d'aquesta Sentència, i atès el que disposen els articles 103 i concordants de la Llei reguladora de la jurisdicció contenciosa administrativa,

HE RESOLT:

Article únic

Disposar el compliment, en els seus termes exactes, de la Sentència de la Secció 4ª de la Sala Contenciosa Administrativa del Tribunal Superior de Justícia de Catalunya, de 15 de juliol de 1991, dictada en el recurs contenciós administratiu 1097/1990.

Barcelona, 17 de desembre de 1991

JOAN VALLVÉ I RIBERA
Conseller d'Agricultura, Ramaderia i Pesca

(91.350.106)

RESOLUCIÓ

de 23 de desembre de 1991, per la qual s'autoritza l'ocupació temporal del camí ramader Carrerada Major, del terme municipal de Tortosa.

Vist l'informe favorable de la Secció Territorial del Medi Natural de Tarragona;

Ateses la Llei 22/1974, de 27 de juny, de vies pecuàries, el seu Reglament aprovat pel Decret 2876/1978, de 3 de novembre, la Llei de procediment administratiu i altres disposicions concordants,

Sumario:

Juan Carlos I,
Rey de España

A todos los que la presente vieren y entendieren. Sabed:
Que las Cortes Generales han aprobado y Yo vengo en sancionar la siguiente Ley.

EXPOSICIÓN DE MOTIVOS.

El Consejo de la Unión Europea, con fecha 29 de marzo de 1999, adoptó la Directiva 1999/22/CE, relativa al mantenimiento de animales salvajes en parques zoológicos, con el fin de establecer una base común a los Estados miembros que propicie la correcta

aplicación de la legislación comunitaria en materia de conservación de la fauna silvestre, y que, por otro lado, asegure el desempeño por los parques zoológicos de su importante papel en la educación pública, la investigación científica y la conservación de las especies. Con esta finalidad, la directiva exige el establecimiento de un régimen de autorización y de inspección de los parques zoológicos, que garantice el cumplimiento de condiciones básicas de sanidad, bienestar y seguridad, para mantener la buena salud física y psíquica de los animales salvajes que habitan en dichos parques.

Las prescripciones de la citada directiva son coherentes con las obligaciones impuestas en el Reglamento (CE) nº 338/97 del Consejo, de 9 de diciembre de 1996, relativo a la protección de especies de la fauna y flora silvestres mediante el control de su comercio, que obliga a los Estados miembros a disponer de instalaciones adecuadas para el albergue y cuidado para los casos de importación de especímenes vivos de gran número de especies, y se prohíbe la exposición pública con fines comerciales de especímenes de las especies de su anexo A, salvo en caso de concreta excepción justificada por fines educativos, de investigación o cría.

Asimismo, son coherentes con lo dispuesto en la Directiva 79/409/CEE del Consejo, de 2 de abril de 1979, relativa a la conservación de las aves silvestres, y en la Directiva 92/43/CEE del Consejo, de 21 de mayo de 1992, relativa a la conservación de los hábitats naturales y de la fauna y flora silvestres, que prohíben la captura, mantenimiento y comercio de gran número de especies, pero permiten determinadas excepciones, precisamente, para la investigación, la educación y la cría, repoblación y reintroducción de especies.

Por otro lado, el Convenio para la Conservación de la Diversidad Biológica, hecho en Río de Janeiro el 5 de junio de 1992, es el primer instrumento jurídico internacional que recoge los términos *conservación "in situ" y "ex situ"* como mecanismos de protección de los recursos biológicos y genéticos. A este respecto, dicho convenio define las medidas *in situ* como *la conservación de los ecosistemas y los hábitats naturales y el mantenimiento y la recuperación de poblaciones viables de especies en sus entornos naturales*, al tiempo que determina la importante función complementaria de las medidas *ex situ*, orientadas a establecer instalaciones para la conservación y la investigación de plantas, animales y microorganismos, a adoptar medidas para la recuperación, rehabilitación y reintroducción de especies amenazadas en sus hábitats naturales, a gestionar la recolección de recursos biológicos de los hábitats naturales y a cooperar, financiera, científica y técnicamente a la conservación *ex situ*. Acciones, todas ellas, en las que los zoológicos pueden y deben ser sujetos activos de gran valor.

En definitiva, los parques zoológicos deben ser una fuente de conocimientos científicos que esté a disposición de universidades, de instituciones dedicadas a la investigación y de organizaciones comprometidas con la conservación de la naturaleza, a fin de que estas entidades puedan contribuir no sólo a la conservación *ex situ* de las especies silvestres, sino también a su conservación *in situ* a medida que sus hábitats se van reduciendo y su distribución geográfica se va haciendo más fragmentada.

En España existe un vacío jurídico sobre la protección de la fauna silvestre en cautividad, pues la Ley 4/1989, de 27 de marzo, de Conservación de los Espacios Naturales y de la Flora y Fauna Silvestres, aunque contempla las medidas de conservación fuera del hábitat natural de cada especie (conservación *ex situ*), lo hace

tímidamente, como criterio de actuación de las Administraciones públicas en favor de la preservación de la diversidad genética. Además, la legislación española sobre agrupaciones zoológicas en general sólo establece requisitos de tipo higiénico-sanitario, fundamentalmente, y también algunas normas sobre autorización y registro de núcleos zoológicos, establecimientos para la equitación, centros para el fomento y cuidado de animales de compañía y similares.

Asimismo, los parques zoológicos deben tener como función el fomento de la educación y de la toma de conciencia por el público en lo que respecta a la conservación de la biodiversidad.

Por todo ello, la obligatoria incorporación de la normativa ambiental europea y el compromiso internacional adquirido en la firma de convenios sobre protección ambiental y conservación de la naturaleza, unidos al referido vacío jurídico, hacen necesaria esta Ley que, con el carácter de legislación básica en materia de medio ambiente, pretende asegurar la protección de la fauna 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 cautividad, profilácticas y ambientales indicadas a continuación y, en su caso, a las establecidas por las comunidades autónomas:

a. Alojar a los animales en condiciones que permitan la satisfacción de sus necesidades biológicas y de conservación.
b. Proporcionar a cada una de las especies un enriquecimiento ambiental de sus instalaciones y recintos, al objeto de diversificar las pautas de comportamiento

que utilizan los animales para interaccionar con su entorno, mejorar su bienestar y, con ello, su capacidad de supervivencia y reproducción.

c. Prevenir la transmisión de plagas y parásitos de procedencia exterior a los animales del parque zoológico, y de éstos a las especies existentes fuera del parque.
d. Evitar la huida de los animales del parque zoológico, en particular de aquellas especies potencialmente invasoras, con el fin de prevenir posibles amenazas ambientales y alteraciones genéticas a las especies, subespecies y poblaciones autóctonas, así como a los hábitats y los ecosistemas.

Artículo 4. Programas.

Los parques zoológicos quedan obligados a la elaboración, desarrollo y cumplimiento de los programas indicados a continuación y, en su caso, a los establecidos por las comunidades autónomas.

a. Programa de conservación *ex situ* de especies de fauna silvestre que, al realizarse fuera de su hábitat natural, debe estar orientado a contribuir a la conservación de la biodiversidad, por lo que deberá constar de una o varias de las siguientes actividades:
    1. Participación en un programa de investigación científica que redunde en la conservación de especies animales.
    2. Formación en técnicas de conservación de especies animales.
    3. Intercambio de información para la conservación de especies animales entre zoológicos y organismos públicos o privados implicados en la conservación de las especies.
    4. 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. Información sobre las especies expuestas y sus hábitats naturales, en particular de su grado de amenaza.
    2. Formación del público sobre la conservación de la fauna silvestre y, en general, de la biodiversidad.
    3. 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. 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. La asistencia clínica de los animales del parque zoológico que estén enfermos, por medio de tratamientos veterinarios o quirúrgicos adecuados, así como la revisión veterinaria periódica de los animales sanos.
    3. Un plan de nutrición adecuada de los animales.

Artículo 5. Personal especializado y medios materiales.

Los parques zoológicos deben disponer del personal necesario especializado y de los medios materiales adecuados para la ejecución de las medidas de bienestar, profilácticas, ambientales y de seguridad indicadas en el artículo 3, así como para el desarrollo y cumplimiento de los programas señalados en el artículo 4 de esta Ley.

Tanto el personal como los medios deberán ser acordes con las necesidades derivadas de las colecciones de animales de cada parque zoológico. La formación continua del personal a cargo de los animales estará basada en la evaluación del conocimiento de los animales silvestres, de su conservación y especialmente de su bienestar.

Artículo 6. Registro de especies y ejemplares.

1. Los parques zoológicos dispondrán de un registro actualizado de sus colecciones de animales, adecuado a las especies y subespecies a las que éstos pertenezcan.

En dicho registro deberán figurar, al menos, los datos relativos a las entradas y salidas de animales, muertes y causa del fallecimiento, nacimientos, origen y destino, y los necesarios para su identificación y localización.

2. Los sistemas de identificación utilizados serán los previstos en su caso en la normativa específica de aplicación para cada especie. En el caso de que, por las características físicas o de comportamiento de la especie, no fuera posible su identificación individualizada, se procederá a la identificación por lotes.

3. La información de dicho registro deberá facilitarse, en todo momento, al órgano competente de la comunidad autónoma.

CAPÍTULO III. AUTORIZACIÓN E INSPECCIÓN.

Artículo 7. Autorización.

1. La apertura al público, la modificación sustancial y la ampliación de los parques zoológicos están sujetas a autorización del órgano competente de la comunidad autónoma donde cada uno de ellos se ubique. Esta autorización es independiente de cualquier otra que sea exigible a los parques zoológicos en virtud de otras disposiciones legales que sean de aplicación.

2. El órgano competente concederá la autorización previa comprobación de que el parque zoológico para el que ha sido solicitada, cumple los requisitos establecidos en los artículos 3, 5 y 6, además de cumplir con los programas previstos en el artículo 4.

3. La autorización fijará las condiciones específicas aplicables al parque zoológico, para asegurar el cumplimiento de lo establecido en esta Ley y en la normativa autonómica correspondiente.

4. Se entenderá denegada la autorización si, transcurridos seis meses desde la recepción de la solicitud en el órgano correspondiente no se hubiera notificado la resolución.

Artículo 8. Inspección.

1. Mediante las correspondientes inspecciones, el órgano competente de la comunidad autónoma comprobará el cumplimiento por los parques zoológicos de las medidas de conservación comprendidas en el capítulo II de esta Ley y en la normativa autonómica de aplicación, así como de las condiciones específicas fijadas en las respectivas autorizaciones.

El órgano competente de la comunidad autónoma realizará, cuando menos, una inspección anual de cada parque zoológico, sin perjuicio de las inspecciones que pueda realizar en cualquier momento, de oficio o por denuncia.

2. Los titulares y empleados de los parques zoológicos están obligados a permitir a los inspectores acreditados el acceso a las dependencias y a proporcionarles la información y ayuda que sean precisas para la inspección.

CAPÍTULO IV. REGISTROS DE PARQUES ZOOLÓGICOS.

Artículo 9. Registro de los parques zoológicos.

1. Las comunidades autónomas deberán mantener un registro de los parques zoológicos autorizados en su territorio respectivo, con información actualizada sobre las colecciones de animales que mantengan en sus instalaciones.

2. A efectos estadísticos, las comunidades autónomas deberán mantener informado al Ministerio de Medio Ambiente de los datos de sus registros, en especial facilitando los relativos a las colecciones de animales mantenidas en los parques.

Artículo 10. Inventario nacional de parques zoológicos.

Se crea el Inventario nacional de parques zoológicos, dependiente del Ministerio de Medio Ambiente, que tendrá carácter informativo, y en el que se incluirán los datos facilitados por los órganos competentes de las comunidades autónomas exigidos en el párrafo 2 del artículo 9 de esta Ley.

CAPÍTULO V. INFRACCIONES Y SANCIONES.

Artículo 11. Responsabilidad.

1. El incumplimiento de lo establecido en esta Ley será sancionado con arreglo a lo dispuesto en este capítulo y en el título IX de la Ley 30/1992, de 26 de noviembre, de Régimen Jurídico de las Administraciones Públicas y del Procedimiento Administrativo Común.

2. La responsabilidad será solidaria cuando sean varios los responsables y no sea posible determinar el grado de participación de cada uno de ellos en la comisión de la infracción.

3. En todo caso, el titular del parque zoológico será responsable subsidiario de las infracciones cometidas por el personal que preste servicio en el propio parque zoológico.

4. La responsabilidad administrativa por las infracciones a las que se refiere esta Ley no exonerará de cualquier otra responsabilidad civil, penal o de otro orden que en su caso pudiera exigirse.

Artículo 12. Cierre cautelar.

El órgano competente de la comunidad autónoma y también el instructor, en el caso de que se hubiera iniciado el procedimiento sancionador, podrán ordenar, mediante acuerdo motivado y con carácter provisional, el cierre total o parcial del parque zoológico para garantizar la conservación de los animales existentes en ellos, cuando su apertura, modificación sustancial o ampliación se haya realizado sin la autorización exigida en el artículo 7 de esta Ley.

El cierre ordenado con anterioridad a la iniciación del procedimiento sancionador deberá ser confirmado, modificado o levantado en el acuerdo de iniciación del procedimiento, que deberá efectuarse dentro de los 15 días siguientes al cierre.

Artículo 13. Infracciones.

1. Sin perjuicio de las infracciones que, en su caso, puedan definir las comunidades autónomas, las infracciones que se tipifican en este artículo se clasifican en leves, graves y muy graves.

2. A los efectos de esta Ley se consideran infracciones leves:

a. El deficiente funcionamiento del registro de colecciones de especies y ejemplares.
b. La insuficiencia de los medios personales y materiales exigidos en esta Ley.

3. A los efectos de esta Ley se consideran infracciones graves:

a. El incumplimiento de las condiciones específicas establecidas en la autorización de apertura al público.
b. La carencia del personal especializado o los medios materiales exigidos en esta Ley.
c. El incumplimiento de las medidas profilácticas, de bienestar, ambientales y de seguridad pública establecidas en esta Ley.
d. La liberación no autorizada, negligente o intencionada, de los animales del parque zoológico.
e. La falsificación, la ocultación u omisión de datos y documentos presentados ante la administración correspondiente.
f. El incumplimiento de las actividades establecidas para la elaboración, desarrollo y cumplimiento de los programas de conservación, educación y atención veterinaria contemplados en el artículo 4 de esta Ley.
g. El incumplimiento del deber de colaboración con la autoridad inspectora.

4. A los efectos de esta Ley se consideran infracciones muy graves:

a. La apertura al público, la modificación sustancial o la ampliación del parque zoológico sin la autorización del correspondiente órgano competente.
b. La liberación no autorizada, negligente o intencionada, de animales del parque zoológico pertenecientes a especies potencialmente invasoras.
c. Dar muerte de manera intencionada a los animales del parque zoológico o la eliminación de sus restos intencionadamente sin causa justificada.
d. El maltrato, abandono o deterioro intencionados o por negligencia de los animales del parque zoológico.

Artículo 14. Sanciones

Previa instrucción del correspondiente procedimiento sancionador, el órgano competente de la comunidad autónoma impondrá a los responsables las siguientes multas:

a. De 300 a 600 euros, las infracciones leves.
b. De 601 a 60.100 euros, las infracciones graves.
c. De 60.101 a 300.500 euros, las infracciones muy graves.

Artículo 15. Otras sanciones

1. El órgano competente de la comunidad autónoma impondrá el cierre temporal o definitivo, total o parcial, del parque zoológico cuando los hechos sean constitutivos de la infracción tipificada en el artículo 13.4.a.

2. El órgano competente de la comunidad autónoma podrá imponer las siguientes sanciones accesorias:

a. La adopción de las medidas de corrección, seguridad o control precisas en cada caso que paralicen los hechos constitutivos de la infracción y que eviten la continuidad en la producción del daño, con indicación del plazo correspondiente.
b. El cierre temporal o definitivo, total o parcial, del parque zoológico cuando los hechos sean constitutivos de algunas de las infracciones tipificadas en el apartado 3 y en los párrafos b, c y d del apartado 4, todos ellos del artículo 13.

Artículo 16. Medidas por cierre.

1. Cuando haya sido ordenado el cierre temporal o definitivo, total o parcial, de un parque zoológico, el órgano competente de la correspondiente comunidad autónoma acordará las medidas de tratamiento, conservación y traslado de los animales afectados y el plazo para ejecutarlas.

2. En caso de incumplimiento de lo dispuesto en el apartado anterior en el plazo fijado, el órgano competente citado procederá a la ejecución subsidiaria de esas medidas, repercutiendo su coste en el obligado.

DISPOSICIÓN ADICIONAL PRIMERA. Medidas de seguridad pública.

1. Sin perjuicio de cualquier otra normativa aplicable, los parques zoológicos deberán establecer medidas específicas de seguridad en las instalaciones y en cada uno de los recintos de los animales, atendiendo a las características de cada especie, para prevenir cualquier riesgo para la salud o integridad física del público visitante y del personal del parque, así como para evitar la huida de los animales al exterior.

2. En el caso de animales especialmente peligrosos, se deberá contar con un sistema de control permanente, a cargo del personal especializado del parque zoológico.

En todo caso, deberá informarse al público de dicha circunstancia por medio de indicadores visibles.

DISPOSICIÓN ADICIONAL SEGUNDA. Medidas de conservación de animales no silvestres.

Las medidas de conservación establecidas en el artículo 3 de esta Ley, de aplicación a los animales de la fauna silvestre que habite en parques zoológicos, les serán asimismo aplicadas a los animales no silvestres que puedan habitar en dichos parques en régimen de cautividad.

DISPOSICIÓN ADICIONAL TERCERA. Centros de Rescate

El Gobierno remitirá al Consejo de Ministros en el plazo más breve posible desde la aprobación de esta Ley, una propuesta de normativa sobre el destino de especímenes y Centros de Rescate en el marco del Convenio sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestres (CITES) y del Reglamento (CE) nº 338/97 relativo a la protección de especies de la fauna y flora silvestres mediante el control de su comercio.

DISPOSICIÓN TRANSITORIA ÚNICA. Adaptación de parques zoológicos existentes.

Los parques zoológicos que estén abiertos al público en la fecha de entrada en vigor de esta Ley deberán ajustarse a lo establecido en ella y solicitar la correspondiente autorización en el plazo de un año.

Se podrá entender concedida la autorización si, en el plazo de seis meses desde la recepción de la solicitud en el órgano competente no se hubiera notificado la resolución.

Los parques zoológicos que no soliciten la autorización correspondiente en el plazo señalado deberán cerrar sus instalaciones al público y les serán de aplicación las medidas establecidas en el artículo 16 de esta Ley.

DISPOSICIÓN FINAL PRIMERA. Título competencial.

Esta Ley tiene el carácter de normativa básica de acuerdo con el artículo 149.1.23 de la Constitución.

DISPOSICIÓN FINAL SEGUNDA. Aplicación de otras normas.

El cumplimiento por los parques zoológicos de los requisitos señalados en esta Ley no exceptúa la observancia de las prescripciones establecidas en la legislación de sanidad animal, de policía de espectáculos públicos y actividades recreativas, y de cualquier otra que sea de aplicación.

DISPOSICIÓN FINAL TERCERA. Modificación de los requisitos.

El Gobierno podrá modificar las medidas y programas establecidos en los artículos 3 y 4, siempre que la modificación venga exigida por la normativa de la Unión Europea y se ajuste a ella.

DISPOSICIÓN FINAL CUARTA. Actualización de las multas.

Se faculta al Gobierno para actualizar, mediante real decreto, el importe de las multas previstas en el artículo 14 de esta Ley, de acuerdo con la variación anual de los índices de precios de consumo.

DISPOSICIÓN FINAL QUINTA. Facultad de desarrollo.

El Gobierno, en el ámbito de sus competencias, dictará las normas de desarrollo que requiere esta Ley.

DISPOSICIÓN FINAL SEXTA. Entrada en vigor.

La presente Ley entrará en vigor el día siguiente al de su publicación en el *Boletín Oficial del Estado.*

Por tanto, Mando a todos los españoles, particulares y autoridades, que guarden y hagan guardar esta Ley.

Madrid, 27 de octubre de 2003.

- Juan Carlos R. -

El Presidente del Gobierno,
José María Aznar López.

DIRECTIVA 1999/22/CE DEL CONSEJO

de 29 de marzo de 1999

relativa al mantenimiento de animales salvajes en parques zoológicos

EL CONSEJO DE LA UNIÓN EUROPEA,

Visto el Tratado constitutivo de la Comunidad Europea y, en particular, el apartado 1 de su artículo 130 S,

Vista la propuesta de la Comisión,

Visto el dictamen del Comité Económico y Social [1],

De conformidad con el procedimiento establecido en el artículo 189 C del Tratado [2],

Considerando que el Reglamento (CE) nº 338/97 del Consejo, de 9 de diciembre de 1996, relativo a la protección de especies de la fauna y flora silvestres mediante el control de su comercio [3], establece que la importación en la Comunidad de especímenes vivos de un gran número de especies ha de estar subordinada a que se acredite disponer de instalaciones adecuadas para su albergue y cuidado; que dicho Reglamento prohíbe la exhibición pública con fines comerciales de especímenes de las especies enumeradas en el anexo A, salvo en caso de que esté justificada una excepción concreta con fines educativos, o para investigación o cría;

Considerando que la Directiva 79/409/CEE del Consejo, de 2 de abril de 1979, relativa a la conservación de las aves silvestres [4], y la Directiva 92/43/CEE del Consejo, de 21 de mayo de 1992, relativa a la conservación de los hábitats naturales y de la fauna y flora silvestres [5], prohíben la captura, el mantenimiento y el comercio de un gran número de especies y prevén excepciones en determinadas circunstancias, como investigación y enseñanza, repoblación, reintroducción y cría;

Considerando que la correcta aplicación de la legislación comunitaria actual y futura en materia de conservación de la fauna silvestre, así como la necesidad de garantizar que los parques zoológicos desempeñen debidamente su importante papel en la educación pública, la investigación científica y la conservación de las especies, hacen necesario el establecimiento de una base común para la legislación de los Estados miembros relativa a la autorización e inspección de los parques zoológicos, el mantenimiento de animales en los parques zoológicos, la formación del personal y la educación del público visitante;

Considerando que la Comunidad debe intervenir para que los parques zoológicos de la Comunidad contribuyan a la conservación de la biodiversidad con arreglo a la obligación comunitaria de adoptar medidas en materia de conservación *ex situ*, con arreglo al artículo 9 del Convenio sobre la diversidad biológica;

Considerando que algunas organizaciones como la Asociación europea de zoológicos y acuarios han establecido directrices para el cuidado y alojamiento de los animales en los parques zoológicos que podrían ser de utilidad, cuando proceda, para el establecimiento y adopción de orientaciones nacionales,

HA ADOPTADO LA PRESENTE DIRECTIVA:

Artículo 1

Objetivos

Los objetivos de la presente Directiva son proteger la fauna silvestre y conservar la biodiversidad mediante la adopción, por parte de los Estados miembros, de medidas relativas a la autorización e inspección de los parques zoológicos en la Comunidad, potenciando así su papel en la conservación de la biodiversidad.

Artículo 2

Definición

A efectos de la presente Directiva, por «parques zoológicos» se entenderán todos los establecimientos permanentes en donde se mantengan animales vivos de especies silvestres para su exposición al público, durante siete o más días al año pero no los circos, las tiendas de animales ni los establecimientos a los que los Estados miembros eximan de los requisitos de la presente Directiva por no exponer un número significativo de animales o especies al público y por no poner en peligro los objetivos de la misma.

Artículo 3

Requisitos aplicables a los parques zoológicos

Los Estados miembros deberán adoptar medidas de conformidad con lo previsto en los artículos 4, 5, 6 y 7 para garantizar que todos los parques zoológicos cumplan las siguientes medidas de conservación:

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[1] DO C 204 de 15.7.1996, p. 63.
[2] Dictamen del Parlamento Europeo de 29 de enero de 1998 (DO C 56 de 23.2.1998, p. 34). Posición común del Consejo de 20 de julio de 1998 (DO C 364 de 25.11.1998, p. 9), Decisión del Parlamento Europeo de 10 de febrero de 1999 (aún no publicada en el Diario Oficial).
[3] DO L 61 de 3.3.1997, p. 1; Reglamento cuya última modificación la constituye el Reglamento (CE) nº 2307/97 (DO L 325 de 27.11.1997, p. 1).
[4] DO L 103 de 25.4.1979, p. 1; Directiva cuya última modificación la constituye la Directiva 97/49/CE de la Comisión (DO L 223 de 13.8.1997, p. 9).
[5] DO L 206 de 22.7.1992, p. 7. Directiva cuya última modificación la constituye la Directiva 97/62/CE (DO L 305 de 8.11.1997, p. 42).

— participación en la investigación que redunde en la conservación de especies, o formación en técnicas pertinentes de conservación, o intercambio de información sobre la conservación de especies o, cuando proceda, cría en cautividad, repoblación o reintroducción de especies en el medio silvestre;

— fomento de la educación y de la toma de conciencia por el público en lo que respecta a la conservación de la biodiversidad, en particular facilitando información sobre las especies expuestas y sus hábitats naturales;

— alojamiento de los animales en condiciones que persigan la satisfacción de las necesidades biológicas o de conservación de cada especie, entre otras cosas proporcionando a las especies los recintos adecuados a cada una de ellas y manteniendo un nivel elevado en la cría de animales, con un programa avanzado de atención veterinaria preventiva y curativa y de nutrición;

— prevención de la huida de los animales para evitar posibles amenazas ecológicas a las especies indígenas y prevención de la introducción de plagas y parásitos de procedencia exterior;

— mantenimiento de los registros actualizados de las colecciones del parque zoológico adaptados a las especies registradas.

Artículo 4

Autorización e inspección

1. Los Estados miembros deberán adoptar medidas sobre autorización e inspección de los parques zoológicos existentes o nuevos para garantizar que se cumplan los requisitos del artículo 3.

2. Cada parque zoológico deberá contar con una autorización válida en un plazo de cuatro años tras la entrada en vigor de la presente Directiva o, en el caso de parques zoológicos de nueva creación, antes de su apertura al público.

3. Cada autorización deberá incluir condiciones relativas a la ejecución de los requisitos del artículo 3. El cumplimiento de estas condiciones deberá controlarse, entre otros, mediante inspecciones periódicas y se deberán adoptar las medidas pertinentes para garantizar dicho cumplimiento.

4. Antes de conceder o denegar una autorización, de ampliar su duración o de modificarla de forma significativa, se deberá efectuar una inspección por parte de las autoridades competentes del Estado miembro con el fin de determinar el cumplimiento o incumplimiento de las condiciones de autorización o de las condiciones de autorización propuestas.

5. Si un parque zoológico no cuenta con una autorización de conformidad con la presente Directiva o las condiciones de autorización no se cumplen:

a) la autoridad competente cerrará el parque zoológico o parte del mismo al público, o

b) el parque zoológico deberá ajustarse a las condiciones impuestas por la autoridad competente para garantizar el cumplimiento de las condiciones de autorización.

En el caso de que dichas condiciones no se cumplan en un plazo adecuado, que deberán fijar las autoridades competentes y que no podrá exceder de dos años, la autoridad competente retirará o modificará la autorización y cerrará el parque zoológico o parte del mismo.

Artículo 5

Las condiciones de autorización que se determinan en el artículo 4 no se aplicarán cuando un Estado miembro pueda demostrar en una forma que la Comisión considere satisfactoria que el objetivo de la presente Directiva, de acuerdo con lo dispuesto en el artículo 1, así como las condiciones aplicables a los parques zoológicos establecidas en el artículo 3 se cumplen y mantienen de manera constante mediante un sistema normativo y de registro. El mencionado sistema debería contener, entre otras, disposiciones relativas a la inspección y cierre de los parques zoológicos equivalentes a las contenidas en los apartados 4 y 5 del artículo 4.

Artículo 6

Cierre de parques zoológicos

En caso de que deba cerrarse un parque zoológico o parte del mismo, la autoridad competente deberá garantizar que los animales afectados sean tratados o trasladados con arreglo a condiciones que el Estado miembro considere pertinentes y adecuadas al objetivo y a las disposiciones de la presente Directiva.

Artículo 7

Autoridades competentes

Los Estados miembros designarán las autoridades competentes a los efectos de la presente Directiva.

Artículo 8

Sanciones

Los Estados miembros fijarán las sanciones aplicables a las infracciones de las disposiciones nacionales que se adopten con arreglo a la presente Directiva. Dichas sanciones serán proporcionadas, disuasorias y eficaces.

Artículo 9

Aplicación

1. Los Estados miembros pondrán en vigor las disposiciones legales, reglamentarias y administrativas necesarias para ajustarse a la presente Directiva a más tardar en abril de 2002. Informarán inmediatamente de ello a la Comisión.

Cuando los Estados miembros adopten dichas medidas, éstas incluirán una referencia a la presente Directiva o irán acompañadas de tal referencia en su publicación oficial. Corresponderá a los Estados miembros decidir los métodos de plasmación de dicha referencia.

2. Los Estados miembros comunicarán a la Comisión las principales disposiciones legales de Derecho nacional que adopten en el ámbito regido por la presente Directiva.

Artículo 10

Entrada en vigor

La presente Directiva entrará en vigor el día de su publicación en el *Diario Oficial de las Comunidades Europeas*.

Artículo 11

Los destinatarios de la presente Directiva serán los Estados miembros.

Hecho en Bruselas, el 29 de marzo de 1999.

Por el Consejo

El Presidente

F. MÜNTEFERING

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT:23

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si (resposta clara i concisa jaja)

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana**

tenint en compte que no en tinc ni idea..la europea

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.?

Si, tot i que potser no tots els zoologics les respecten

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **l'espai**
- **les condicions sanitaries**
- **l'alimentació**
-

5.- Què entens tu per benestar animal?

La seva qualitat de vida

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal?

Deuen ser més encarades a les especies mes comunes de cada regió i a especies(no subespecies) i a les que estan en perill d'extinció

7.- Creus que les lleis de benestar animal es compleixen?

Mmm..no totes?

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes?

Nomes he anat al de bcn...aixi que..BCN!

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **preservar especies**
- **educar noves generacions sobre la importancia de la fauna**
- **motius economics**
-

10.- Estàs d'acord en l'existència de zoològics i centres similars?

Son una manera de mostrar com habiten les diferents especies en els seus habitats, però crec que es cruel privar-los de la llibertat.

No estic d'acord!

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 22

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? Si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **Espai**
- **Alimentació**
-
-

5.- Què entens tu per benestar animal? Que estigui amb bones condicions

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No

7.- Creus que les lleis de benestar animal es compleixen? Algunes

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Zoo Barcelona

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Mostrar els animals al públic**
- **Econòmic**
- **Científic**
-

10.- Estàs d'acord en l'existència de zoològics i centres similars? Si

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 22

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? Si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **m^2**
- **Alimentació**
- **Salut dels animals**
-

5.- Què entens tu per benestar animal? Que estigui en condicions de vida naturals

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? Si

7.- Creus que les lleis de benestar animal es compleixen? No

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Zoo de Barcelona

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Econòmic**
- **Ivestigació**
- **Oci**
-

10.- Estàs d’acord en l’existència de zoològics i centres similars? Si

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 46

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? SI

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic? LA EUROPEA

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? SI

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **BON TRACTE**
- **ESPAI I HABITAT SEMBLANT AL SEU LLOC D'ORIGEN**
- **ALIMENTACIÓ ADEQUADA**
- **ESTAR AMB ALTRES DE LA SEVA ESPECIE**

5.- Què entens tu per benestar animal? EL MILLOR BENESTAR ÉS LA LLIBERTAT

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? NO

7.- Creus que les lleis de benestar animal es compleixen? NO SEMPRE

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? EN CAP

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **GUANYAR DINERS, SÓN UN NEGOCI**
- **TENIR BON ASPECTE PER ATRAURE PUBLIC**
- **QUE ELS ANIMALS ESTIGUIN SANS**
-

10.- Estàs d’acord en l’existència de zoològics i centres similars? NOMÉS PER ELS ANIMALS QUE ESTAN EN PERILL D’ EXTINCIÓ.

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 16

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Sí

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**- AQUESTA (els peninsulars anem molt endarrere en tot)
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.?...suposo, però segur que no suficient (és a dir: no)

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- Espai/hàbitat adequat
- Alimentació
- Contacte amb el públic
- Sanitat

5.- Què entens tu per benestar animal?

Una assistència correcta a les necessitats dels animals per tal de que estiguin en unes bones condicions sanitàries, higièniques, nutricionals, físiques…etc.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal?

Si (però m'ho esteu posant en dubte)

7.- Creus que les lleis de benestar animal es compleixen?

No (claríssimament, no)

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes?

-

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- Ensenyar
- Preservar varietat d'espècies en llocs no habituals
- Divertir pixapins
- Empresonar animals per divertir pixapins

10.- Estàs d'acord en l'existència de zoològics i centres similars?

No quan fan una funció d'entreteniment de cara al públic.

Sí mentre que els animals tinguin unes garanties i siguin utilitzats en fi d'ensenyar als més menuts o els més grans (granges escola)

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 36

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana XX**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **intentar ajustar medio artificial a sus hábitos naturales**
- **respetar hábitos alimenticios**
- **respetar distribución de especies (separar depredador, de depredado!!) para evitar situaciones de estrés**
-

5.- Què entens tu per benestar animal?

En el caso de los zoológicos, me resulta difícil hablar de bienestar, sobretodo por cuestión de superficie.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No.

7.- Creus que les lleis de benestar animal es compleixen? Creeria que si.

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? No he visitado ninguno en España, pero no he visto tampoco ninguno en el cual se respeten las pautas de hábitat, es decir, que tengan las superficies suficientes para respetar sus hábitos.

9.- Quins objectius creus que tenen els centres zoològics i centres similars? Entretenimento de la gente.

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10.- Estàs d’acord en l’existència de zoològics i centres similars? No, a lo mejor estoy mas de acuerdo con parques naturales, o estilo safari.

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 22

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea XX**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **els metres quadrats.**
- **l'àmbit social de cada espècie, és a dir, que no estigui tot sol un animal de manada.**
- **que pugui mantenir minimament els seus instints d'alimentació, per exemple.**

5.- Què entens tu per benestar animal?

Que un animal pugui realitzar el màxim dels seus costums naturals, sense patir stress.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? no

7.- Creus que les lleis de benestar animal es compleixen? Depen de la magnitud de cada lloc, supos.

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes?

A un qu vaig visitar al regne unit estava mes o manco bé. El de Barcelona no em va agradar gens quan aig anar. Els zoologics en general em pariesen molt tristos.

9.- Quins objectius creus que tenen els centres zoològics i centres similars?.

- **ser un espectacle per la gent**
-
-
-

10.- Estàs d'acord en l'existència de zoològics i centres similars? No, a lo mejor estoy mas de acuerdo con parques naturalees o safaris

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 44

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea-AQUESTA**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? Si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **L'espai on estan estigui adaptat al seu Hàbitat**
- **Alimentació**
- **Salut animal**
-

5.- Què entens tu per benestar animal?

Que tinguin unes condicions òptimes per poguer-se desenvolupar sense que això perjudiqui el seu creixament natural.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal?

No

7.- Creus que les lleis de benestar animal es compleixen?

Si

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes?

Aqualeon i Zoo de Barcelona

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Donar a conèixer la fauna no autòctona.**
- **Que els nens tinguin una visió realista dels animals**
- **Poder veure directament els animals.**
-

10.- Estàs d'acord en l'existència de zoològics i centres similars?

Psi…

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT:17

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Sí

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? No

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **Els m2 que ha de tenir**
- **Mirar d'acondicionar el millor el seu hàbitat**
- **Un bon menjar**
-

5.- Què entens tu per benestar animal? Doncs que no els hi falti de res i que es sentin agobiats i que no pateixin per les condicions climatològiques del lloc on són o que no pateixin per l'agobiament de la gent.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No crec.

7.- Creus que les lleis de benestar animal es compleixen? Al 100% no

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Només he anat al Zoo de Barcelona i no està del tot malemtn pero tampoc mata.

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Ensenyar els animals a la gent**
- **Cuidar-los bé si se'ls troben ferits o això**

-

-

10.- Estàs d’acord en l’existència de zoològics i centres similars?

Per una part sí perquè és una manera de veure els animals que potser mai podries veure però d’altra banda no perquè quina culpa tenen ells que perquè nosaltres els puguem veure doncs hagin d’estar tancats en un recinte.

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT:

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? SI

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea X**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? La veritat no crec que siguin tant meticulosos en la regulació de les condicions dels animals.

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **L'espai mínim segons l'espècie i la quantitat.**
- **L'alimentació.**
- **Cada quant s'han de fer revisions.**
- **En el cas que el recinte s'hagi de netejar, cada quant s'hauria de fer.**

5.- Què entens tu per benestar animal? Què els animals visquin en unes condicions que intentin minimitzar el fet de que no estiguin al seu hàbitat natural.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? NO

7.- Creus que les lleis de benestar animal es compleixen? NO

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Fa molt que no vaig a un zoològic.

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Guanyar diners exhibint animals.**

- Protectores i parcs naturals és més probable que pretenguin protegir l'animal.

-

-

10.- Estàs d’acord en l’existència de zoològics i centres similars? SI

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 41

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? no

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic? europea

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? no

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **L'habitat**
- **L'alimentació**
- **La salut de l'animal**
- **I el gast per mantener-los**

5.- Què entens tu per benestar animal? Que estiguin ben alimentats, en un bon habitat adequat per a ells.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No.

7.- Creus que les lleis de benestar animal es compleixen? No

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Al Zoo de Barcelona.

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Perpetuar l'espècie**
- **Evitar el maltractament animal**
- **El propi benefici econòmic**
- **I per els estudiants de biologia, veterinària, etc.**

10.- Estàs d’acord en l’existència de zoològics i centres similars? Si.

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 23 anys

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea ← crec**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? Si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **Benestar de l'animal**
- **Les instal·lacions adequades**
- **Bon control veterinari**
- **Alimentació adaptada per cada animal**

5.- Què entens tu per benestar animal? Que tingui un nivell adequat de qualitat de vida

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? Si

7.- Creus que les lleis de benestar animal es compleixen? De vegades

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Aqualeon (tipus safari) o zoo de tenerife

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **exhibir els animals**
- **intentar reproduir espècies en perill**
- **econòmic, obtención de beneficis**
- **evitar l'extinció d'espècies**

10.- Estàs d’acord en l’existència de zoològics i centres similars? Si

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT:23

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic? Europea

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? No

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **Instalacions adequades per a cada animal**
- **Alimentació**
- **Que tinguin prou espai**
-

5.- Què entens tu per benestar animal? Que estiguin el més semblant al seu entorn natural

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No

7.- Creus que les lleis de benestar animal es compleixen? Sí

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Només he estat al Zoo de Barcelona

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Culturals**
- **Entreteniment**
- **Econòmic**
-

10.- Estàs d’acord en l’existència de zoològics i centres similars? Si

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 22

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? SI

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? SI

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **ALIMENTACIO**
- **SANITAT**
- **M2**
-

5.- Què entens tu per benestar animal? QUE ES CUMPLEIXIN ELS ASPECTES ANTERIORS

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? NO

7.- Creus que les lleis de benestar animal es compleixen? A VEGADES

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? --

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **GUANYAR DINERS**
- **ENSENYAR ELS ANIMALS AL PUBLIC**
-

10.- Estàs d'acord en l'existència de zoològics i centres similars? NO

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 27

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana X**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? No

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **Alimentació**
- **Grandària del Recinte**
- **Neteja**
- **Veterinari a la seva disposició**

5.- Què entens tu per benestar animal? Que l'animal se senti bé

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No

7.- Creus que les lleis de benestar animal es compleixen? No sempre

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Bcn

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Investigació**
- **Guany de diners**
- **Ajuda als animals que ho necessiten**
-

10.- Estàs d'acord en l'existència de zoològics i centres similars? Si

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 22

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana X**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? No

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **Alimentació**
- **Equip mèdic**
- **Neteja**
- **Instal·lacions adequades**

5.- Què entens tu per benestar animal? Que l'animal es desenvolupi amb llibertat.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No

7.- Creus que les lleis de benestar animal es compleixen? Espero que si

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Bcn

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Econòmic**
- **Ajudar animals en perill d'extinció**
- **Recerca**

10.- Estàs d'acord en l'existència de zoològics i centres similars? No

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 22

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- **Catalana**

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? Si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **Espai**
- **Nutrició**
-
-

5.- Què entens tu per benestar animal? Que els animals estiguin en bones concidions tant físiques com psíquiques.

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? No

7.- Creus que les lleis de benestar animal es compleixen? Mes o menys

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Zoo de Bcn (únic que he estat)

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Protegir espècies en perill d'extinció**
- **Guanyar diners**
- **Ensenyar animals de tot el món**
-

10.- Estàs d’acord en l’existència de zoològics i centres similars? Si

ENQUESTA SOBRE LA PROTECCIÓ/BENESTAR D'ANIMALS DE ZOOLÒGIC

EDAT: 21

1.- Creus que existeix alguna llei sobre la protecció/benestar dels animals de zoològic? Si

2.- Quina de les lleis següents creus que és més exigent en relació a la protecció/benestar dels animals de zoològic?

- **Europea**
- **Espanyola**
- Catalana

3.- Creus que les lleis actuals regulen aspectes com el m^2 que han de tenir les instal·lacions, el tipus d'alimentació dels animals, l'acondicionament del recinte etc.? Si

4.- Quins aspectes creus que són importants alhora de regular legalment en animals de zoològic?

- **m^2**
- **Alimentació**
- **Control veterinari**
- **Acondicionament del recinte**

5.- Què entens tu per benestar animal? Maxima llibertat i comportament natural

6.- Creus que les lleis de benestar animal regulen les necessitats de cada tipus d'animal? Si

7.- Creus que les lleis de benestar animal es compleixen? Si

8.- Dels zoològics o centres similars en els que has estat, en quin creus que els animals estan en unes condicions més òptimes? Zoo de Bcn

9.- Quins objectius creus que tenen els centres zoològics i centres similars?

- **Entreteniment**
- **Educatiu**
- **Econòmic**
- **Cientific**

10.- Estàs d’acord en l’existència de zoològics i centres similars? En bones condicions sí

Només mostrem una part de les enquestes realitzades (les que has respos via mail) ja que la resta estan fetes personalment escrites en paper.

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Comparison of the behaviour of European brown bears (*Ursus arctos arctos*) in six different parks, with particular attention to stereotypies

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Abstract

In order to assess the influence of environmental parameters on their behaviour, 16 European brown bears were observed in six different zoological parks. Activities were measured by scan sampling and their relationships to housing conditions were established by multifactorial correspondence analysis and cluster analysis. The largest enclosures were characterised by high scores of play, social behaviours, eating, and interest in the inside as well as the outside of the enclosure. Because these parks were newer, their bears were the youngest of those studied. Stereotypies were associated with medium age animals and small enclosures. The oldest subjects were characterised by high frequencies of resting. Stereotyped walk was observed only in those parks where keepers throw food to the bears. This result and detailed observation of stereotyped movements suggest that the meaning of the stereotypy for the animal could be to induce the keeper's arrival.

Keywords: Enrichment; Housing; Husbandry procedures; Welfare; Zoo animals

1. Introduction

Bears are very widespread in zoos and are among the most popular zoo animals. They are large, impressive, and the subject of considerable folklore (Forthman et al., 1992). Brown bears (*Ursus arctos arctos*) reproduce very well in captivity (Tumanov, 1998).

Many bears are still maintained in narrow concrete pits, with a small pond, poor vegetation and sometimes no trunks or rocks to climb (Pappas, 1993; Poole, 1997; Usher Smith and Kolter, 1998). Numerous attempts at improvement of housing conditions of captive wild animals have been made in the past 20 years (Bacon, 1992; Shepherdson, 1992; Mellen and MacPhee, 2001). Broadly, enrichment is typically designed to permit or encourage animals to display their natural behavioural repertoire (Mellen and MacPhee, 2001). Compared with the wild, captive environments lack novelty, are spatially limited, lack complexity and generally provide the inhabitant with little control over its environment (Carlstead, 1996; Poole, 1998). As a consequence, a general aim is to provide animals opportunities to have plenty to do and to provide a range of pleasurable activities, allowing goals to be achieved and choices made. Animals should have 'control' over their environment (Broom and Johnson, 1993).

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Improvement of the behavioural repertoire is often used as a welfare criteria (Healy, 2000). For spectacled bears, introduction of a climbing structure resulted in increased behavioural diversity, both in use of the enclosure's physical space and in behaviours displayed in various parts of the enclosure (Renner and Lussier, 2002). Renner et al. (2000) suggested that an environment could be considered appropriately enriched if the resident animals display normal exploratory and curiosity behaviours.

Many methods try to stimulate functional foraging and feeding behaviour in confined bears (Twamley, 1993; Koene, 1994b). Because eating is one of the most stimulating activities of captive bears, feeding enrichment through multiple feedings, concealment of food, or various devices that either must be manipulated to get food or offer food at unpredictable times has been shown to stimulate the life of zoo bears and reduce stereotypies (Fischbacher and Schmid, 1999). Renner et al. (1999) recommended use of problem-solving as a behavioural enrichment technique for captive animals. They observed in polar bears that addition of problem-solving to an existing management routine does not lead to undesirable secondary effects, and provides periods of increased activity for the animals that extend beyond trial sessions.

Indeed, it is essential to encourage the expression of investigatory and manipulatory foraging behaviours, to reduce levels of stereotypy (Carlstead et al., 1991a). Stereotypies have been described in a variety of domestic and wild animal species (Hediger, 1950; Morris, 1964; Boorer, 1972; Fraser and Broom, 1990). A stereotypy is a behaviour pattern that is repetitive, invariant, and has no obvious goal or function (Carlstead et al., 1991a, Mason, 1991) and is therefore considered abnormal. There are diverse behaviours with form, timing and frequency depending not only upon the species in question but also on the individual (Bashaw et al., 2001). Examples include chain manipulation and excessive drinking in sows (Terlouw et al., 1993), pacing in fennec foxes (Carlstead, 1991b), licking of non-food objects in giraffes and okapis (Bashaw et al., 2001) and head weaving in elephants (Wiedenmayer, 1998). Ursids or felids engage in stereotypies (e.g. head weaving/head throw back and pacing) during 60–80% of the day (Van Keulen-Kromhout, 1978; Wechsler, 1991).

Until quite recently occurrence of stereotypies was only considered as an indicator of a boring, poor environment. Nevertheless they can appear in complex and varied enclosures (Mason, 1991; Fischbacher and Schmid, 1999)

As emphasized by Wechsler (1992), it is widely accepted that stereotypies develop and are performed in situations characterised by motivational conflict. However, little is known about the nature of this motivational conflict. It is hypothesized that stereotypies develop from frustrated appetitive behaviour. Stereotypies of spectacled bears were sometimes interpreted as a consequence of a lack of suitable resting site (Fischbacher and Schmid, 1999). In the same way, after her enclosure was enlarged, a female polar bear stopped her stereotypic behaviour. This change was interpreted as a result of decreasing contact with her cage mates. Aggressive acts by the male were often followed by the female pacing at positions as far as possible from the male (Ames, 1993).

All bears anticipated the arrival of their meal and attended to the passing or arrival of keepers. They would often stop whatever they were doing and sniff the air in the direction of the approaching keeper (Van Keulen-Kromhout, 1978). Swaisgood et al. (2001) distinguished 'feeding anticipation' from other behavioural variables. It was operationally defined as being alert, within one body length of the area where food is commonly delivered, and oriented in the direction from where food is brought. Animals fed on a fixed interval schedule learn to predict the length of the interval between feedings. Animals maintained on this schedule of reinforcement developed stereotyped behaviour (Kolter, 1995; Mellen and MacPhee, 2001; Waitt and Buchanan-Smith, 2001). For this reason, in the present study we compared parks with different husbandry procedures.

Stereotypic behaviours develop in different ways. They are influenced by sex, age or other individual characteristics (Ames, 2000). Well established stereotypies are easily transferred to different situations. Consequently a situation associated with a stereotyped behaviour is not necessarily its origin (Hinde, 1975; Kiley-Worthington, 1977). In the case of a medium-aged female and a young male spectacled bear, three months of experience with an enriched feeding routine in a complex, large enclosure could not prevent them from performing previously developed

stereotypies (Fischbacher and Schmid, 1999). In the same way, Borchardt and Ganslosser (2002) showed that an established stereotypy in a brown bear did not disappear after transfer to a novel larger enclosure.

Spendrup and Larsson (1998), studied brown bears' stereotypic behaviour in five different enclosures (in four different zoos), differing both in size and habitat quality. With regard to the amount of stereotypies, a large area seemed to be more favourable than an enriched small one. Most previous studies were limited to a single enclosure. To the contrary, in our study, bears were observed in six different parks in order to determine the influence of environmental factors on the behavioural repertoire and stereotypies. A previous study on captive wolves pointed out the interest of such a comparative method (Frézard and Le Pape, 2003). The parks were chosen because of their important diversity in housing conditions and ages of subjects. Besides evaluating characteristics of the parks as determinants of behaviour, we looked for associations between stereotypies and other activities in order to highlight behavioural profiles of stereotyped subjects.

2. Animals and methods

2.1. Parks

Sixteen bears were observed in five French parks, Pescheray, Rhodes, Gramat, Le Clos aux Ours, Vincennes, and a Belgian one at Han sur Lesse. Characteristics of the enclosures are described in Table 1.

The five French parks were studied at least three times at different seasons, totalling 272 h. Han sur Lesse was observed only one time for 20 h, just before the transfer of the cubs (Grenouille and Gromy) to Pescheray.

Surfaces of enclosures were very variable from 17,000 to 300 m^2. Before analysis they were encoded as 'large' (17,000 m^2), 'medium' (1000 or 800 m^2) and 'small' (600 m^2 or less). Ages of subjects at the beginning of observations were also very variable, from one to 35 years. They were encoded as 'young' (1–5 years; seven subjects), 'medium' (11–14 years; five subjects) and 'old' (21 years or more; four subjects).

2.2. Observation method

Observation sessions lasted at least three consecutive days and at least seven hours per day. Although not ideal, we chose consecutive days in each park for logistical reasons, long distances between parks. However we made sure that no unusual change or event occurred during the weeks before our observations. When bears spent the night inside cages, observations began when they left the cages and continued until they returned inside. When bears spent the night outside, observations began at 9 a.m. and ended at 6 p.m. As a consequence the durations of observation sessions were not exactly homogeneous. A scan was performed every minute. Activity and location of the activity were recorded on each scan for each subject. All observations were carried out by the same person.

2.3. Behavioural items

To know what is interesting for a bear seams to be an important step to understand them (Despret, 2002). Because bears spent a lot of time looking, sniffing or straining one's ear in specific directions, we designed three behavioural items called "attentive to" the most important parts of the enclosure. Most behavioural items were pooled into activities in order to reach sufficient numbers for statistical analysis. This was the case for positives and negatives social interactions except play. Because play is generally considered as a good indicator of welfare it was recorded separately. Stereotyped movements were also recorded separately because they are of special interest in this study. Ten groups of activities (Table 2) were described.

2.4. Data analysis

Because observation sessions were not of the same exact duration, the relative score for each activity was used, the total amount of activities being 100%. The table of relative frequencies of activities had 10 active columns. Characteristics of bears (sex, age) and parks were used as supplementary variables. Each row of the 46 row table corresponded to one observation session of one bear.

Because only six parks were studied, only descriptive statistics were used. The table was described by multifactorial correspondence analysis (MCA). This

Table 1
Description of enclosures, animals and observation periods

Parks and observation sessions	Observing time	Animals, sex and age at the beginning of observations	Brother/sister relationship	Parental relationship	Surface of the enclosures and place during night	Ground and vegetation	Percent of scan samples comprising stereotypy in sessions order
RHODES							
April 2001	16 h	Graouly: male—3 years	1	a	17,000 m^2 inside	Grass	No stereo
November 2001	12 h	Groseille: female—3 years	1	a		Trees	11, 28, 24
April 2002	25 h	Sophia: female—3 years	2			Trunks	1, 0, 4
		Volga: female—3 years	2			Water	No stereo
PESCHERAY							
May 2001	17 h	Gromy: male—1 year	1	a	1000 m^2 outside	Grass	0, 0, 0, 1
June 2001	15 h	Grenouille: female—1 year	1	a		Trees	No stereo
November 2001	14 h					Trunks	
June 2002	16 h						
GRAMAT							
June 2001	20 h	Victor: male—27 years		Fc	800 m^2 outside	Concrete	0, 0, 21
October 2001	14 h	Nénette: female—12 years	3	c		Grass	2, 1, 2
July 2002	20 h					Water	
HAN SUR LESSE							
April 2001	Willy 10 h mother and cubs 10 h	Marlène: female—11 years	4	Ma	500 m^2 inside	Concrete	19
		Willy: male—11 years	4	Fa		Grass	35
		Gromy: male—1 year	1	a		Trunks	No stereo
		Grenouille: female—1 year	1	a		Water	No stereo
LE CLOS AUX OURS							
June 2001	20 h	Antoine: male—12 years	3	c, Fb	600 m^2 inside	Concrete	12, 48, 36
October 2001	18 h	Segolène: female—12 years	3	c, Mb		Grass	4, 4, 20
July 2002	18 h	Myrtille: female—5 years		b		Trunks	25, 31, 34
						Water	
VINCENNES							
February 2001	Titus 10 h, Fem 5 h	Folette: female—24 years			300 m^2 inside	Concrete	0, 4
March 2001	Titus 5 h, Fem 9 h	Jacquotte: female—35 years				Trunks	0, 1
July 2001	Titus 14 h	Titus: male—21 years				Water	0, 17, 29

Park's name, observation sessions and its duration, bears name, age and sex are given for each park. Two subjects with the same number are brothers or sisters. Parental relationships are indicated: Fa: father of the 'a' bear, Ma: mother of the 'a' bear, etc. Place over night, surface and layout of each enclosure are given. Percentage of stereotypic behaviours are indicated per individual and per observation session in the last column.

Table 2
Description of the behavioural items

Attentive to cages	The bear goes or stays near cages, scratches cages or watches cages from any part of the enclosure
Attentive to inside	The bear digs, sniffs a tree or a rock, scratches the ground or a tree, looks around inside the enclosure, sniffs or watches the ground while walking
Attentive to outside	The bear observes or listen outside the enclosure, watches the visitors, the keeper or the observer, or begs for food
Eating	The bear drinks. He sniffs or carries food, bites, gnaws or licks food, rips leaves or bark off, grazes, catches insects
Locomotion	The bear walks without sniffing the ground, runs or climbs
Social (except play)	The bear watches, approaches, sniffs or licks another bear, sniffs urine, faeces or the previous place of another bear, snuggles against another or rests with body contact The bear avoids, follows, chases or rushes at another bear
Social play	Bears run together with constant distance, play fighting or biting with peaceful open mouth and/or cuddly paw movements
Solitary play	The bear raises or snaps branches, paddles in the water, plays with his own paws. He rolls or runs zigzagging
Resting	The bear stands or sits, sometimes leaning on a trunk, with no particular attention to something. He lies down with open or closed eyes
Stereotypy	Pacing: the bear continuously walks from left to right in a straight line placing the feet exactly in the same position each way Circling: the bear walks in the same path in a longer or less circling pattern Swaying: the bear stands in front of the cage door or of the fence rocking the head from side to side continuously and/or leaping in the air Head-tossing: the bear suddenly throws the head back and turns it

technique is a kind of principal component analysis, but using a relative chi-square criterion to show differences and similarities between frequencies of qualitative variables (Lebart et al., 1984). Briefly, active variables are placed in a multidimensional cloud in which two activities will be at a short distance if they show similar proportions in the same individuals and conversely they will be distant if they are expressed by different individuals. A multidimensional cloud of individuals is calculated in the same way, in which two subjects will be close if they have similar behavioural profiles. Supplementary variables (characteristics of the parks) are placed subsequently in the subjects cloud, each modality being placed at the centre of gravity of individuals sharing this modality. Both clouds are then displayed together by projection onto planes. Each plane is defined by two factors (or axis), each factor accounting for a given proportion of the total variance of the cloud. The first factorial plane defined by F1 and F2 is the most representative of the cloud. Before performing the analysis the overall heterogeneity of the table was checked by a chi-square test at the $P = 0.001$ level.

Similarities between individuals was described by a cluster analysis of the 46 rows of the table. The clustering method is performed on the coordinates in the individual's cloud. After dividing the tree in clusters, characteristics of each cluster were calculated using an hypergeometric criterion at the $P < 0.001$ level: characteristic activities of a given cluster had a relative frequency significantly higher than the mean score; characteristic parks were significantly over-represented in the cluster.

3. Results

The relationships between activities and characteristics of the different parks can be seen in Fig. 1.

A short distance between a given activity and a supplementary modality means that bears with a relatively high score for this activity were characterised by this modality. The first factorial plane of the analysis accounted for 59.7% of the total variance.

The main opposition, on the F1 axis, was between observation sessions with a relatively high score of stereotypy and observation sessions with a high proportion of social behaviours, play and eating. Stereotypies were mainly associated with Le Clos. In this park the three subjects spent a high proportion, up to

Fig. 1. MCA of the table crossing observations of each bear (rows) and relative frequencies of activities (columns). Activities are marked by a triangle and are in bold. The size of triangles is proportional to the contribution of each variable. Individuals are grouped in a 'sex-age' supplementary variable, e.g. M-young. Characteristics of the parks are also used as supplementary variables. The names of the parks are upper-case and underlined.

50% of the time, in stereotyped walk. Because the only two males of medium age, one in Le Clos and one in Han, showed a high score of stereotypy, the 'M-medium' point had a very extreme position on the graph.

During the only observation session in Han both adults were outside cages at different moments of the day because of the presence of two cubs. While the male spent 35% of time in stereotyped walk, the female spent 20% and the cubs did not. This finding explains the central position of this park on the graph.

Rhodes and Pescheray parks were on the left side of the graph, characterised by social behaviours, play, attentive to inside the enclosure and eating. These two parks were the most 'comfortable' in this study, providing grass, trees, trunks and rip-rap. Bears of these two parks were also the youngest of the study, three years and one year old, respectively.

The opposition on the F1 axis between "attentive to inside the enclosure" and "attentive to cages" was noticeable, the latter being on the same side as stereotypy.

Observation sessions characterised by high scores of resting were separated on the second factor, F2. Associated parks were Vincennes and Gramat. In these parks animals spent 70 to 30% of the time resting. These subjects were the oldest of the study. Because the only winter observation session was in Vincennes the point 'season = winter' had an extreme position on the graph. Nevertheless this park was also studied in spring. In Gramat observations were made in summer and in fall.

After the cluster analysis, a partition of the tree was performed using the most important steps in variance. This led to five classes in the observation sessions (see Fig. 2).

The most distinctive class, at the top, comprised 60% of bears from Le Clos and 20% of bears from Han. Bears of this class were mostly either young (45%) or medium age (45%). These sessions were

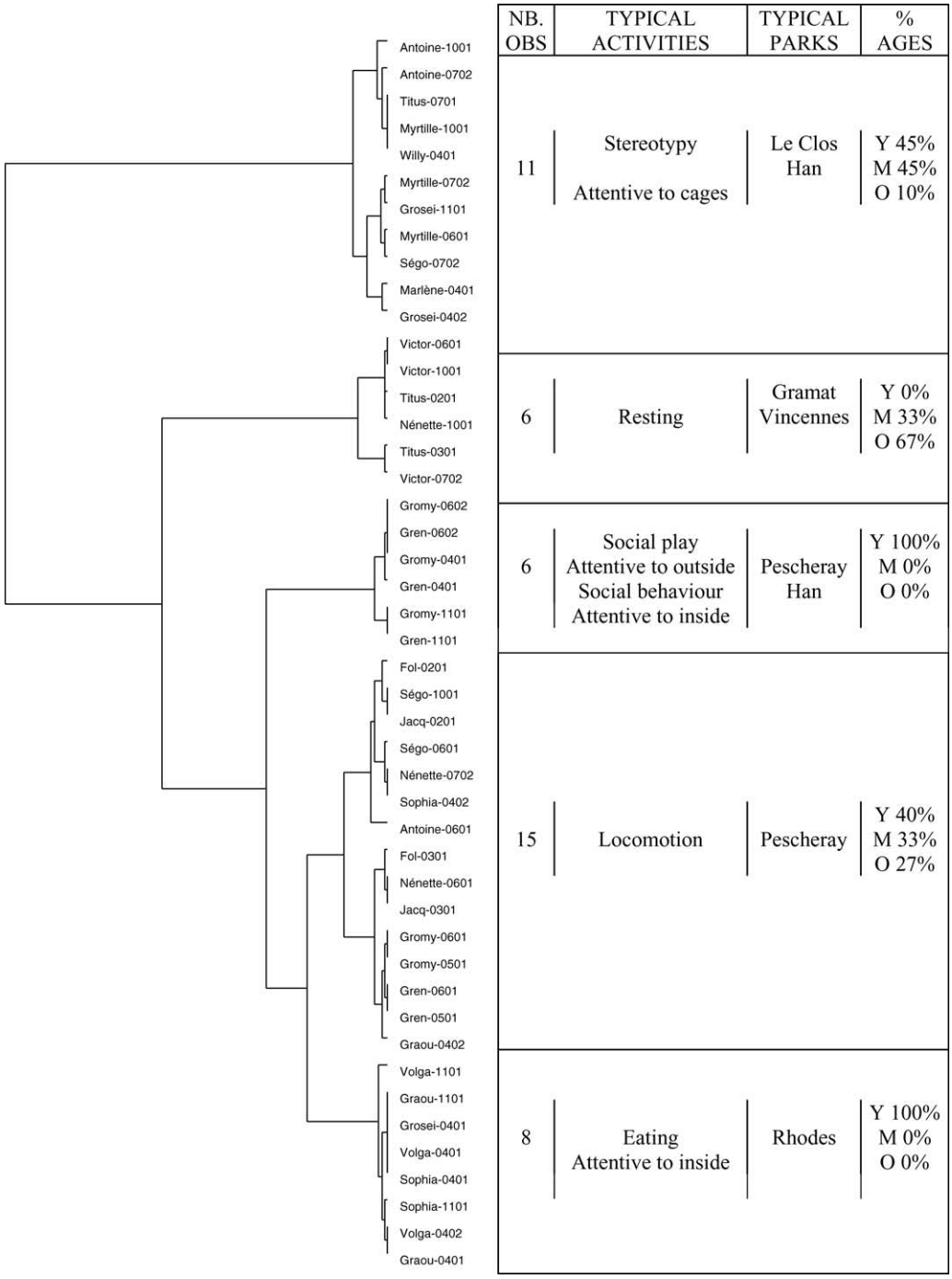

Fig. 2. Cluster analysis of bears observation sessions and partition of the tree in five clusters. The name of the bear and the observation period (month and year) is given for each session. Number of sessions, most characteristic activities, characteristic parks and proportions of the different age categories (Y: young, M: medium, O: old) are given for each cluster.

characterised by high scores of stereotyped behaviour and animals interested in the cages.

The next class comprised six sessions, three at Gramat and three at Vincennes. These sessions were characterised by high scores of resting and by old bears.

The third class included only two one year old cubs. These observations were done in April 2001 in Han before their transfer, and then in Pescheray 7 months later and one year later. The similarity of the results in Han and in Pescheray suggested that the transfer did not modify their behaviour widely, except that more locomotion occurred in Pescheray. These sessions were characterised by social behaviours and a frequent interest in what happened inside and outside the enclosure.

Fifteen sessions, mainly characterised by locomotion, comprised the next and largest class. All parks but Han, were represented in this class, in which Pescheray was the most associated with locomotion. All three age categories were represented in the class, as were the two observation sessions performed on the cubs transferred from Han just after transfer and one month later.

The last class consisted of eight sessions from Rhodes where all subjects were young. These young bears spent significant time looking for food and grazing. The bears were relatively attentive to inside the enclosure.

4. Discussion

Results were highly structured by the age of subjects. Exhibition of bears in large enclosures is relatively recent in France. Traditionally, bears were thought to be content with a small concrete pit. As a result young subjects are found chiefly in spacious enclosures and vice versa. This association made interpretation of the MCA and of the cluster analysis uncertain. So, high scores of play and social behaviours in Pescheray and Han were probably related to the youth of the animals. In the same way, increased resting time was the main effect of increased age; and Gramat and Vincennes were the oldest parks in this study.

High scores of eating and looking for food could be related to resources offered by a relatively rich environment. In particular, bears spent a lot of time grazing when grass was abundant. When logs were present, bears spent a lot of time turning them over to look for insects. This was the case in recent parks such as Rhodes. However, the MCA revealed that most housing parameters (i.e. height of visitors' viewing area, rocks, den, or night spent inside versus outside) did not appear to have strong effects. Moreover, in accordance with Ames' data from polar bears (2000), we observed neither differences in stereotypy related to sex or season, nor similarities related to kinship.

Proportions of stereotypies were not necessarily related to the age or to the facilities. Young (5 years old) and medium-age animals showed the highest stereotypy scores. Stereotyped behaviour was also observed in the largest and best equipped park (Rhodes) and in the poorest and smallest one (Vincennes) or in intermediate ones. This heterogeneity is in accordance with Fischbacher and Schmid's observations (1999).

Detailed observation of animals performing a stereotyped walk showed that in most cases the bears walked along the same path and exhibited an intermediate head posture. The bears did not carry their head high, nor did they sniff the ground. In every case we noted that bears gave a very quick look, always the same direction and always from the same point of the path. The point they looked at was always one where food could be provided by keepers or visitors. The place was either the cage's door or the visit site or the keeper's arrival route. This finding can be compared to that of Wechsler's study in polar bears (1991) in which stereotyped walking was associated with yawning, tongue-flicking, and looks towards the caretaker and visitor's path.

Animals spending the night inside received their main meal at the time they returned to the cage. Cages door were then related to food delivery. A common characteristic of subjects displaying stereotypy was that they were, or had been in parks where keepers frequently threw food from the viewing point, in order to add some life to the enclosure. Moreover, in each park associated with this style of feeding, we observed stereotyped behaviour of at least one subject. This management brought about food expectation. Moreover, stereotyped walk was exhibited near the feeding place, generally on a concrete path.

As was the case for various behaviours (Varela et al., 1993), stereotyped activities can be studied from the point of view of their *meaning for the animal*. If locomotion along a given path is sometimes followed by feeding, the animal is able to associate his movement with the reinforcement. We suggest that the bear *induces* the keeper's arrival by his walk, in the same way as begging *induces* feeding by the visitors. Such an expectation linked to stereotyped walk could be an explanation of the quick look at the cage's door or the keeper's arrival path. Stereotypies exhibited in front of cages became more and more intense as feeding time approached. This increase in intensity was especially obvious when feeding was delayed. As suggested by Wechsler (1992) the stereotyping animal *does* something.

This effect was not related to undernourishment. In some parks, the daily diet was doubled in order to reduce stereotypies, but in vain. It should be noted that the brown bear is reputed to be very interested in food and that food thrown from the visitors' viewing place by keepers is generally very tempting. Van Keulen-Kromhout (1978) suggested this kind of feeding as a method to reduce stereotypy: when they beg and try to reach thrown food, bears 'kept occupied' similarly as during the natural food finding activity and so they didn't develop stereotypy. Otherwise, we suggest, this practice induces stereotypies. When cubs were introduced to Pescheray, we observed the beginning of a stereotyped walk in front of the visitors' viewing site where keepers threw food. The cub stopped his behaviour after this kind of feeding was forbidden. This change was possible because we acted to change the feeding procedure before the stereotyped behaviour had become firmly established. Unfortunately, as is well known, old stereotypies are very difficult to reduce (Koene, 1994a; Wemelsfelder, 1993).

5. Conclusions

Comparisons of the diversity of the behavioural repertoire of brown bears in a variety of housing conditions would lead to better welfare programs. In particular, such projects would enhance understanding stereotypic behaviours. Attention that animals pay to keepers and visitors merits further study because it is an important part of captive life.

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Stereotypic Behavior in Asiatic Black and Malayan Sun Bears

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The stereotypies of individually caged Asiatic black bears (*Ursus thibetanus*) and Malayan sun bears (*Helarctos malayanus*) were studied in detail. Stereotypies were performed by 27 of the 29 subjects, were primarily locomotory in form (e.g., pacing), and occupied on average 18% (standard error of the mean (SEM) = 2.5) of daylight hours. Stereotypy levels during the night were almost negligible and were highly correlated with daytime levels. Total stereotypies peaked prior to food arrival, although oral stereotypies were most frequent after feeding. In general, stereotypies were performed in locations from which food arrival could be viewed, although Asiatic black bears were equally likely to exhibit stereotypy near a neighboring bear. Across individuals, stereotypy frequency was inversely correlated with inactivity and increased with age. Older bears also showed less normal activity and a reduced diversity of normal behavior. Stereotypy levels were unrelated to levels of "compulsive" behavior (e.g., hair plucking) or repetitive self-sucking–a potential deprivation stereotypy. More frequent stereotypies were performed more invariantly (i.e., were more predictable from one repetition to the next) and in more diverse contexts, namely 1) outside the pre-feeding period, and 2) during the night. Contrary to observations reported elsewhere, higher frequencies of stereotypy were not associated with reduced behavioral diversity, or with a more elaborate repertoire of stereotypy forms and sequences. Although the two species did not differ in overall frequency, the stereotypies of sun bears appeared to be more food-motivated than those of Asiatic black bears: the sun bears displayed a higher frequency and diversity of oral stereotypies, and higher levels of pre-feeding stereotypy, and performed significantly more of their total stereotypies in locations from which they could view food arrival. This study demonstrates how analyzing stereotypies in detail can help identify the motivations that underlie these behaviors, and potentially reveal their degree of establishment–both of which are important factors in stereotypy treatment. Zoo Biol 23:409–430, 2004. © 2004 Wiley-Liss, Inc.

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INTRODUCTION

Stereotypies are invariant in style, performed repetitively, and appear to have no function [Ödberg, 1978; Mason, 1991a]. Common in a range of animal species and husbandry systems, they are of concern primarily because of their association with poor welfare [reviewed by Mason, 1991b; Mason and Latham, 2004], but also because they often have negative consequences (for example, on health [e.g., Fraser and Broom, 1990]). For zoos, stereotypies represent a further problem in that they may be detrimental to conservation efforts [e.g., Shepherdson, 1994; Vickery and Mason, 2003] and visitor education [Carlstead, 1998], and may also attract criticism from the public and animal welfare organizations [Fielding, 2001].

Captive bears appear to be particularly susceptible to stereotypies. In a survey of stereotypies in 33 carnivore species, ursids displayed both the highest frequency (i.e., proportion of observed time) and maximum prevalence (i.e., percentage of individuals affected) compared to other families (e.g., canids and felids) [Clubb, 2001]. Studies of stereotypies in bears have documented a wide range of forms. Pacing appears to be the most common stereotypy, and is performed along straight routes, in circles, or in figure-eights [Meyer-Holzapfel, 1957; Ames, 1994, 2000; Langenhorst, 1998]. However, other behaviors, such as weaving, head-swaying, stereotypic swimming, and tongue-flicking [Meyer-Holzapfel, 1968; Fox, 1971; Wechsler, 1991; Kolter and Zander, 1995; Hennessy, 1996; Ames, 2000] have also been reported. Individual frequencies are highly variable: some bears display no stereotypy at all [e.g., Tepper et al., 1999], while others may exhibit stereotypy for up to 77% of observed time [Wechsler, 1991]. Individual variation is often high even within a species [Ames, 1994, 2000], and has been linked with variation in behavioral persistence [Vickery and Mason, 2003] (Vickery and Mason, unpublished results). Other properties of bear stereotypies are less commonly assessed, and our ability to draw general conclusions is further hampered by variations in methodology, husbandry, and individual factors. However, broadly speaking, bear stereotypies appear to be highly invariant (i.e., their movements are very predictable from one repetition to the next). For example, in a study of pacing in three polar bears, Wechsler [1991] reported that "at a given place an equal number of steps is repeated over and over, the paws regularly touch the ground on the same spots, and the duration of a lap hardly varies [p 187]." They also tend to be performed in highly specific areas [Langenhorst, 1998] and to peak before feeding [Langenhorst, 1998; Landrigan et al., 2001].

Many studies have attempted to alleviate bear stereotypies, usually by enrichment [Carlstead et al., 1991; Forthman et al., 1992; Fischbacher and Schmid, 1999; Swaisgood et al., 2001], but also with the use of homeopathic [Jordan-Owers, 2003], anti-depressant [Poulsen et al., 1996, 1998], and anti-psychotic [Uchida and Dodman, 1998] drugs. However, despite the focus on reducing these behaviors, few studies on bears have examined stereotypies in any depth. Indeed, of 36 studies that quantitatively assessed stereotypy in zoo-housed bears (90% of which attempted to reduce stereotypy (see Vickery [2003] for details), most (58%) quantified only the

frequency, and made no reference to the behavior's invariance, timing, or location–properties that could offer clues to the stereotypy's motivational basis and degree of establishment [Mason, 1993a; Carlstead, 1998; Vickery and Mason, 2003b]. Therefore, it seems that in their haste to alleviate these behaviors, zoo keepers have actually spent little time on trying to understand them.

Perhaps because of this, many gaps exist in our knowledge of bear stereotypy. For example, we do not know whether bears perform stereotypies at night, why certain locations are preferred, why stereotypies differ in form, how they develop over time, or how they impact on general behavior. In some cases we can make predictions based on studies of other species. For example, previous studies have shown that animals exhibit stereotypies in areas where they can detect something they crave, such as food or escape [Mason, 1993a; Lyons et al., 1997; Nevison et al., 1999], and/or areas that offer high levels of sensory stimulation [Roynon, 2000, cited in Knowles and Plowman, 2001]. Developmental studies of laboratory rodents, and farmed pigs and mink, have shown that stereotypy increases in frequency with age and/or time spent in captivity [Cronin and Wiepkema, 1984; Cooper and Ödberg, 1991; Terlouw et al., 1991; Mason, 1993a; Würbel et al., 1996]. It has been observed in mink studies that the most frequent stereotypies are also performed the most invariantly [Mason, 1993a; Clubb, 2002], a finding consistent with many developmental theories of stereotypy [e.g., Fentress, 1976, 1977]. In some species, the number of different stereotypies performed, and the sequence complexity appear to increase with increasing frequency and/or age, although the forms themselves may become abbreviated [Goosen, 1981; Cronin and Wiepkema, 1984; de Jonge et al., 1986]. Furthermore, later in their development, stereotypies may be elicited by stimuli that did not trigger them during earlier stages–for example, by generally "arousing" stimuli such as loud noises [Berkson and Saxon, 1963; Lukas, 1999]. In this way, stereotypies may come to be performed in more diverse situations [Cronin, 1985]. They are then termed "emancipated" because they appear to be divorced from their original underlying motivation [Ödberg, 1978; Cooper and Ödberg, 1991]. However, such features have not been well studied in terms of bear stereotypies, and since even closely related strains of the same species can differ quite radically in their expressions of stereotypy [e.g., Würbel et al., 1996], there is some risk in assuming that what is true for a laboratory rodent or farmed pig is equally true for a zoo-housed carnivore.

Therefore, in this paper we present a detailed analysis of the behavior of captive Asiatic black bears (*Ursus thibetanus*) and Malayan sun bears (*Helarctos malayanus*), two ursid species that have been the subject of disproportionately few behavioral studies. We assessed the properties of the bears' stereotypies to supplement the somewhat patchy information currently available, to test hypotheses concerning stereotypy development, and to better understand their motivational bases.

MATERIALS AND METHODS

Animals and Housing

Observations were carried out on 29 bears (18 Asiatic black bears (7.11) and 11 Malayan sun bears (5.6)) housed in a government wildlife facility in Thailand. The bears ranged in age from approximately 1.5 to 11 years (the ages were approximated

on the basis of center records), and most (n = 26) were adults (> 3 years old). All were wild-born, but had been poached as cubs for illegal wildlife trafficking and later confiscated by the Thai Royal Forest Department. The exact age at which the bears were taken from their mothers is unknown, but many were probably taken before they were fully weaned. The ages and lengths of time in captivity are thus almost perfectly confounded.

The bears were individually and identically housed in $5 \times 4 \times 3$ m (L × W × H) concrete-floored cages. A covered den, to which access was constantly available, measured $2 \times 4 \times 3$ m and contained a bench for resting. The cages were arranged in pairs, and furnished with logs and tires for enrichment. Other forms of environmental enrichment were offered occasionally and irregularly. The bears were fed a single meal of rice, chicken, and fruit between 1500 and 1600 hr, Monday through Saturday, and between 0700 and 0730 hr each Sunday (the data presented here are for Monday–Saturday only). Water was available ad libitum from water nozzles in the main cage section. The facility was closed to the public.

Data Collection

Data were collected over five periods spaced over ~2 years (Table 1). Behavior was assessed by scan-sampling [Martin and Bateson, 1993] from observation hides between the cages. Pilot studies confirmed that such data were comparable to data obtained from video recordings (i.e., the bears were unaffected by the scanning method) [Vickery, 2003]. For each scan, the hides were visited in a predetermined order, and each bear's behavior was recorded by instantaneous sampling. A complete scan of all individuals took 9–19 min depending on the number of bears involved, and up to 43 scans (5–8 hr each) were completed daily. All scans were evenly distributed between 0700 and 1800 hr.

Behaviors were classified as 1) normal, 2) stereotypic (e.g., pacing or weaving), 3) compulsive (defined as nonrepetitive, apparently functionless behaviors that are self-directed and/or bizarre, e.g., self-biting and hair-plucking), and 4) repetitive self-sucking (sometimes accompanied by a "humming" vocalization). In the present study this latter behavior was considered a "deprivation stereotypy" [e.g., Ridley and Baker, 1982] on the basis that in bears it apparently is exclusive to very early-weaned individuals [van Keulen Kromhout, 1976; Hawes, 1997] (Molloy, unpublished results; Maas, unpublished results), it resembles normal suckling by

TABLE 1. Details of behavioral assessment periods

Study year	Calendar year	Dates of assessment period	Number of observation days	Mean number of scans per bear per day	Number of bears observed
1	2000	June 1st–30th	25	24.3	16
	2000	November 21st–29th	8	25.8	9
	2001	February 7th–17th	9	28.2	15
2	2001	November 15th–December 9th	19	20.8	18
	2002	February 25th–March 8th	9	27.8	17

bear cubs [Davids, 1982], and it is similar to behaviors seen in isolation-reared primates and other early-weaned mammals [Richter, 1925; Cross and Harlow, 1965; de Passille and Rushen, 1997]. See Table 2 for a full ethogram of behaviors.

Stereotypies were watched for up to three repetitions of the behavior or sequence (i.e., a commonly repeated chain of movements, such as "pacing – head-dipping – pacing – head-rearing"), and were termed "Invariant" when three successive identical repetitions (with or without pause) were observed. Cage location was also recorded for all stereotypies.

During an additional assessment period (April 2001), nocturnal data were collected from 2000 to 0600 hr for 14 bears (eight Asiatic black bears and six sun bears). Since it was not possible to conduct full scans in the dark, a maximum of four bears were observed each night from a single hide. The behavior of each was sampled every 15 min with the use of night-vision binoculars (model BN5; Newcon, Toronto, Canada).

Statistical Analyses

To control for seasonal differences, we pooled the data collected over the five assessment periods, with the exception that for bears studied during years 1 and 2 ($n = 7$), means were calculated from year 1 data only, so that an age could be specified for each data set.

We analyzed the data to examine the effects of age, species, sex, and context on the bears' stereotypies, and to look for relationships between stereotypy frequency and other behavioral measures. Whenever possible, ANOVAs and parametric regression analyses were used for data analysis, and were performed with the use of general linear models (GLMs; Minitab 12, Minitab Inc., PA, USA) so that other variables could be statistically controlled for when necessary, and categorical and continuous variables could be combined. Nonparametric statistics were used when the assumptions of parametric testing were not upheld, and no appropriate transformation could be found.

Properties of Stereotypy

Frequency

Stereotypy frequency (i.e., the number of scans in which stereotypy was observed as a proportion of all scans made) was tested for effects due to age, species, and sex. The frequencies of stereotypy performed during a 2.5-hr period immediately prior to feeding (hereafter termed "pre-feed") were compared with frequencies during an equivalent period after food delivery ("post-feed"). Observations of feeding and normal activity were statistically controlled for to ensure that any changes in stereotypy frequency were not artifacts of increased feeding or reduced normal activity in the post-feed period. We also calculated frequencies of stereotypy outside the pre-feed period to test whether bears with arguably more established stereotypies (as indicated by age, stereotypy frequency, and/or variability) performed them in more diverse situations (i.e., outside the most "usual" time).

Form

Stereotypies were categorized as 1) locomotory forms, involving walking or running (e.g., pacing); 2) oral forms, involving movements of the tongue or jaw (e.g., sham-chewing); and 3) other forms, i.e., movements falling outside the

TABLE 2. Full ethogram of normal, stereotypic, and compulsive behaviors observed during the study

Normal stance and locomotor activities	
Rest, drowsy/asleep	Sitting or lying with body motionless for at least 30 sec and/or eyes closed; does not appear alert.
Rest alert	Sitting or lying with eyes open; appears alert.
Stand	Bi-pedal or quadrapedal stationary stance.
Locomote	Move from one location to another at floor level by walking or running.
Pause	Pause of less than 5 sec duration during locomotion. (Pauses of 5 sec or more are classed as "stand".)
Change stance	Any change between the stances: lie, sit, and stand at floor level.
Climb	Stand or locomote above floor level with no body weight supported by the cage floor.
Normal behaviors	
Feed	Ingestion of edible material.
Drink	Consumption of water.
Eliminate	Defecation and urination.
Maintenance	Any nonstereotyped maintenance activity (e.g., scratch, rub, lick, shake, stretch any part of body and swat at flies on body).
Manipulate cage	Any nonstereotyped manipulation (e.g., lick, bite, grasp, chew, scratch) directed at the cage structure or permanent apparatus.
Manipulate water nozzles	Any nonstereotyped manipulation of water nozzles for purposes other than drinking.
Manipulate food items	Any nonstereotyped manipulation (but not actual ingestion) of edible food materials.
Manipulate other items	Nonstereotyped manipulation of previously uncategorized items (e.g., coconut husks, feathers).
Sniff ground or object	Sniffing cage floor or object attentively for a period of more than 5 sec.
Sniff air	Sniffing air attentively for a period of more than 5 sec.
Neighbor interaction	Behavior directed at bear in the adjacent cage. Sub-categories are affiliative, neutral, and agonistic.
Auto-play	Energetic and exaggerated play movements that may or may not involve objects.
Other	Any nonstereotyped behavior not falling into one of the above categories.
Stereotypic behaviors	
Locomotory stereotypies	
Standard pace	Locomotion (straight ahead) along a full cage length; body aligned with cage bars or wall and head held centrally.
Extended pace	As "Standard pace" but pace exceeds one cage length.
Standard weave	Locomotion (to left and right alternately) with body perpendicular to cage bars or wall; front feet occupy two or more positions; rear feet may be lifted and repositioned or only shuffled.
Short weave	As "Standard weave" but front feet occupy only one definite position and may hover over a second.
Weave with steps	Standard or short weaving movements interspersed with back and forth movements so that the body traces a T-shape.
Loop	Locomotion (straight ahead) tracing a circular or elliptical route.
Steps	One or two steps (to left and/or right) taken in conjunction with "head sway".
Head throw	Throwing head back and over shoulder during locomotion (straight ahead) tracing a diagonal path across the cage.

Turning movements and elements used only in conjunction with pace	
Head rear	Muzzle angled up; all feet remain on ground.
Head dip	Muzzle angled downwards and bows towards cage floor.
Head scoop	Head reared and dipped in a single movement; may also be shaken at base of dip.
Body rear	Head and upper body reared; front feet are lifted off ground.
Body flop	Head and upper body reared and fall in a collapse-like movement.
Water bath	Water bath stepped up onto or sat upon.
Oral stereotypies	
Tongue flick	Tongue is flicked in and out of mouth.
Tongue curl	Tongue is extended and curled up and around muzzle.
Jaw clamp	Teeth are clamped together repetitively.
Sham chew	Jaws are moved as though food is being chewed but the mouth is empty.
Self-lick	Repetitive licking of a body area (distinguished from "excessive manipulation" by the invariance and repetition of movements).
Retch food	Food taken into the mouth, chewed, and retched onto a paw or cage surface repeatedly (differs from regurgitation and reingestion in that the food doesn't reach the stomach between repetitions).
Other stereotypies	
Head sway	Body positioned as in "short weave" but primary movement is a pendulum-like swaying of head with eyes directed at cage floor; front feet touch the ground at only one definite position.
Head lean	Head smoothly leaned far back over shoulders without throwing action.
Head circle	Head rotated in a circular fashion.
Hopping	Body positioned as in "short weave" but weight is transferred back and forth between the front feet in a hopping motion.
Claw grate	Claws of front feet are rasped together producing a grating noise.
Deprivation stereotypies	
Self-suck	Repetitive sucking of a body area, often accompanied by a distinct 'humming' vocalization.
Compulsive behaviors	
Self-directed aggression	Biting, slapping, grasping, or aggressively pulling at own body, usually the head or rear legs.
Excessive body manipulation	Excessive, but nonaggressive manipulation of body areas (e.g., over-grooming, hair plucking, and excessive nibbling or licking).
Bar lick	Tongue is held against cage bars for an extended period of time (usually >30 sec); edge of tongue may be curled around or pressed up against bars.
Foam	Large amounts of white foamy saliva are produced and held in the mouth, allowed to drip down over the jaw and/or hurled from the mouth by rapid back and forth head movements.
Coprophagy	Eating of own feces.
Urine drinking	Drinking of own urine.
Other	
Out-of-sight	Bear is in the den.
Obscured	The majority of the bear's body is obscured making accurate identification of behavior impossible.

previous categories (e.g., head-swaying). Some (e.g., head-rearing) were performed only during pacing sequences (usually to reverse the direction of locomotion) and were never observed by themselves. These were termed stereotypic "elements," and were categorized as locomotory. The frequency with which bears exhibited each type was calculated as a proportion of total stereotypy. Frequencies were also calculated for the pre- and post-feed periods separately, for comparison. For each bear, the total number of different forms and sequences performed was also calculated.

Variability

The proportion of total stereotypy categorized as "Invariant" was calculated for each bear that had 10 or more observations of stereotypy per assessment period (equivalent to Mason's [1993a] "rigidity index"). Previous analyses [Vickery, 2003] showed that this measure is in part influenced by the duration of a given form of stereotypy: short-duration stereotypies (e.g., head-swaying) are more likely to be scored as "Invariant" than longer forms (e.g., pacing) simply because they are less likely to be interrupted mid-cycle. To control for this, the mean duration of each bear's main form of stereotypy (one complete repetition) was measured and included as a covariate in analyses involving variability. Stereotypy variability was tested for effects due to age, species, sex, and stereotypy frequency.

Timing

We calculated the mean stereotypy frequencies for each observation hour (0700–1800 hr) to plot temporal patterns and test for species differences. Stereotypy frequencies during the night were tested for a correlation with daytime levels. We also looked for differences in age and daytime stereotypy frequency between bears that did and did not perform stereotypies at night.

Location

Stereotypy location was assessed for all bears that had 10 or more observations of stereotypy per assessment period, and whose main or sole stereotypy was not circular pacing (a form involving all cage sides equally). Each bear's main cage area was bordered by four sides, which were classified as 1) "Front," a 3-m length of barred cage with an external door fitting; 2) "Back," a 3-m length of barred cage opposite of the "Front"; 3) "Adjacent," a 4-m length of barred cage shared with a neighboring cage (which may or may not have housed another bear, and was termed "Adjacent-neighbor" and "Adjacent-empty," respectively); and 4) "Wall," a 4-m length of cage consisting of a solid cement wall.

The cage sides that were associated with 1) the first view of food arrival (variable across bears, depending upon cage location), and 2) contact with a neighboring bear ("Adjacent-neighbor") were hypothesized to be most frequently associated with stereotypy. In contrast, the cage sides that offered low sensory stimulation (i.e., the cement wall ("Wall" for all bears), and adjoining empty cages ("Adjacent-empty")) were predicted to be less frequently used for stereotypy. To test this, we identified the cage sides associated with these factors for each bear, calculated the proportion of all stereotypies that occurred along each side, and then compared for the two species separately using Mann-Whitney tests. We adjusted the

accepted *P*-values to control for multiple testing using the Hochberg step-up procedure [Hochberg, 1988].

Other Behaviors

We calculated the frequencies of normal activity, inactivity, compulsive behavior, and repetitive self-sucking to test for relationships with stereotypy frequency, age, species, and sex.

Using data collected during each bear's longest assessment period, we calculated normal behavioral diversity using the Shannon-Wiener function "H" [Shannon and Weaver, 1949]. With this index, a greater number of behaviors and/or a more even distribution among behaviors acts to increase the index value, with higher values of H representing greater behavioral diversity. Effects of age, species, sex, and stereotypy frequency on behavioral diversity were looked for.

RESULTS

Properties of Stereotypy

Prevalence and frequency

Stereotypy was highly prevalent, being exhibited by 27 of the 29 bears. Frequencies ranged between 0 and 51% of all observations (mean = 18%; standard error of the mean (SEM) = 2.5), and were unaffected by species or sex. However, older bears exhibited higher frequencies (GLM: $F_{1,24} = 7.59$; $R^2 = 52\%$; $P = 0.011$), and this relationship held when levels of normal activity were statistically controlled for (GLM: $F_{1,24} = 7.37$; $R^2 = 35.2\%$; $P = 0.012$; Fig. 1). Frequencies of stereotypy were significantly higher during the pre-feed period than the post-feed period (statistically controlling for frequencies of feeding and normal activity; GLM: $F_{1,25} = 11.09$; $P = 0.003$). Neither a bear's age nor the variability of its stereotypy predicted its level of stereotypy outside the pre-feed period. However, there was a trend for overall stereotypy frequency to explain this measure: bears with higher total frequencies performed a greater proportion of their stereotypy outside the pre-feed period (GLM: $F_{1,19} = 3.68$; $R^2 = 47.3\%$; $P = 0.070$).

Form

Twenty-five stereotypic forms or elements were observed (see Table 2). Across all bears, locomotory stereotypies were significantly more frequent than oral or other forms (Kruskal Wallis: $H = 45.65$; $DF = 2$; $P < 0.001$), and comprised 81% of all stereotypies. As a proportion of total stereotypies, the frequencies of locomotory forms did not differ between the two species; however, Asiatic black bears displayed higher frequencies of stereotypies categorized as "other" (mean = 27.4% of total stereotypy, compared to 2%; Kruskal Wallis: $H = 6.52$; $DF = 1$; $P = 0.011$), while sun bears performed higher frequencies of oral stereotypy (mean = 0.7% of total stereotypy, compared to 0.03%; Kruskal Wallis: $H = 4.79$; $DF = 1$; $P = 0.029$). The sun bears also performed a greater number of different oral stereotypies (six forms) compared to the Asiatic black bears (one form).

The average individual repertoire included three (SEM = 0.4) stereotypic forms or elements. This number did not relate to stereotypy frequency, age, or sex, but the sun bears displayed significantly more forms than the Asiatic black bears (4.8 vs. 1.6,

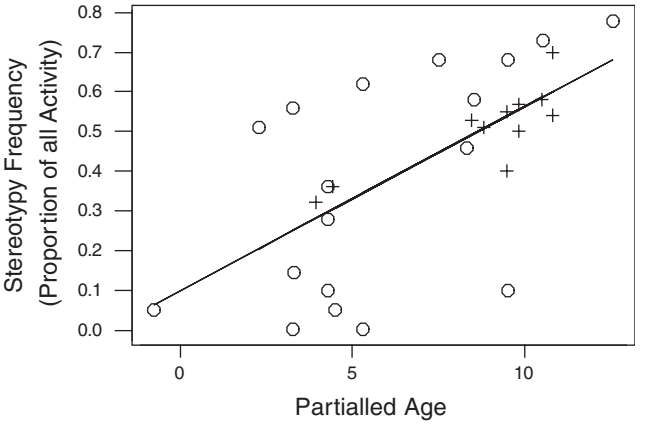

Fig. 1. Regression relationship between stereotypy frequency (as a proportion of all activity) and age (statistically controlled ["partialled"] for sex and species), for Malayan sun bears (crosses, n = 11) and Asiatic black bears (circles, n = 18).

respectively; GLM: $F_{1,27} = 16.2$; $P < 0.001$). In the average repertoire these forms were combined into two (SEM = 0.3) stereotypic sequences, and again the number of sequences exhibited was not predicted by stereotypy frequency, age, or sex. However, the sun bears performed more sequences than the Asiatic black bears (3.6 vs. 1.2, respectively; GLM: $F_{1,27} = 13.46$; $P = 0.001$). Across both species, the proportion of stereotypy that comprised locomotory and "other" forms did not differ between the pre- and post-feed periods, but frequencies of oral stereotypy were significantly higher after feeding (Mann-Whitney: W = 624.5; DF = 1; $P = 0.048$; Fig. 2).

Variability

The proportion of stereotypy categorized as "Invariant" differed greatly across bears, but was not explained by age, species, or sex. However, frequency did predict variability, with the most stereotypic animals performing higher proportions of "Invariant" stereotypy (GLM: $F_{1,18} = 4.79$; $R^2 = 44.2\%$; $P = 0.042$; Fig. 3).

Timing

All of the bears showed similar temporal patterns of stereotypy (Fig. 4a and b): a morning peak, a main pre-feeding peak (more pronounced in sun bears), and a rise toward the end of the day. When the time of day was controlled for, species differences in stereotypy frequency were only significant between 1400–1500 hr (i.e., during the pre-feeding peak), when the sun bears' levels were highest (GLM: $F_{1,24} = 25.79$; $P < 0.001$). Nocturnal frequencies of stereotypy were very low (mean = 1.9%; n = 14; SEM = 1.0), and positively correlated with a bear's level of daytime stereotypy (GLM: $F_{1,12} = 32.8$; $R^2 = 73.2\%$; $P < 0.001$). Bears that exhibited stereotypy during the night (n = 5) had higher levels of daytime stereotypy than those that did not (n = 9) (Kruskal Wallis: H = 6.6; DF = 1; $P = 0.010$), and there was also a trend for these bears to be older (Kruskal Wallis: H = 2.92; DF = 1; $P = 0.087$).

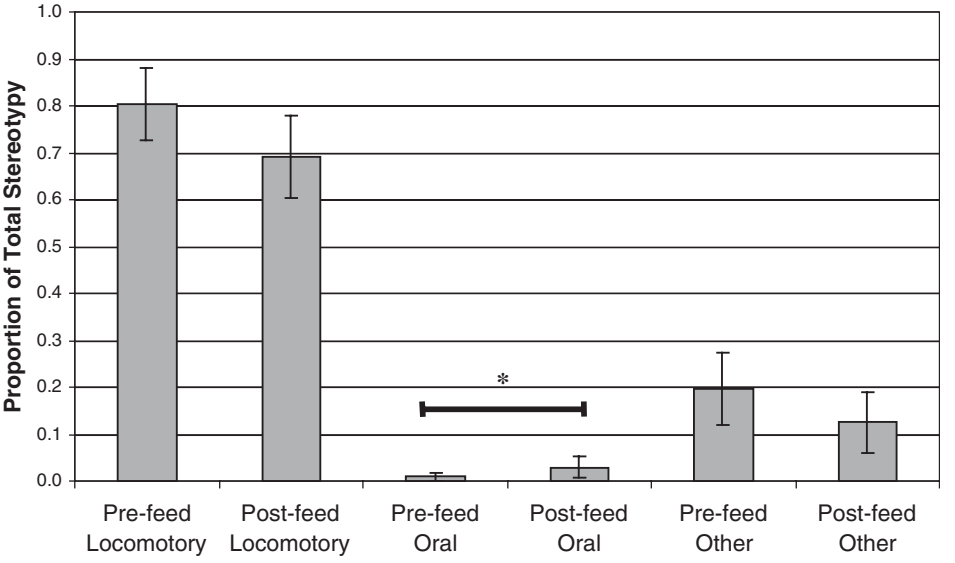

Fig. 2. Frequencies of locomotory, oral, and other stereotypies as a proportion of all stereotypies performed during a 2.5-hr period immediately prior to feeding (''pre-feed'') and an equivalent period after food delivery (''post-feed''). $^{*}P < 0.05$.

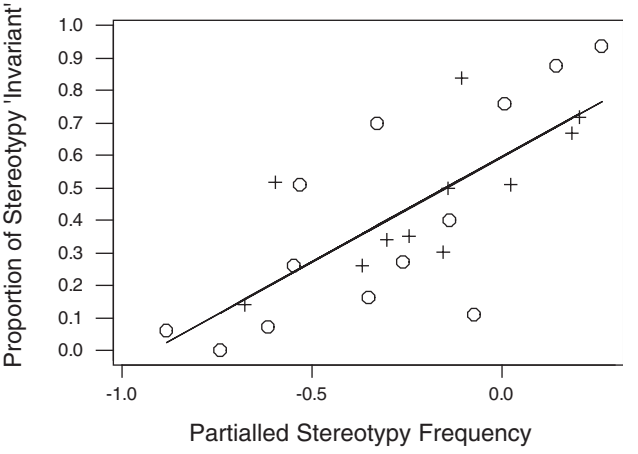

Fig. 3. Regression relationship between stereotypy frequency (statistically controlled [''partialled''] for sequence duration, sex, and species) and the proportion of stereotypy categorized as ''Invariant,'' for Malayan sun bears (crosses, n = 11) and Asiatic black bears (circles, n = 13).

Location

As predicted, feeding-related cues influenced stereotypy location. Sun bears performed most of their total stereotypy along the cage side from which they were first able to view food arrival (Mann-Whitney tests with ''Adjacent-neighbor'' (W = 129; DF = 1; $P = 0.003$); ''Adjacent-empty'' (W = 118; DF = 1; $P < 0.001$); and ''Wall'' (W = 182; DF = 1; $P < 0.001$); Fig. 5a). This cage side was also frequently

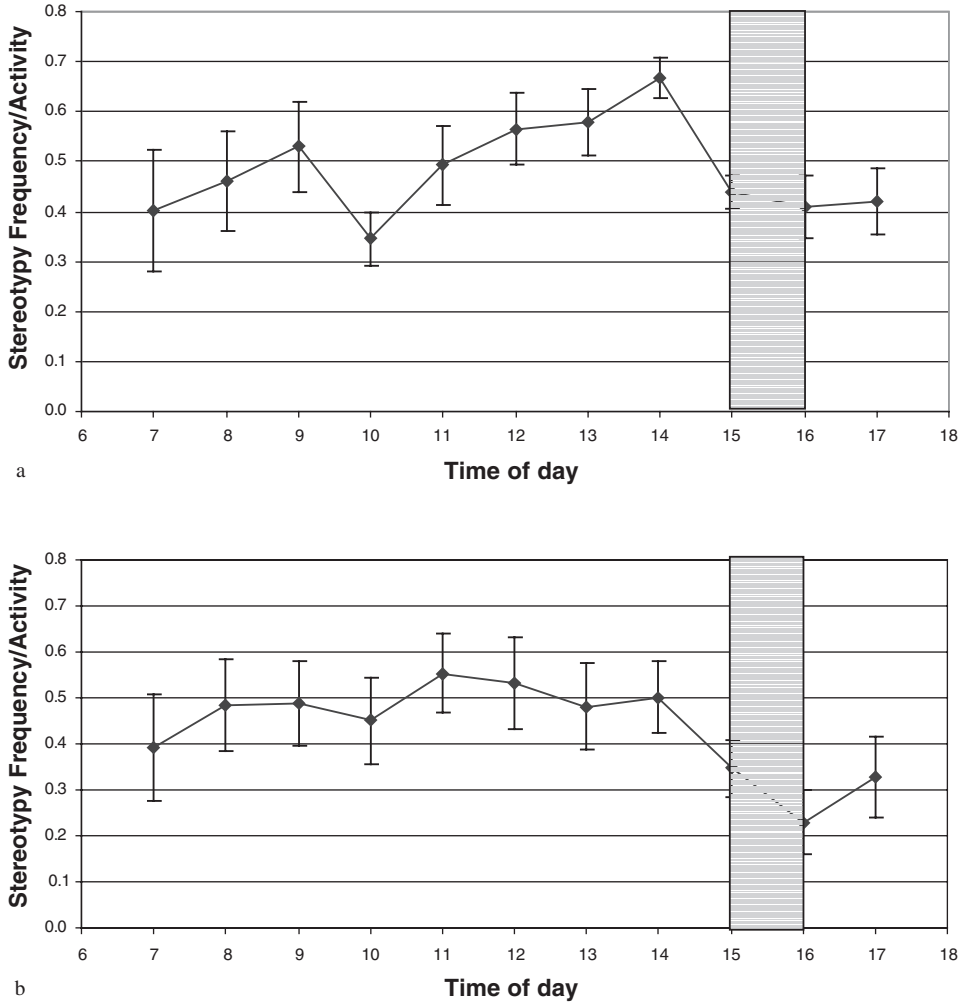

Fig. 4. Temporal distribution of stereotypy (as a proportion of all activities) between 0700 and 1800 hr. Vertical bars represent the SEM, and the shaded area represents observations taken around feeding time (1500–1600 hr). **a:** Malayan sun bears (n = 11). **b:** Asiatic black bears (n = 16).

used by Asiatic black bears, although not significantly more so than "Adjacent-neighbor." Differences only reached significance for "Adjacent-empty" ($W = 63$; $DF = 1$; $P = 0.045$) and "Wall" ($W = 126$; $DF = 1$; $P < 0.001$) (Fig. 5b).

Other Behaviors

Stereotypy frequency was inversely correlated with inactivity (GLM: $F_{1,26} = 86.4$; $R^2 = 78.5\%$; $P < 0.001$), but was unrelated to normal activity levels. Older bears were less active than their younger counterparts, even when their higher levels of stereotypy were statistically controlled for (GLM: $F_{1,26} = 25.67$; $R^2 = 49.8\%$; $P < 0.001$), but levels of normal activity did not differ with species or sex. Values of normal behavioral diversity ranged between 0.69 and 2.09

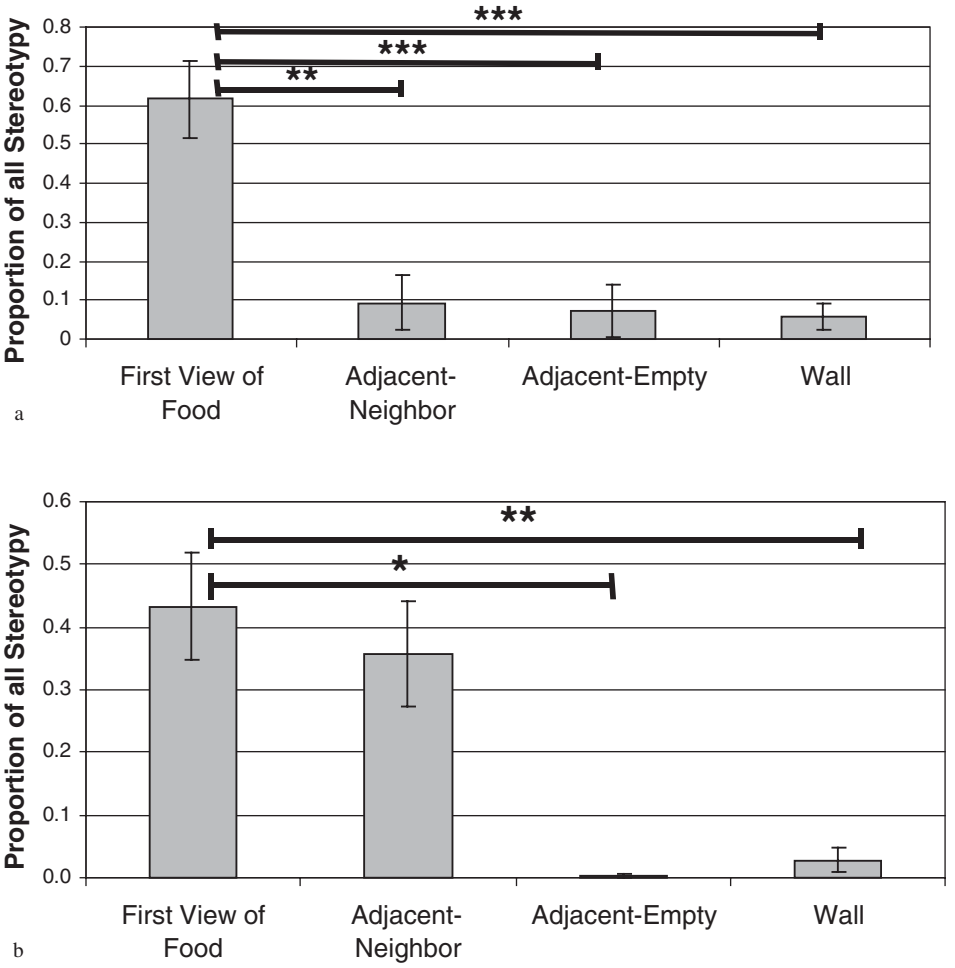

Fig. 5. Mean proportion of total stereotypies performed along cage sides associated with the 1) first view of food arrival, 2) neighboring bear, 3) adjoining empty cage, and 4) cement wall. Vertical bars represent the SEM. **a:** Malayan sun bears (n = 11). **b:** Asiatic black bears (n = 9). $^{*}P<0.05$, $^{**}P<0.01$, $^{***}P<0.001$.

(mean = 1.31; SEM = 0.07 (from a potential maximum value of 3.09)), and were unrelated to stereotypy frequency. Older bears had less diverse behavioral repertoires (GLM: $F_{1,26} = 24.81$; $R^2 = 48.8\%$; $P<0.001$), but this effect was due to their reduced normal activity levels, and became nonsignificant when normal activity was statistically controlled for.

Compulsive behavior was observed in only 34% of the bears studied. Frequencies of this behavior were low (mean for "performers" = 0.5%; SEM = 0.2) and unrelated to stereotypy frequency, age, or sex, but were significantly higher in sun bears than in Asiatic black bears (Kruskal Wallis: H = 5.19; DF = 1; $P = 0.023$). Repetitive self-sucking was less prevalent still, being observed in 17% of

bears, although the mean frequencies of this behavior were higher than for compulsive behavior (mean for "performers" = 5.3%; SEM = 4.7). Levels of repetitive self-sucking were unrelated to stereotypy frequency, age, species, or sex. However, the bears that performed this behavior were younger than those that did not (mean age of "performers" = 3.7; SEM = 1.02, and mean age of "non-performers" = 7.7; SEM = 0.4: Mann-Whitney: W = 26.0; DF = 1; $P = 0.005$).

DISCUSSION

General Properties of Stereotypy

Stereotypies were highly prevalent: only two (both female Asiatic black bears) of the 29 bears studied showed no stereotypy at all. Frequencies were highly variable across individuals, occupying up to 51% of daylight hours in the most stereotypic animals. Bears that exhibited higher frequencies of stereotypy performed them more invariantly (although, unexpectedly, variability was not related to age). This finding is consistent with previous observations in farmed mink [Mason, 1993a; Clubb, 2002], and may have implications for treatment, since it appears harder to alleviate less variable stereotypies by enrichment [Vickery, 2003]. As seems typical of bears (see Introduction), and indeed all carnivores [Clubb and Mason, 2001], locomotory stereotypies, such as pacing, predominated. The number of different forms or sequences performed was unrelated to stereotypy frequency. Interestingly, oral stereotypies, but not locomotory or "other" forms, increased in frequency after the bears were fed. Similar post-feed oral stereotypies have been well-documented in other taxa (e.g., pigeons [Palya and Zacny, 1980], pigs [Rushen, 1984], and poultry [Kostal et al., 1992]), and have often been attributed to an inability to carry out feeding or specific foraging behaviors (for review see Mason and Mendl [1997]).

Stereotypies were primarily concentrated in the hours of daylight and peaked prior to the bears' scheduled feeding time, a finding previously reported for other bear species [e.g., Wechsler, 1991; Langenhorst, 1998; Landrigan et al., 2001] and other carnivores [e.g., Mason, 1993a; Carlstead, 1998; Clubb, 2002]. A less substantial stereotypy peak was also observed in the early morning, perhaps reflecting an increased motivation to feed or locomote at this time of day. In the wild, many diurnal species begin the day with an intense period of feeding or other activity [Oates, 1986], and peaks in locomotion shortly after sunrise have been observed in wild bears [Garshelis and Pelton, 1980; Nawaz, 2002]. Alternatively, this peak may reflect the first human disturbance of the day, since the keepers arrived at $\sim$0800 hr.

Along with the timing of stereotypies, the main location in which they occurred (i.e., along cage sides from which food arrival could be viewed) suggested that feeding motivation played an important role. Similarly, captive felids have been observed to pace in areas from which they could see their keeper approach [Carlstead, 1998], and mink have been reported to orientate their stereotypies toward an approaching food cart [Mason, 1993a]. Interestingly, however, the Asiatic black bears (but not the sun bears) were equally likely to exhibit stereotypy along a cage side adjoining a neighbor's cage. This behavior may have represented (or developed from) territorial patrolling or attempts to prompt interaction with the neighboring animal, or this cage side may have been favored simply because it offered greater sensory stimulation. As expected, the concrete wall and the cage side adjoining an

empty cage were the least-used areas for stereotypy. Overall, the order of use of the different cage sides highlights the importance of feeding, and suggests that (as has been reported for other species [e.g., Nevison et al., 1999; Roynon, 2000, cited in Knowles and Plowman, 2001]) bears perform stereotypies in locations that offer high levels of sensory stimulation. Unfortunately, however, we were unable to determine whether these areas were particularly preferred for stereotypy, or were favored for all activities, with the data collected.

Relationships Between Stereotypy and Other Behaviors

Stereotypy frequencies were inversely correlated with levels of inactivity, but were unrelated to normal activity levels, contrary to previous findings in polar bears [Ames, 2000]. Thus, the stereotypic bears were less inactive but showed the same amount of normal behavior as the less stereotypic animals. In contrast to some studies of other animals [Stolba et al., 1983; Dantzer, 1986; Gunn and Morton, 1995], higher levels of stereotypy were not associated with a reduced diversity of normal behavior, even though other studies of these subjects have shown a link between stereotypy and general behavioral persistence [Vickery and Mason, 2003] (Vickery and Mason, in press). Finally, a bear's stereotypy frequency also did not predict its level of compulsive or repetitive self-sucking behavior, which suggests that different motivations and/or processes may underlie these different abnormal behaviors [Garner, 1999].

Age-Related Changes in Stereotypy and Other Behaviors

Stereotypy frequency increased with age, consistent with previous findings in other taxa [e.g., Cronin and Wiepkema, 1984; Mason, 1993a; Würbel et al., 1996]; however, unexpectedly, invariance did not increase with age. Some evidence of emancipation was also found, in that bears with higher total frequencies of stereotypy performed a greater proportion of their total stereotypy outside the pre-feed period. (This was not true of older bears or those with more invariant stereotypies, however.) High stereotypers were also more likely to exhibit stereotypy at night, and there was a related trend for age to predict nocturnal stereotypy. However, it should be noted that this line of reasoning assumes that the bears' stereotypies first arose in the pre-feed period and then became emancipated in other contexts. This seems plausible given that all bears performed stereotypies in the time before food delivery, but it remains to be confirmed by longitudinal studies. An alternative explanation is that older bears simply acquire more diverse motivations for stereotypic behaviors.

The number of different stereotypic forms or sequences was unrelated to a bear's age, which suggests that stereotypies became neither more elaborate [c.f., Goosen, 1981; Cronin and Wiepkema, 1984] nor more restricted (as suggested by some hypotheses of stereotypy development [e.g., Fentress, 1976, 1977]) through repetition.

Older bears exhibited lower levels of normal activity, as previously reported for polar bears [Ames, 1994, 2000], and also showed an associated reduction in behavioral diversity. Importantly, reduced normal activity with age was not simply due to behavioral competition with increasing levels of stereotypy. This effect persisted even when stereotypy frequency was statistically controlled for. Normal activity may decline as a consequence of time spent in captivity, or, alternatively, the

decline may represent the natural progression of behavior, given that wild adults are often less active than their subadult counterparts [Garshelis and Pelton, 1980; Reid et al., 1991] (although it is not clear whether activity levels in the wild lie along the continuum found here or fall into more distinct age brackets).

Although levels of compulsive behavior and repetitive self-sucking did not covary with age, as a group the bears that engaged in self-sucking behavior were significantly younger than those that did not. In other species, some deprivation stereotypies have been reported to occur most frequently in young animals and then decline with age [e.g., Cross and Harlow, 1965]. This may be further evidence that this well-reported but often ambiguously interpreted behavior (e.g., it can be viewed as a sign of contentment or a displacement activity [Domico, 1988]) is indeed a deprivation stereotypy stemming from premature weaning.

Species Differences

Overall, stereotypy frequencies did not differ between the two species, but in the period prior to feeding, the sun bears performed significantly more stereotypies than the Asiatic black bears. The sun bears also performed significantly more of their total stereotypic behaviors along cage sides from which they could view food arrival, exhibited a greater diversity of stereotypy forms and sequences, and displayed a higher frequency and greater number of oral stereotypies (a form often associated with thwarted feeding motivation [Sambraus, 1985; Kostal et al., 1992; Bashaw et al., 2001]). They also showed more compulsive behavior (e.g., hair-plucking).

Prior to this study, the Asiatic black bears had occasional access to an outdoor grass enclosure, whereas no such enclosure existed for the sun bears. Other than that, however, the rearing, husbandry, and housing conditions were virtually identical, and the two species did not differ in age. It therefore seems likely that differences in their stereotypies reflect biological species differences. Interestingly, the main differences were feeding-related, perhaps reflecting differences in the natural feeding ecology of the two species. Although both species are naturally omnivorous and spend large proportions of their time foraging, the sun bear's distribution is closer to the equator than the Asiatic black bear's, hence their food sources probably fluctuate less with the seasons. In contrast to Asiatic black bears, which rely on seasonally available fruits and vegetation [Schaller et al., 1989; Reid et al., 1991], sun bears typically consume large quantities of invertebrates, such as termites and beetle larvae, which are available year round [Wong et al., 2002]. Compared to sun bears, Asiatic black bears also appear to maintain larger annual home ranges and travel greater distances each day: home range sizes for adult males have been reported to be 36–50 km^2 (based on eight individuals [Reid et al., 1991; Hazumi, 1994]) and 6–20 km^2 (based on four individuals [Wong, 2002]) respectively, while daily distances traveled have been reported in the region of 3–6.8 km per day for Asiatic black bears [Reid et al., 1991] and 1.45 km per day for sun bears [Wong, 2002]. These figures suggest that the Asiatic black bear's food sources may be more widely dispersed. (Interestingly, although wide-ranging carnivores have been reported to be more prone to stereotypy [Clubb and Mason, 2003], this was not true of these two species, since their overall stereotypy frequencies did not differ. This may indicate that other biological factors are important too, or may merely reflect their slightly different previous housing conditions.)

Differences in natural foraging behavior and activity may therefore underlie the species differences in stereotypy outlined above. Perhaps because their feeding habits are less seasonally variable, sun bears are more prone to developing oral stereotypies when their foraging behaviors are not allowed for in captivity, whereas the naturally more flexible feeding behavior of Asiatic black bears may be less affected. Alternatively, the observed differences may stem from differences in the time the two species spend foraging in the wild, their temporal patterns of foraging activity, or the type of foraging behaviors they employ, because these may dictate how they adapt to feeding in captivity. These hypotheses are speculative at this stage, since the natural feeding ecology of the two species (particularly the sun bear) is still poorly understood. However, natural ecology undoubtedly plays an important role in the development of stereotypies [e.g., Mason and Mendl, 1997; Clubb and Mason, 2003], and hence might well explain this interesting species difference.

Relevance of Findings to Other Zoological Facilities

Although the housing and husbandry conditions of these bears differed widely from those of many zoological facilities (e.g., good Western zoos), the main findings of this study are still relevant to the management of captive bears in general. The stereotypy frequencies were well within the ranges reported for bears housed in European and North American zoological facilities [e.g., Forthman et al., 1992; Spendrup and Larsson, 1998; Ames, 2000]. Also, other properties of the bears' stereotypies (i.e., form, variability, timing, and location), and the developmental changes observed, are in accordance with reports of stereotypy in bears and other animals studied in quite different setups. Clearly, the precise influences on stereotypy for the bears studied here may well differ from those observed in bears held in more conventional zoo facilities (for example, the provision of just one meal per day may have led to an inflated effect of feeding on their stereotypies). However, the findings of this study offer general, statistically tested, and important insights into probable motivations, patterns, and relationships that would be very difficult to ascertain in bears housed in zoos.

How Might Examining the Properties of Stereotypies Improve our Ability to Tackle Them?

The basic properties of stereotypies (how, when, and where they are performed) are not arbitrary, but relate to how and why the behavior developed. Form, timing, and location can sometimes indicate the motivations that underlie a stereotypy, while frequency, variability, and the degree to which a stereotypy is emancipated might reveal its stage of development (discussed further in Vickery and Mason [2003b]).

It is important to understand the underlying causes of a stereotypy in order to treat it, and to reduce such behaviors in the long term [e.g., Carlstead and Seidensticker, 1991; Kolter and Zander, 1995]. In the current study, stereotypies were primarily locomotory in form, suggesting that thwarted locomotion (perhaps to seek food or mates, patrol a territory, or escape) may underlie these behaviors. Also, as discussed above, the higher incidence of oral stereotypy exhibited by the sun bears further suggests that thwarted feeding or foraging motivations may play a significant role in their stereotypy, and more so than in the Asiatic black bears. Both the timing of the bears' stereotypy (concentrated in the period prior to feeding) and (especially

in sun bears) the location in which it was performed (along cage sides from which food arrival could be viewed) further indicate the importance of the feeding event (particularly for sun bears) and point to a role of thwarted feeding and/or foraging. Thwarted feeding-related motivations may underlie stereotypy directly or indirectly–for example, by increasing the aversiveness of an environment that offers little opportunity for feeding/foraging, hence increasing the motivation to escape, or by increasing arousal when food is not forthcoming. Husbandry changes, such as increasing the frequency of feedings, offering a more natural diet (in terms of food types and diversity), and providing food earlier in the day, might reduce these motivations and hence alleviate stereotypy.

However, some caution is needed when one interprets the timing of a stereotypy. As we have seen here, more established stereotypies may be performed in more diverse situations that may not necessarily correspond to the original cause. Furthermore, stereotypies may peak in the pre-feed period simply because of anticipation of an important event (c.f., schedule-induced behavior [Staddon, 1977; Mistlberger, 1994]), with the regular scheduling of food either inducing stereotypy in the pre-feed period due to high arousal at that time, or influencing the timing of stereotypy that develops from other causes, so that it becomes concentrated prior to food arrival. Indeed, regularly scheduling other nonfood events (such as access to drinking water or to a conspecific) during a captive animal's day can similarly trigger anticipatory peaks in activity [Mistlberger, 1992; Van den Berg et al., 1999], and perhaps in stereotypy as well.

The other properties of stereotypy assessed here–frequency and "Invariance"–were shown to increase with age, which suggests that they may reflect the degree of establishment of the behavior. Established stereotypies (as assessed by age, stereotypy frequency, and invariance) typically are more difficult to alleviate by environmental enrichment [Sorensen, 1987, cited in Powell et al., 2000; Cooper et al., 1996; Vickery, 2003], and therefore these measures might be useful for identifying those individuals that are likely to respond best to enrichment attempts. Also, since well-developed stereotypies might have become emancipated from their original underlying motivations, these measures of development may also predict how faithfully the properties of a stereotypy reveal its original cause.

CONCLUSIONS

1. The stereotypies of Asiatic black and Malayan sun bears were primarily locomotory in form, concentrated in the hours of daylight, peaked immediately prior to feeding, and performed in locations from which food arrival could be viewed (both species) and alongside a neighbor (Asiatic black bears only).

2. High frequencies of stereotypy were associated with less variable movements and reduced inactivity (resting/sleeping), but not with a reduced level or repertoire of normal behavior.

3. Older bears displayed higher frequencies of stereotypy and lower levels of normal activity, which were associated with a reduced behavioral repertoire. It is unknown whether this reflects age per se or a greater number of years spent in captivity. However, unexpectedly, their stereotypies were not less variable.

4. Some evidence of emancipation (i.e., the performance of stereotypy in more diverse situations) was found, in that bears with higher overall frequencies of

stereotypy were more likely to perform stereotypies at night as well as in the day, and also performed a greater proportion of their total stereotypy outside the pre-feed period.

5. Levels of total stereotypy did not differ between the species; however, compared to the Asiatic black bears, the sun bears performed a greater proportion of their stereotypy in areas from which they could view food arrival, exhibited significantly higher pre-feed stereotypy peaks, and showed a greater number of stereotypy forms and sequences, a higher frequency of oral stereotypies, and more compulsive behavior.

6. In general, most efforts to alleviate stereotypy would benefit from such detailed analyses, since the properties of stereotypies may offer clues to their motivational bases and degrees of establishment.

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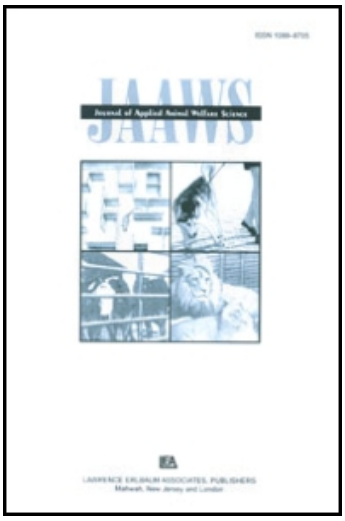

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Effects of Inedible, Manipulable Objects on Captive Bears

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Bears in captivity often show abnormal behaviors such as stereotypies and periods of excessive inactivity. Most of the research aimed at reducing abnormal behaviors in bears has focused on feeding enrichment. However, the effects of feeding enrichment only seem to last as long as it takes a bear to consume the food. This study investigated the effects of inedible, manipulable objects on bears. Two polar bears (*Ursus maritimus*) received plastic floats. A sloth bear (*Melursus ursinus*) and a spectacled bear (*Tremarctos ornatus*) received plastic balls. During a 7-week period, polar bears nearly doubled their activity in the presence of toy floats, and the spectacled bear halved its pacing in the presence of toys. The sloth bear did not respond to the objects. These findings indicate that access to manipulable nonfood objects such as plastic toys can result in prolonged engagement in appetitive behaviors by polar bears.

The environmental and behavioral deficits faced by nonhuman animals in captivity are well documented. In captivity, animals do not need, and are often unable, to engage in a wide array of activities characteristic of their counterparts who live in the wild. Captive animals fill their time engaging in abnormal behaviors, including stereotypy and long periods of inactivity (Hediger, 1950).

Enriching captive environments to encourage species-typical activities is one solution (Carlstead, Seidensticker, & Baldwin, 1991; Forthman et al., 1992; Hediger, 1950; Markowitz, 1982; Shepherdson, 1994). An enclosure conducive for activity might include cage furnishings and manipulatable objects that provide suitable opportunities for an increased range of behaviors. These added elements could create more complex environments (Coe, 1985; Hancocks, 1980; Hutchins,

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Hancocks, & Crockett, 1979). Complexity encourages interaction between the animal and its environment and reduces some of the distress produced by captivity (Snyder, 1975).

The bear family (*Ursidae*), one animal group popular in zoo settings, often engages in stereotypic behavior in captivity (van Keulen-Kromhout, 1976). Only a few empirical studies, however, have focused on enriching the environments of captive bears, and most have investigated only the use of food-related objects or activities to promote foraging and feeding behaviors.

Markowitz (1982) trained two polar bears (*Ursus maritimus*) to "request fish" by vocalizing at a voice box. Contingent on vocalization, a catapult-like apparatus would throw fish into the bears' grotto. Markowitz reported increased activity in both bears as well as an increase in the natural species-specific sequence of feeding behaviors of diving, swimming, and catching fish by the male.

In a more recent study, Carlstead et al. (1991) introduced honey-filled logs to brown (*Ursus arctos*), American black (*Ursus americanus*), and sloth (*Melursus ursinus*) bears. They found that the sloth bear decreased its pacing when provided a honey log, but the other two species were not affected. However, the decreased pacing in the sloth bear lasted only as long as it took him to consume the honey, and the time to extract honey decreased with practice. Further, the bear habituated to the honey logs by the third exposure.

Forthman et al. (1992) provided a kodiak bear (*Ursus arctos*) and two polar bears with ice blocks and "fishcicles" and an Asiatic black bear (*Selenarctos thibetanus*) with browse. Only the Asiatic black bear showed increased activity and decreased passivity as a function of food enrichment (browse). In a second experiment, the kodiak and polar bears received ice blocks with treats frozen inside. Activity in each of the bears increased and passivity decreased. In addition, pacing decreased in one of the polar bears. However, changes in behavior were significant only for the 30-min periods immediately following enrichment.

As is evident from these studies, one serious constraint of using food-related objects for environmental enrichment is that the effects last only as long as the food lasts. However, food-getting behaviors in most species of wild bears include a wide array of manipulations (Forthman et al., 1992). Objects other than food may elicit this array. Therefore, the use of inedible objects could afford more enduring opportunities for bears to engage in appetitive behaviors. This study investigated the effects of using inedible, manipulable toys to enhance the well-being of three bear genera exhibited at the Philadelphia Zoo (sloth bear, spectacled bear [*Tremarctos ornatus*], and two polar bears). Habituation to the toys over a longer time period was investigated in the polar bears.

At the onset of this study, the sloth and spectacled bears spent a considerable amount of time each day pacing (25 and 52%, respectively). The polar bears spent 67% of their 7 hr on exhibit lying down. Pacing and inactivity were target behaviors in this study as indices of stress or diminished well-being. Inactivity in captiv-

ity may be indicative of distress when it is excessive relative to a particular species (Marriner & Drickamer, 1994). During summer observations, Stirling (1974) found that wild polar bears slept or were inactive (unrelated to hunting) only 42% of the time. Pacing is most often observed in animals living in environments with limited opportunities for appetitive behaviors (Ames, 1994; van Keulen-Kromhout, 1976, 1978). Although, as some suggest, pacing may be an adaptive response to a restrictive environment (Mason, 1991; Wechsler, 1991), it flags a type of environment that provokes a wide range of abnormal behaviors in both human and nonhuman animals (Mason, 1991; Meyer-Holzapfel, 1968; Wechsler, 1992). This study investigated the hypothesis that manipulable objects decrease pacing in the sloth and spectacled bears and increase activity in polar bears.

METHOD

Subjects

Four captive bears were observed in this study: one male Indian sloth bear, one male South American spectacled bear, and two female Arctic polar bears. The bears were captive-born and transferred to the Philadelphia Zoo when they were between the ages of 10 months and 2.3 years. The sloth and spectacled bears were 10-year-old adults. The polar bears were 8 years old. Each bear had been housed at the bear complex for a minimum of 6 years.

Housing and Maintenance

The sloth bear was housed alone. The spectacled bear was housed alone in an indoor den, but, after the 2nd week of data collection, he shared an outdoor yard with a female spectacled bear. The polar bears shared an outdoor yard but were housed separately indoors. The yards of the sloth and spectacled bears consisted of adjacent grassy areas separated only by a low electrical barrier. Each enclosure contained climbable trees, horizontal logs, and a water trough leading to a small pool. The polar bear yard contained a rocky, flat area with vegetation and a large, deep-water tank. In each yard, a recessed, concrete well near the keepers' access door prevented the bears' being seen by the general public. Portions of the moat areas also made the bears difficult to see.

Apparatus

The polar bears received two large (61-cm long × 122-cm diameter), hollow, industrial-strength white plastic drums with handles (Bonar Plastic AquaCulture Floats, Bonar Plastics, Wenham, MA). One of the drums was airtight and could float. Small holes along one seam allowed the other drum to fill with water. The spec-

tacled bear received two plastic balls (the size of volleyballs) attached to a rope. The sloth bear received one white plastic ball and a boomer ball, a heavy, basketball-sized, solid brown ball.

Data Collection Procedure

Behavioral observations at all three exhibits were recorded using a continuous focal animal sampling procedure (Altmann, 1974) with a fixed time interval of 15 min. Each exhibit was observed once an hour. At the polar bear exhibit, observations were alternated between the two polar bears. Observations occurred over a 4-week period in the summer from 9:00 a.m. to 5:00 p.m., 4 to 7 hr each day, 5 to 7 days each week. Observations on the polar bears continued for an additional 3 weeks. These observation periods, systematic samples across time of day, sampled a focal animal's behavior during each hour of the day and at different times within the hour. The order in which the bears were observed per hour was systematically counterbalanced as was the order in which the two polar bears were selected as the focal animal. This schedule produced a total of 95 hr of observation for the spectacled, sloth, and polar bears (26.5, 28, and 40.5 hr, respectively), collected over a 28-day period (a 49-day period for the polar bears).

Data were collected by using a standard behavior checksheet. The starting time of each change in behavior was recorded and behaviors were later grouped into four categories. Behaviors were categorized as (a) *active:* walking, running, manipulating, climbing, scratching (self and objects), sniffing, biting, grooming, shaking, eliminating, interacting socially with another bear in the same exhibit, entering or exiting pool, swimming, splashing, diving; (b) *inactive:* standing, sitting, lying down, sleeping; (c) *pacing:* a fixed, repetitive, apparently purposeless locomotion accompanied by head turning (Ames, 1994); and (d) *not visible:* could not be seen by the observer.

Data were collected for all bears in the 1st and 3rd weeks on baseline rates of behavior. In the 2nd and 4th weeks, all subjects received manipulable plastic objects. The polar bears retained their toys for an additional 3 weeks. At the beginning of the 3rd week, a female spectacled bear was unexpectedly reintroduced into the yard of the male spectacled bear. In the past, the bears had shared the enclosure. Because of management constraints, however, they had been separated for almost a year. The female was included in the study not as a subject but as a new manipulation within the male spectacled bear's environment. Thus, the second baseline and toy conditions for the spectacled bear included the presence of a female.

Analysis

The proportion of time that polar, sloth, and spectacled bears engaged in the four categories of behavior (i.e., active, inactive, pacing, and not visible) per 15-min ob-

servation period was calculated. For the polar bears, nonorthogonal, planned contrasts, using the Bonferroni correction ($p < .01$; Keppel, 1991), were carried out for the proportion of time in which the bears engaged in each category of behavior per observation period as a function of the environment manipulation (i.e., plastic drums) across weeks. Pacing was not included, as the polar bears were not observed pacing during the study. Because the polar bears had a history of playing with drums, contrasts were used to examine the direct question of whether the opportunity to manipulate the drums would increase mean proportions of active time.

Different analyses were performed for the sloth and spectacled bears, as they did not have a prior history of manipulating plastic toys in their outdoor enclosures. This led to the more general question of what effects the toys had on the bears in terms of the four categories of behavior. Therefore, separate Kruskal-Wallis one-way analyses of variance, corrected for ties (Gibbons, 1985; Siegel & Castellan, 1988) and with multiple post hoc comparisons (Gibbons, 1985; Hollander & Wolfe, 1973), were run on both bears for each category of behavior ($p < .05$). Scores (mean rank proportions per observation) were compared across the 4 weeks of baseline and toy conditions. The use of these statistics is consistent with those used by Carlstead et al. (1991), Wechsler (1991, 1992), and Markowitz, Aday, and Gavazzi (1995).

RESULTS

Polar Bear

Figure 1 shows the mean proportion of time that the polar bears were active, inactive, and not visible across baseline and toy conditions. For the polar bears, activity during the toy conditions was twice as high as activity at baseline, $F(1, 155) = 22.49$, $p < .001$. Further, 59% of the activity directly involved manipulating the plastic drums, compared with 2% manipulating other objects, such as candy wrappers, without the drums present. As the polar bears became more active, they also became more visible to the public, $F(1, 155) = 18.37$, $p < .001$.

Spectacled Bear

Figure 2 shows the mean proportion of time that the spectacled bear was active, inactive, pacing, and not visible across baseline and toy conditions. The most meaningful behavioral change across conditions for the spectacled bear was a change in the amount of pacing ($H = 41.62$, $p < .001$). Pacing decreased markedly between the first baseline condition (52%) and the first toy condition (27%) and then virtually disappeared when the female was present in the second baseline and toy conditions (1% and 8%, respectively). The second baseline and toy conditions also showed a sharp increase in the amount of time that the bear was not visible to the observer

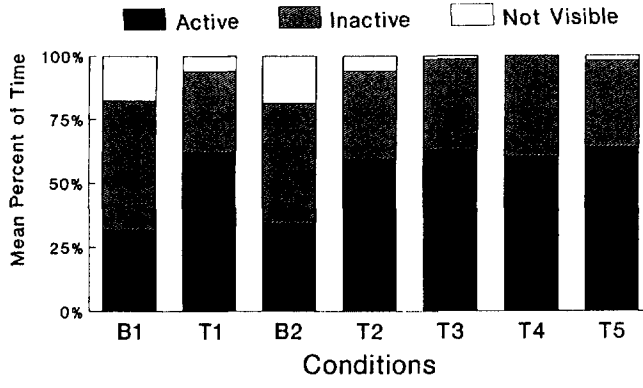

FIGURE 1 The mean proportion of time that the polar bears were active, inactive, and not visible across baseline (B) and toy (T) conditions.

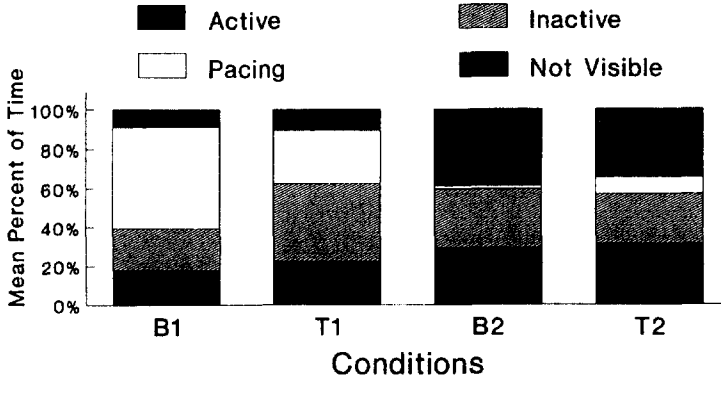

FIGURE 2 The mean proportion of time that the spectacled bear was active, inactive, pacing, and not visible across baseline (B) and toy (T) conditions.

(39% and 34%, respectively), compared with the first set of conditions (9% and 10%; $H = 10.84, p < .02$).

Sloth Bear

Figure 3 shows the mean proportion of time that the sloth bear was active, inactive, pacing, and not visible across baseline and toy conditions. The sloth bear also showed changes across conditions in the amount of pacing ($H = 15.08, p < .002$) and

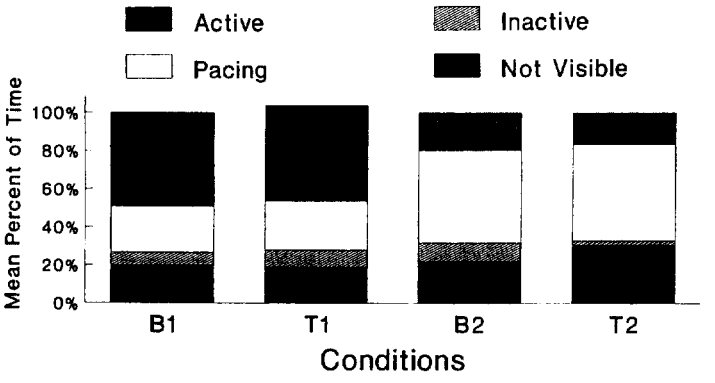

FIGURE 3 The mean proportion of time that the sloth bear was active, inactive, pacing, and not visible across baseline (B) and toy (T) conditions.

time spent out of the observer's view ($H = 12.68, p > .006$). However, these changes in behavior did not correspond with baseline and toy conditions but with the presence of the female spectacled bear in the adjoining exhibit during the 3rd and 4th weeks. During the first baseline and toy conditions, the bear showed significantly less pacing (24% and 26%, respectively) than during the second baseline and toy conditions (49% and 51%, respectively). As pacing increased, the amount of time spent out of the observer's view decreased in a corresponding fashion. The sloth bear spent less time out of sight when the female spectacled bear was present (16% and 20%, respectively) compared with when she was absent (1% and 8%, respectively).

DISCUSSION

These data are partially consistent with the hypothesis that the use of inedible, manipulable objects decreases pacing, excessive inactivity, or both in bears. Polar bears presented with the opportunity to manipulate large plastic drums not only increased their activity but also engaged in a wider range of behavior patterns seen with polar bears living in the wild—especially those patterns involved with hunting. Wild polar bears pounce on seals, flip them out of the water, and grasp blocks of ice to use as tools for breaking open seal lairs (DeMaster & Stirling, 1977; Lopez, 1986; Stirling, 1974).

The captive polar bears displayed similar behavior patterns with the drums. They climbed out of the pool and pounced on the floating airtight drum. They were observed flipping the drum into the air with their paws, floating on their backs with their paws wrapped around the drum, pushing the drum ahead of them with their snouts, or pulling the drum with their teeth. They were also observed pulling the

perforated drum underwater, letting it fill with water, pushing it back up to the surface, and then alternately flipping and dragging the drum out of the water. They would prop up the drum against the steps and, pushing up and down on it with their front paws, force the water from it. When they had drained the drum, they would knock it back into the pool and repeat the process. Thus, contrary to Newberry (1995), who argued that toys offered little functional relevance to animals, the presence of manipulable objects afforded the polar bears a wider variety of appetitive behaviors in which to engage, reducing their captivity-related inactivity. Activity did not appear to decline across weeks—there was no evidence of habituation to the plastic drums after a month.

The effects of enrichment with manipulable objects on the spectacled bear are less definitive. The most salient change in the male bear's behavior during the study was a complete disappearance in pacing in response to the female's presence in the enclosure. Once the female was reintroduced into the exhibit, most of the male's behavior consisted of unrequited affiliative attention toward the female. However, based on the comparison of the first baseline and toy conditions (when the female was absent from the enclosure), the plastic balls also had an effect on the spectacled bear's behavior. Pacing was nearly halved from the baseline condition to the first toy condition.

In contrast to the polar and spectacled bears, the sloth bear was unresponsive to the presence of plastic toys. This was unexpected, as the sloth bear had a history of playing with the boomer ball in the indoor pen. Conditions that elicited active play indoors may not have been present in the outdoor exhibit. The sloth bear, out of the sight but not the hearing, of the keepers, had previously banged the ball against the walls. This condition was not possible in the outdoor yard.

Unexpectedly, the only environmental change that affected the sloth bear's behavior was the presence of a female spectacled bear in the adjoining yard. In the presence of the female (second baseline and toy conditions), the sloth bear's pacing doubled relative to the first 2 weeks of the study when the female was not present. This suggests that the male sloth bear reacted to the presence of the female spectacled bear in the adjoining exhibit.

Increasing a captive animal's opportunities to interact with its environment is the goal of environmental enrichment in zoos—increasing the animal's range of species-typical behaviors, at the same time decreasing behaviors that suggest diminished well-being caused by captivity. To date, published studies have focused only on feeding enrichment for bears in captivity, the effects of which have lasted only as long as it has taken the bears to consume the food. Thus, while food getting is one of the most time-consuming behaviors in the wild (Ames, 1994; Carlstead et al., 1991; Stirling, 1974), and thus a target behavior for food enrichment, it has not been a prolonged activity in captivity. However, this study demonstrated that inedible, manipulable objects could elicit and sustain appetitive behaviors in bears

drums served as model prey for the carnivorous polar bears. This was not the case for the primarily frugivorous spectacled bear or for the primarily myrmecophagous sloth bear, demonstrating the importance of developing species-appropriate toys to elicit appetitive behaviors in captivity for prolonged periods of time.

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Feeding Enrichment and Stereotypic Behavior in Spectacled Bears

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The effect of feeding enrichment on the behavior of three spectacled bears (*Tremarctos ornatus*) was investigated in a large, complex zoo exhibit. Feeding enrichment significantly extended the time bears spent foraging, but no delayed effect on other behaviors was found. The frequency of stereotypic behaviors performed by an old female and a young adult male was not influenced outside the morning feeding period. As yet, a young adult female has not developed stereotypic behaviors. In the old female, the frequency of stereotypic behavior was inversely correlated with the frequency of resting. In the male, the frequency of stereotypic behavior was inversely correlated with the frequency of social interactions with either female. Zoo Biol 18:363–371, 1999.

Key words: *Tremarctos ornatus*; resting behavior; social frustration

INTRODUCTION

Zoo exhibits for bears are usually small and often poorly furnished [Forthman et al., 1992; Keulen-Kromhout, 1978]. Bears kept in such barren environments, particularly from an early age, tend to perform stereotypies [Ames, 1993; Carlstead et al., 1991; Forthman et al., 1992; Keulen-Kromhout, 1978; Wechsler, 1991]. In general, the development of stereotypies indicates that the animal's environment is suboptimal [Mason, 1991]. For the welfare of captive animals and for the educational purposes of modern zoos, improvements in animal management and exhibition designed to promote natural behavior and prevent or reduce stereotypies continue to be a primary task for zoo designers.

It is hypothesized that stereotypies develop from frustrated appetitive behavior [Kolter, 1995; Mason, 1991; Wechsler, 1991]. Highly motivated animals are unable to find adequate stimuli or situations to perform the consummatory act, which would

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reduce the underlying motivation. Environmental enrichment, such as furnishing barren enclosures with natural or artificial objects that offer these missing stimuli, may eliminate the possible causes of stereotypies.

Because eating is one of the most stimulating activities of captive bears, feeding enrichment through multiple feedings, concealment of food, or various devices that either must be manipulated to get food or offer food at unpredictable times has been shown to stimulate the life of zoo bears and reduce stereotypies [Ames, 1993; Carlstead et al., 1991; Forthman et al., 1992; Wechsler, 1991].

At the Zürich Zoo, bears were kept in two small (170 m^2 each) bear pits since 1929. In 1995, this outdated construction was replaced by a 2,540-m^2 outdoor exhibit for spectacled bears (*Tremarctos ornatus*). The enclosure is environmentally enriched by natural substrates, running water, living vegetation, and several climbing facilities. Furthermore, several feeding enrichment devices were installed that had been designed and tested in the old enclosures [Krause, 1992, unpublished; Gaillard, 1995, unpublished].

The aim of our study was to test the efficiency of these feeding devices in the complex enclosure and their effects on the behavior of the bears. Special attention was given to the occurrence of stereotypic behavior and its underlying motivation.

MATERIALS AND METHODS

Subjects

The Zürich Zoo keeps a group of three spectacled bears: two females, Tolima (born January 1980 in Salisbury, at the Zürich Zoo since 1987) and Sisa (born January 1992 in Zürich, daughter of Tolima), and one male Sangay (born January 1992 in Moscow). From January 1994 to September 1995, during construction of the new enclosure, Tolima and Sisa resided in the Tierpark Schönbrunn (Vienna). Sangay arrived at the Zürich Zoo in October 1995. The male and females were not be kept together before January 1996, until Tolima came into estrus. Sangay and Tolima performed well-established stereotypies, whereas Sisa did not.

Housing

The exhibit consists of three outdoor compartments of 1,210, 630, and 700 m^2 enclosed by artificial rock walls, dry moats, and water ponds. The three compartments can be connected by swivel bridges (tree trunks) across the moats or by a fourth outdoor compartment between the exhibit and the indoor dens. The exhibit is furnished with natural soil, living vegetation (meadows, shrubs, bushes, and trees), rocky areas, upright dead climbing trees with resting platforms, several water ponds, and a small stream. Most of the enclosure lies above visitors' level.

In addition to the bears, several rosybills (*Netta peposaca*) and mallards (*Anas platyrhynchos)* live in the enclosure, and free-roaming peafowl *(Pavo cristatus*) regularly fly in. It is also planned to keep a group of coatis *(Nasua nasua*) with the bears, but at the time of this study, the two species were not yet habituated to each other.

From 0945 to 1600 in February and March (winter) and from 0830 to 1700 in April (summer) bears were released to the largest compartment (1,210 m^2). By crossing the bridges, Sangay and Sisa had free access to the second compartment (630 m^2), whereas Tolima had not yet learned to cross the bridges. The third compartment was reserved for the coatis.

Experimental Design

From February 9, to April 25, 1996, the feeding routine was switched weekly between an enriched condition (Rich, Table 1) and a more conventional condition (Conv). To balance any seasonal effects, repeated switching was preferred to a single switch between conditions after several weeks. Each morning, before the bears were let out, 70 to 80% of the food, consisting of apples, pears, carrots, endives, lettuce, bread, and pellets (Bärenalleinfutter, NAVAG, Gossau), was placed in the outdoor enclosure according to the experimental condition. The remaining 20 to 30% was given in the inside dens in the evening. During condition Rich, the following devices were used for feeding enrichment: food holes (concrete tubes in the ground where food was hidden), branch racks (metal constructions where fresh-cut branches can be fixed), branch piles (containing peanuts), holzrugels (wooden logs, 3–10 × 40 cm, with 10 cm deep, narrow holes filled with raisins at one end, fixed to the ground at the other end) and a honey tree (a dead climbing tree with a cup-like hollow at a 3.5 m height to which syrup can be pumped).

Data Collection

Behavioral observations were performed on Friday, Tuesday, Wednesday, and Thursday, i.e., on the first, fifth, sixth, and seventh day after altering the feeding condition. On each of these days, the bears were observed for 3 × 60 minutes, starting after entering the exhibit in the morning (period A; *c.*0945 winter, *c.*0830 summer), before noon (period B; *c.*1100), and in the early afternoon (period C; *c.*1400). A total of 114 observational hours was distributed as follows: condition Rich (5 weeks, 59 hours); period A, 20 hours; period B, 20 hours; period C, 19 hours; condition Conv (5 weeks, 55 hours); period A, 19 hours; period B, 18 hours; period C, 18 hours.

The behavior of each bear was simultaneously recorded on a protocol form every minute (scan sampling [Altmann, 1974]). Intervals were indicated acoustically by a stopwatch with timer function. The following behavioral categories were defined: 1) resting (sleeping, lying, sitting), 2) walking, 3) eating (excluding peanuts from the branch piles and leaves and buds from branches), 4) manipulating feeding devices, and 5) interacting socially (playfighting, sexual behavior). Eating peanuts from the branch piles, raisins from the holzrugels, or parts of the branches from the branch-racks was not recorded as eating but as manipulating feeding devices. Eating and manipulating feeding devices together were called foraging.

Pacing could not be distinguished from walking, and therefore is included in walking. Nevertheless, pacing was combined with a stereotypic, repeated head-tossing, which was recorded if it occurred at least once within an interval (one-zero sampling [Altmann, 1974]).

Meteorological data were collected by the Swiss Meteorological Institute (Landeswetterzentrale LWZ), which is located 800 m southwest of the zoo.

Analysis

The frequency, i.e., the number of scans an animal was performing a certain behavior during 1 hour of observation, was reported as an independent datum. In the case of head-tossing, the frequency was the number of intervals in which head-tossing occurred at least once during 1 hour of observation.

Comparisons of the experimental conditions were made using non-parametric statistics (two-tailed *U*-test, Spearman correlation) [Sachs, 1992]. Because multiple statistical tests were conducted, for each test the overall significance level (e.g., a = 0.05) was divided by the number of tests (P < a/number of tests). This so-called standard Bonferroni adjustment reduces the possibility of rejecting a true null hypothesis (type I error), but strongly reduces the power of a test, i.e., enhances the possibility of maintaining a false null hypothesis (type II error) as well [Chandler, 1995]. Considering this trade-off, tested differences with $P < 0.01$ were taken as statistically significant. For calculations and drawings, STATISTICA software (StatSoft, Inc., Tulsa, OK) was used.

RESULTS

The feeding enrichment under condition Rich significantly extended the time the bears spent foraging (= sum of eating and manipulating feeding devices) in period A, but not in periods B and C (Fig.1). In period A, the medians of foraging were 30.5 (Rich) and 13 (Conv) for Sangay, 24.5 (Rich) and 15 (Conv) for Tolima, and 17 (Rich) and 4 (Conv) for Sisa, and the differences between condition Rich and condition Conv ranged from 9.5 scans (for Tolima) to 17.5 (for Sangay). The freshly baited feeding devices (condition Rich in period A) were used intensively by all three bears (Fig. 2), whereas the empty feeding devices, in general, were neglected (condition Conv and condition Rich in periods B and C).

Because feeding enrichment significantly extended the time the bears spent foraging in the morning, the time for alternative behaviors (resting, walking, interacting) was reduced. Nevertheless, only one comparison of feeding conditions reached significance at a $P < 0.01$ level: Sangay socially interacted less during period A, when feeding was enriched.

The feeding enrichment in the morning could not prevent Sangay and Tolima from performing stereotypies. There was no significant difference in head-tossing between days with enriched and days with conventional feeding in both animals and each period. Across all 114 observational hours, medians (maximum) of head-tossing were 4.5 (42) scans for Sangay and 4 (59) scans for Tolima. Sisa did not show any stereotypic behavior.

TABLE 1. Features of the two experimental feeding conditions

Enriched feeding condition (Rich)	Conventional feeding condition (Conv)
Apples, pears carrots, endives, and pieces of bread are distributed to all food holes in the exhibit.	All foods (excluding raisins and peanuts) are scattered in three feeding areas.
Lettuce is offered in one feeding area.	Lettuce is offered in one feeding area.
Pellets are scattered in three feeding areas.	Pellets are scattered in three feeding areas.
Two handfuls of peanuts are thrown into each of two branch piles.	No peanuts in branch piles.
Four holzrugels (see text for description) were fixed at various places.	No holzrugels are offered.
All five branch racks are filled with branches.	The branch racks remain empty.
The honey tree is activated one per day, but not during observations.	The honey tree is not activated.

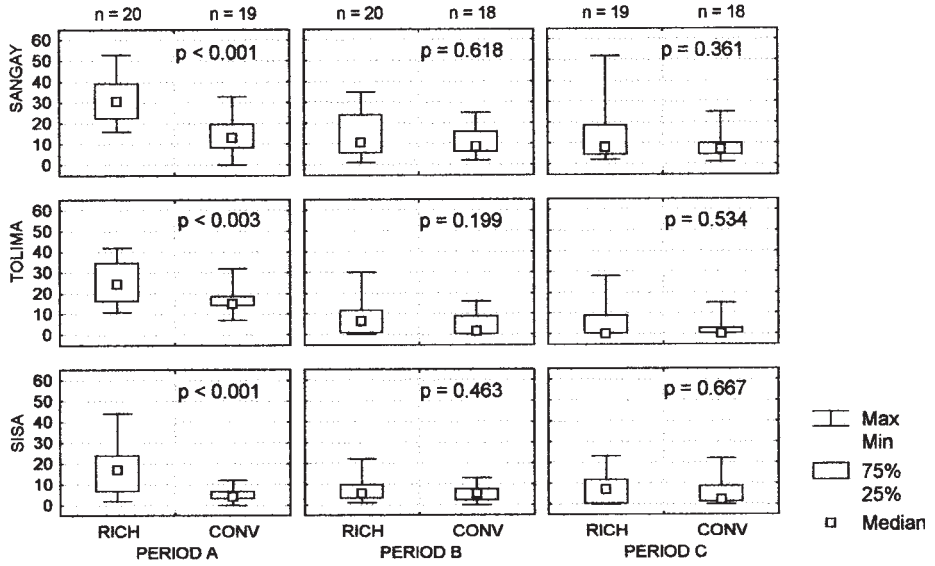

Fig. 1. Comparisons (*U*-tests) of the frequency of foraging (eating + manipulation of feeding devices) between enriched (Rich) and conventional (Conv) feeding condition for each bear and each period (daytime).

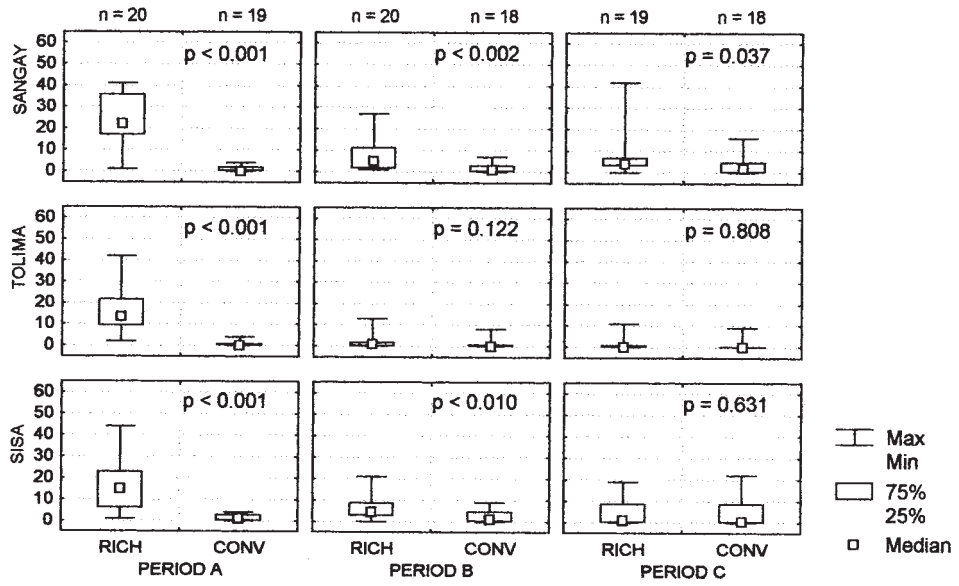

Fig. 2. Comparisons (*U*-tests) of the frequency of manipulating feeding devices between enriched (Rich) and conventional (Conv) feeding condition for each bear and each period (daytime). The feeding devices were baited before period A (Rich). The differences between periods A and B (Rich) were significant ($P < 0.001$ for Sangay and Tolima, $P < 0.008$ for Sisa).

To understand the releasing factors of Sangay's and Tolima's stereotypies, their occurrence was further investigated. Usually Tolima started pacing immediately after she finished foraging. On some days, however, she did not do so, but went to rest. Thus, pacing and resting seemed to be alternatives. Hence, the question is no longer "why did she pace" but "why did she not rest?"

Tolima only rested on one particular platform in the climbing trees. On this platform, she was very exposed to weather. Figure 3 shows the relationship between air temperature and her resting and head-tossing, respectively. Obviously Tolima did only rest at temperatures between 0 and 20°C, and stereotypic behavior was reduced at those temperatures. Also harsh winds and heavy rainfall prevented her from resting on her preferred platform and triggered stereotypic behavior.

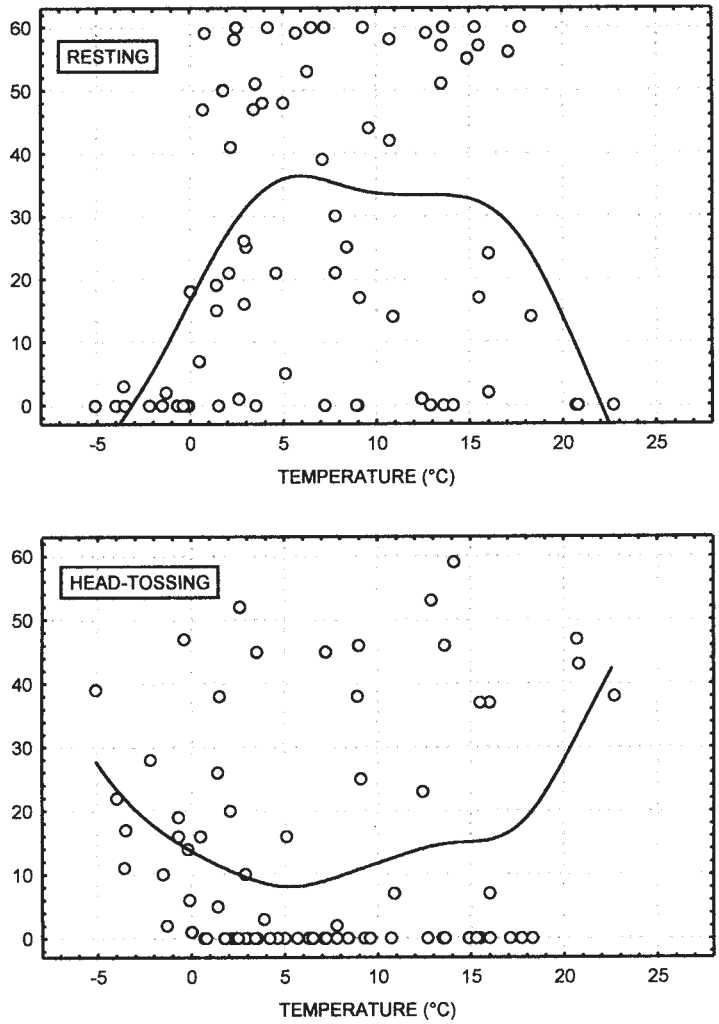

Fig. 3. Relationships between ambient air temperature and the frequency of resting and of stereotypic head-tossing, respectively, of Tolima (combined data from periods B and C). Curves are fitted to the data according to a distance-weighted least-squares smoothing procedure.

With a few exceptions (during 5 of 51 hours between one and four scans), Sangay did not pace before March 19. Instead, he was often involved in long bouts of play-fighting with Tolima at the beginning of the study. Then, after 3 weeks, Sisa came into estrus, and he copulated and played with her regularly for almost 3 weeks. It was on March 19 that Sisa aggressively refused copulation for the first time. From that day on, Sangay paced regularly (during 61 of 63 hours between 2 and 42 scans, median = 19).

Considering only the data after March 19, the following results were found: In period A, there seemed to be an inverse correlation between head-tossing and foraging ($r_s = –0.54$, n = 21, $P = 0.011$), whereas in periods B and C, head-tossing was inversely correlated with social interactions (period B: $r_s = –0.79$, n = 21, $P < 0.0001$; period C: $r_s = –0.58$, n = 21, $P < 0.007$). Hence, social interaction was the alternative to stereotypic behavior in Sangay.

DISCUSSION

Feeding enrichment (condition Rich) extended the time the three spectacled bears at the Zürich Zoo spent foraging after entering the exhibit in the morning (period A) and in doing so, reduced the time for doing anything else. Nevertheless, the effects of this feeding enrichment regimen on foraging behavior were limited to some minutes in the main eating time in the morning (Fig. 1). Later in the morning (period B) and in the afternoon (period C), no delayed effects were observed.

Forthman et al. [1992], studying a Kodiak (*Ursus arctos middendorffii*), an Asiatic black (*Selenarctos thibetanus*), and two singly housed polar bears (*Ursus maritimus*), also found no long-term effect of feeding enrichment on general activity and stereotypies. They stated that behavioral improvements were "the direct result of interactions with the enrichment item, rather than a generalized activation effect" [Forthman et al., 1992, p. 194]. Carlstead et al. [1991] found significant, positive effects (i.e., reduced stereotypic pacing) through feeding enrichment in a sloth (*Melursus ursinus*), an American black (*Ursus americanus*) and a brown bear (*Ursus arctos*), but their data were collected throughout the whole day and it is not possible to distinguish between direct and delayed effects.

Studying a group of three polar bears in a barren enclosure, Wechsler [1994] obtained contradictory results on long-term effects: after manipulation of iced food, the male performed more stereotypies (compared with no feeding), but one female performed fewer. In the other female, no delayed effect was noted. Wechsler argued that in the male bear, the manipulation of iced food may have stimulated appetitive behavior for new stimuli, which did not exist in the barren enclosure.

Our study differs from previous ones on feeding enrichment in bears because we observed animals that lived in a large, already physically enriched enclosure and that had at least 3 months of experience with an enriched feeding routine. Hence, in this sense, we did not study the effect of feeding enrichment in a barren environment, but the effect of impoverished feeding in a physically enriched environment. A delayed effect, such as Wechsler [1994] observed in his male polar bear, was therefore not expected.

Environmental enrichment is intended to promote natural behaviors and to prevent animals from acquiring stereotypies or performing stereotypies already developed. Before and during our observations, the 4-year-old female Sisa did not show

any stereotypies. But in the case of the 16-year-old female Tolima and the 4-year-old male Sangay, the complex, large enclosure with an enriched feeding routine could not prevent them from performing previously developed stereotypies.

After eating, Tolima usually went either to rest or to pace. Her decision seemed to depend on the weather (Fig. 3). Her preferred resting site, the lowest platform in the climbing trees, was only suitable for resting at temperatures from about 0 to 18°C. At lower temperatures, it may have been too cold; at higher temperatures, sun radiation may have been too strong. Also, heavy rainfall made the platform unacceptable for resting. In such situations, Tolima did not choose another resting site, but started to pace. Thus, Tolima's pacing seemed to be her way to cope with the frustrating situation that no suitable resting site was available. Sporadic observations in the summer after the study ended supported this impression, for then the live trees in the exhibit created shady areas where Tolima regularly lay in the cool grass, and her pacing ceased completely.

The importance of appropriate resting sites for bears in zoo exhibits was already mentioned by Thieme and Kolter [1995]. They also found some correlation between the lack of appropriate resting sites and increased locomotion with stereotypic head-tossing in an old female spectacled bear at Cologne Zoo. In the same female, Döring [1992, unpublished] found a decrease in circling in the indoor cage and an increase in nesting and resting behavior after offering nest material.

Sangay's pacing with stereotypic head-tossing was most likely released by social frustration. In the first weeks of the observations, he performed almost no stereotypies; instead, he interacted regularly first with Tolima, later with Sisa. Tolima came into estrus in January and for 10 days, she copulated frequently with Sangay. Afterward Tolima and Sangay regularly were engaged in long bouts of play-fighting. While the two were in this phase, the observations for this study began on February 9. Three weeks later, Sisa came into estrus and Sangay's interest switched to her (March 2). Then Sisa and Sangay copulated and played frequently. On March 19, Sisa aggressively repelled Sangay's approaches for the first time. From that day on, he continued to pace whenever Sisa refused to interact. It was even observed that when Sisa ended an interaction aggressively, Sangay, startled, ran to a wall and immediately began to head-toss and pace. At that time, Tolima was not an attractive alternative partner anymore. The strong negative correlation between the frequency of head-tossing and the frequency of interacting socially in the last 5 weeks of observations (March 20 to April 25) strongly suggests that the stereotypic behavior of Sangay was a reaction to social frustration.

An increase in the amount of stereotypies in captive male bears during the mating season has been shown in American black [Carlstead and Seidensticker, 1991] and polar bears [Ames, 1993; Kolter and Zander, 1995]. Ames [1993] argued that in the zoo situation, the constant presence of females, which may be sexually attractive for some time before and after estrus but do not allow mating, is frustrating for the males and releases their stereotypic behavior. Our results support this hypothesis, but further investigations outside mating season in all male groups or with castrated males, are needed.

CONCLUSIONS

1. In a large, physically enriched enclosure feeding enrichment devices, such as food holes, branch piles, branch racks, and holzrugels, extended the time spectacled bears foraged directly after releasing them into the exhibit (Fig. 1).

2. Feeding enrichment had no long-term or delayed effect on the behavior of the bears during the day.

3. In the new, large, and complex enclosure, the old female Tolima and the young adult male Sangay performed previously developed stereotypies, independent of the feeding condition. The young female Sisa, on the other hand, had not acquired any stereotypies when the study ended.

4. Tolima performed stereotypic behavior when she did not find an appropriate resting site. Acceptability of her preferred resting site seemed to depend on weather.

5. During our observations, Sangay's stereotypic behavior was most likely released by social frustration, in the presence of attractive females that were unwilling to interact. When the females were willing to mate or play, Sangay did not pace.

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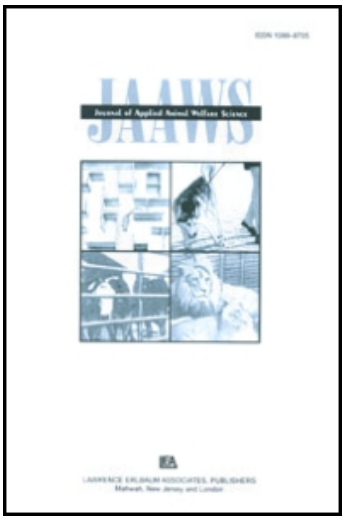

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Introducing a Semi-Naturalistic Exhibit As Structural Enrichment for Two Brown Bears (Ursus arctos). Does This Ensure Their Captive Well-Being?

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Introducing a Semi-Naturalistic Exhibit As Structural Enrichment for Two Brown Bears (*Ursus arctos*). Does This Ensure Their Captive Well-Being?

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In this study we used the daily activity pattern and use of space as indicators of change in the program of structural enrichment, implemented with 2 subjects of the species *Ursus arctos* in the Barcelona Zoo. We collected 930 sampling points in each study phase for each of the individuals: The samples were taken in a balanced way at different times of day. We observed a wider range of behavior in the male than the female. With respect to the indicators, we observed statistically significant differences in behavior in both individuals in the 2 study phases. Both individuals showed an increase in vigilance, maintenance, and inactivity when their enclosure was changed. In terms of the subjects' well-being, we considered the percentage of stereotyped behavior within acceptable limits. The percentage of activity observed in the male was very similar to that of individuals of this species in the wild. In terms of the use of space, we observed homogeneity only in the male during the enrichment program. The 2 individuals responded in different ways to the structural enrichment.

One of the five types of environmental enrichment is *structural enrichment* (Bloomsmith, Brent, & Schapiro, 1991). Consequently, many zoo biologists have begun to collaborate with architects and engineers to design exhibits that enhance the lifestyles of captive, nonhuman animals (Maple & Perkins, 1996). Numerous environmental variables contribute both individually and collectively to the well-being of captive animals. Some of these variables have been classi-

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fied as elements in the physical environment (Maple, 1979). Many of these elements have been used to improve the quality of life of captive bears: changing enclosure size and shape (Van Keulen-Kromhout, 1978; Winhall, 1998), building rest areas (Cowan, 1997; Poulsen & Price, 1997), and introducing some types of manipulable objects made with natural (Acuña, 1993) or artificial material (Cutting, 2002; Ford, 1995; Pfaff, 1999; Willms, 2001). The seminaturalization of exhibits and the increase in space for the bears were chosen to increase behavioral diversity and to provide a more educational and attractive enclosure for visitors (Murray, Waran, & Young, 1998).

The term *postoccupancy evaluation* (POE) is used in architectural language to mean the evaluation of a building once the facility is in use (Zimring & Reizenstein, 1980). POE has been described as a procedure that enables managers to make effective decisions about planning and designing environments (Ross & Lukas, 2003). Maple and Finlay (1987) described it as "the practice of using systematic methods to find out exactly what makes designed environments work well for their users." When a new animal facility is designed, many different users must be involved.

The main users are the animals (Riddle, Keeling, Alford, & Beck, 1982; Ross & Lukas, 2001). However, there are also other types of users (care staff, visitors, and researchers) who must be considered in the design of the environment. Care staff are probably second to the animals in terms of the length of time they spend in building. Zoo visitors expect a pleasant, agreeable, and entertaining experience (Wilson, Kelling, Poline, Bloomsmith, & Maple, 2003). Finally, other users (veterinarians, educators, and support staff) have important design needs for the facility. Ignoring care staff's needs will be detrimental to the animals' well-being (Shettel-Neuber, 1988).

Studies that have examined the effect of increasing the size of the enclosure on behavior (Chang, Forthman, & Maple, 1999; Goerke, Fleming, & Creel, 1987; Line, Markowitz, Morgan, & Strong, 1991; Little & Sommer, 2002; Spendrup & Larsson, 1997b), on the use of space (Kessel & Brent, 1996), or on a combination of both factors (Brent, Lee, & Eichberg, 1991; Hebert & Bard, 2000; Ogden, Finlay, & Maple, 1990; Price, 1992) have mainly focused on the primate order.

No previous studies have examined the effect of an increase in enclosure size on the behavior and use of space in the *Ursidae* family. Articles on this species that discuss entertainment mainly dealt with the effect of food enrichment on the behavior of brown bears (Grandia, Van Dijk, & Koene, 2001; Hare, 1995; Larsson & Tove, 1995; Morimura & Ueno, 1999) and on the relationship between the size of the enclosure and stereotyped behavior in these animals (Spendrup & Larsson, 1997a).

Therefore, this study is the only one on the effect of an increase in enclosure size on the *Ursidae* family. In addition, it is the only one that analyzed both behavior and use of space as indicators of the animal's well-being, using the calculation of an index of spatial homogeneity.

The aim of this study was to analyze the effect of structural enrichment on two captive bears in the Barcelona Zoo in Spain. The daily activity pattern and the use of space were used as indicators of change.

METHOD

The subjects were two bears (*Ursus arctos*) housed at the Barcelona Zoo. Bubu was a 10-year old female (in January 1997), who was captive born and mother reared. Keiko was a 1.5-year-old male (in January 1997), who was wild born and hand reared.

Baseline Phase

Housing and husbandry. During the baseline phase (BL), Bubu was housed with her mother, and Keiko was housed alone in 100-m^2 and 130-m^2 enclosures, respectively (see Figure 1). These animals went out into their exterior enclosures every day, as did the Tibetan bear and the American black bear who occupied the two adjacent bear enclosures. The bears were housed in concrete pits with various uneven exhibits and had a water area for drinking and bathing. Furnishings consisted of several large stones and trees in both exhibits and a large, felled log in Keiko's exhibit. Bubu and Keiko had auditory and olfactory contact with each other because their exhibits were contiguous. Indoor cages were out of view of visitors, as was the drinking trough and concrete substrate (approximately 10 m^2). The

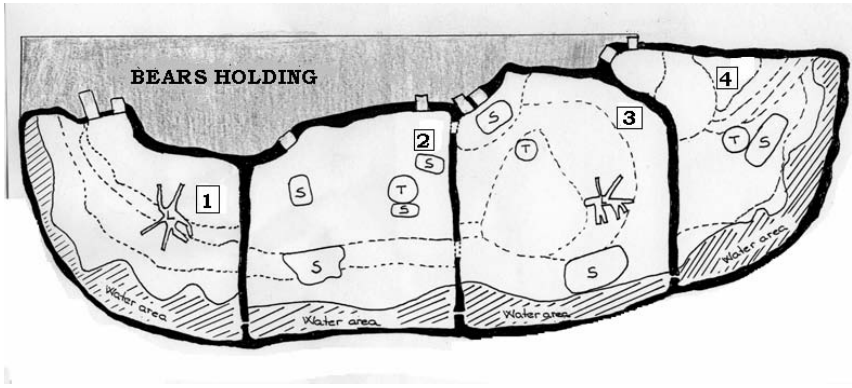

FIGURE 1 A plan of the old bear enclosures. 1 = *Selenarctos thibetanus* enclosure; 2 = *Ursus americanus* enclosure; 3 = *Ursus arctos arctos* enclosure; 4 = *Ursus arctos* enclosure; s = stone; T = tree; L = log; dashed line (- -) = uneven surface.

brown bears were housed individually because there was no interest in reproduction, as Bubu was a hybrid subject. They were on exhibit during daylight hours (9:00 a.m. to 8:00 p.m.). Bubu and Keiko were released into the outdoor enclosure daily. They were fed fruit, vegetables, and meat once a day in the afternoon when they were let into the indoor cages. These animals received a daily session with enriching items in the form of food.

Procedure. César González and collaborators from the ethology group Veterinarian Association for the Attention of Exotic and Wild Animals of the Autonomous University of Barcelona conducted the baseline observations. The bears were observed in the old exhibit in July and August 1997. The observation sessions began at 10:00 a.m. and ended at 8:00 p.m. Data were collected by different observers at different times of day. Observers had previously passed a reliability test, in which a concordance index was calculated (Martin & Bateson, 1986). Focal sampling methods and instantaneous scans were made at 10-min intervals over 22 days for each individual. In total, 75 hr of observation were undertaken for each of the subjects. Sessions were coded according to the time of day: mornings (10:00 a.m. to 1:00 p.m.), afternoons (1:00 p.m. to 4:00 p.m.), and evenings (4:00 p.m. to 8:00 p.m.); the location; and the activity each bear presented.

The study of use of space was carried out according to two different criteria in the division of the enclosure. First, the enclosures were divided into two similar parts in terms of the proximity of animals to the visitors (see Figure 2). Second, the location codes were "right location" when the animals occupied the right half of the enclosure and "left location" when the animals occupied the left half of the enclosure (see Figure 3). The activity categories that were coded are listed in Table 1.

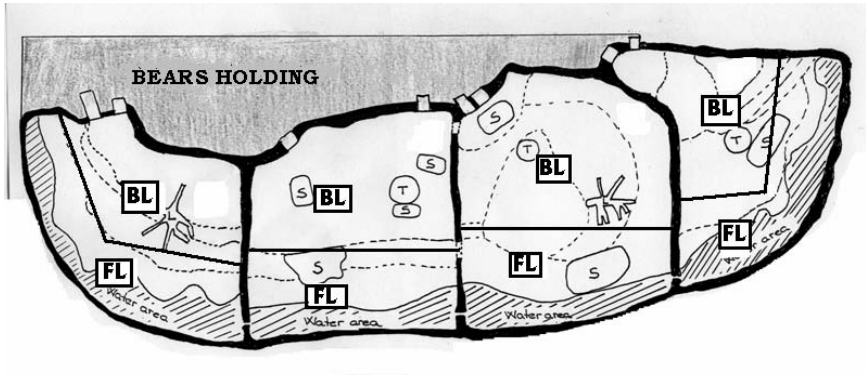

FIGURE 2 A plan of the enclosure showing the division into front and back areas. S = stone; T = tree; L = log; BL = back location; FL = front location; dashed line (- -) = uneven surface.

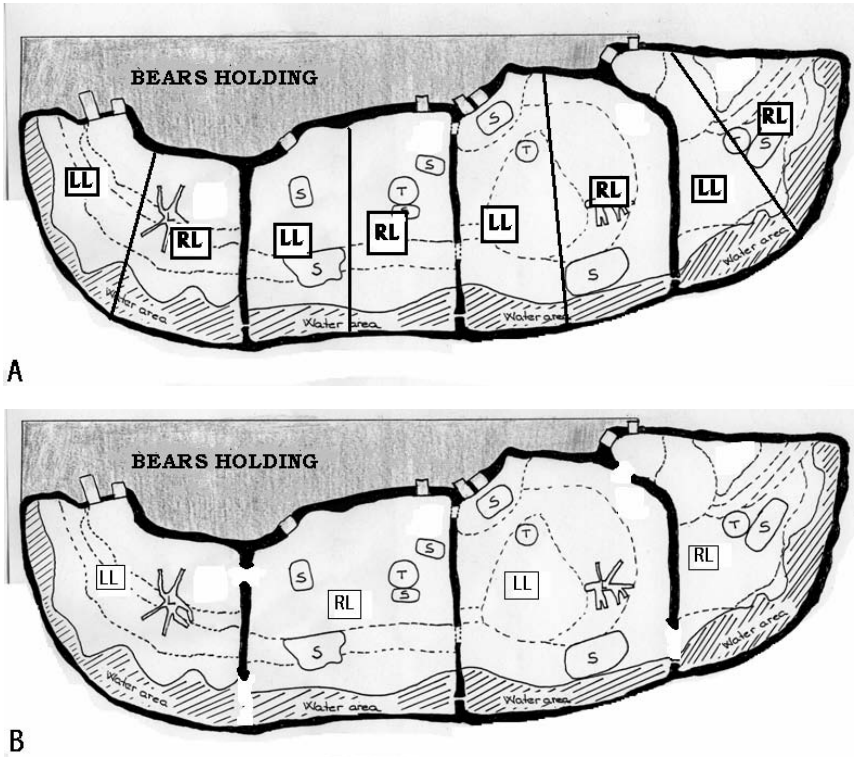

FIGURE 3 A plan of the brown bear enclosure showing the division into left and right areas. A = old exhibit; B = new exhibit; S = stone; L = log; T = tree; LL = left location; RL = right location; dashed line (- -) = uneven surface.

Postoccupancy Evaluation Phase

Housing and husbandry. The changes to the brown bears' enclosures in the Barcelona Zoo were carried out from October 2000 to March 2001. Each of the two new enclosures was formed by joining two of the existing four enclosures (see Figure 4). Therefore, the size of Keiko's enclosure increased by 150m^2; the size of Bubu's enclosure increased by 230m^2. In addition to doubling the surface available for the animals, different areas were made to increase the number of different surfaces. In addition to the cement floor, the new enclosure had areas with beach sand, gravel, and pine bark. New stones and logs were introduced as additional furnishings. The pump system was improved to prevent water from becoming stagnant, as it had been in the BL phase. For the animals' well-being, permanent enriching items were added, such as a honey dispenser and some fixed PVC tubes.

TABLE 1
The Definition of Each One of the Behavioral Categories and Their Classification Into Three Macrocategories

Activity is any behavior that is not classified as inactive, which includes:
Exploration: The animal sniffs the air, substrate, food or objects
Vigilance: The bear is alert with head up and eyes open
Locomotion: The animal moves around the enclosure
Scent marking: The bear rubs against logs
Feeding: The bear consumes food items, this also includes drinking
Solitary play: This mainly involves individual movement, such as vigorous, rigorous, exaggerated-like jumping
Maintenance: The animal self-grooms with mouth and/or paws, scratches, urinates, defecates, or shakes
Manipulation: The bear claws at, swipes at, nibbles at, picks up food, and nonfood items with mouth and/or paws
Human interaction: The bear sits or stands up while looking at humans; this includes different forms of begging, for example while the bear is sitting or standing up it may open its mouth and wave its head from side to side; the animal tries to communicate with the humans
Stereotyped behavior: This behavior has no goal and is repetitive, lasting for a constant time and occurring in the same places
Social interaction: This includes affiliation or agonistic behavior
Inactivity
Stationary: The bear rests lying or sitting with their musculature relaxed
Not Visible
Not visible: The bear or its behavior is not visible

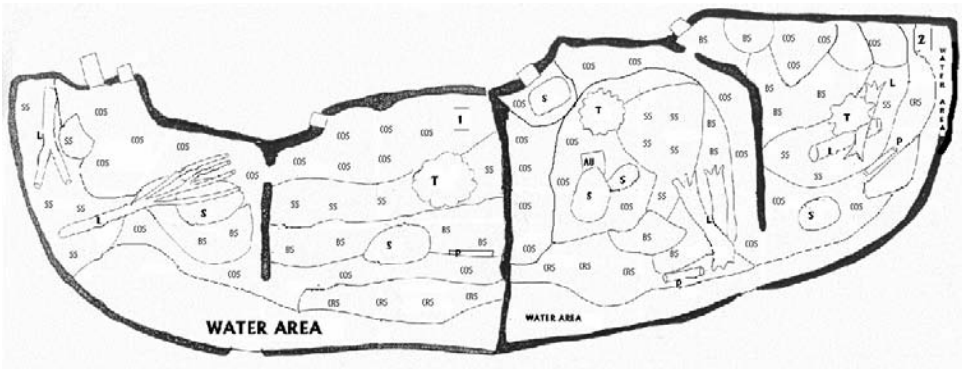

FIGURE 4 A plan of the new bear enclosures. 1 = Keiko's enclosure; 2 = Bubu's enclosure; S = stones; T = tree; L = logs; BS = bark substrates; CRS = crushed stone substrates; SS = sand substrates; COS = concrete substrates; AU = honey dispenser; P = PVC tube.

Both Bubu and Keiko were housed individually during this phase. Again there was no interest in reproduction because Bubu was a hybrid subject. The times at which the bears entered and left the exterior enclosures (they remained outside from 9:00 a.m. to 8:00 p.m.), the diet, and the interior enclosures were kept constant in all phases. However, there was a change in the Barcelona Zoo's collection plan. It was decided that, because of infrastructure considerations, only the species *Ursus arctos* would be maintained. Therefore, the Tibetan bear was removed from the collection, and a young female brown bear was introduced.

As a result, Keiko went into her exterior enclosure on Tuesdays, Thursdays, and Saturdays. On the other days, the young female brown bear went into the exterior enclosure. However, this female was not included in the study because there were no BL data available for her. Bubu also went into the exterior enclose on alternate days. He used the enclosure on Mondays, Wednesdays, Fridays, and Sundays. On the other days, the enclosure was used by the male American black bear. In this case, the animals did not undergo any enrichment program.

Procedure. Ana I. Soriano conducted all the behavioral observations in this present phase. Observations were made during June and July 2001. In this case, the observation sessions were 1 hr long and were carried out according to a monthly schedule in which 5 hr of monthly observation had to be carried out for each individual and for each one of the established time bands (mornings, 10:00 a.m. to 1:00 p.m.; afternoons, 1:00 p.m. to 4:00 p.m.; and evenings, 4:00 p.m. to 8:00 p.m.). Focal sampling methods and instantaneous scans were made at 2-min intervals over 15 sessions of 1 hr each for each individual. A total of 30 hr of observation was undertaken for each one of the individuals in the 2 months of the study while the animals were in the exterior enclosures (9:00 a.m. to 8:00 p.m.). Sessions were coded according to the same variables described in the BL phase.

The method of recording and sampling varied in the two study phases because the established objectives were initially different. However, it was decided that the data could be used to assess structural enrichment.

To compare the two study phases, the BL recording points were matched with those of the POE phase for each of the established time bands. In total, 930 recording points were obtained in each one of the phases and for each individual in the study.

Data Analysis

Using contingency tables, we analyzed the categorical data for behavior and use of space obtained in this study. These tables enabled us to determine whether there were statistically significant differences in the two study phases for the two dependent variables, by means of Pearson's chi-square calculation. This test sta-

tistic was used to determine in exactly which categories (behavior or location) the statistically significant differences could be found. This statistic has an absolute value of 2.96 for a normal distribution, assuming that the significance level is .05 (Haberman, 1978).

To analyze the effect of the enrichment program on a more homogeneous use of the space, a spread-of-participation index was used. A value of 1 indicated minimum use of the facility; a value of 0 indicated that the use of the space was totally homogeneous (Dickens, 1955; Shepherdson, Carlstead, Mellen, & Seindensticker, 1993).

RESULTS

Activity Differences Between BL and POE phases

Statistically significant differences in the two phases of the study for the two individuals are shown in Table 2. The detailed behavioral categories in which there were statistically significant differences (their values were either above or below the test statistic) are shown in Figure 5. Bubu spent more time engaging in the following behaviors: not visible, vigilance, locomotion, maintenance, manipulation, and inactivity; and spent less time engaging in explore, feeding, and social interaction in the POE observations than in the BL observations. Keiko spent significantly more time engaging in vigilance, maintenance, and inactivity and less time engaging in the following behaviors: not visible, explore, locomotion, feeding, solitary play, manipulation, and human interaction in the POE phase than in the BL phase (see Figure 6).

Location Differences Between the BL and POE Phases

Table 3 shows where there were statistically significant differences in the two study phases, the two area division systems, and the two individuals in this study.

TABLE 2
The Value of Pearson's Chi-Square, the Degrees of Freedom and the Significance Level for the Daily Activity Pattern of the Two Brown Bears

Statistic	*Bubu*	*Keiko*
Pearson chi-square	443.306	297.219
df	9	10
p	0*	0*

*Statistically significant difference.

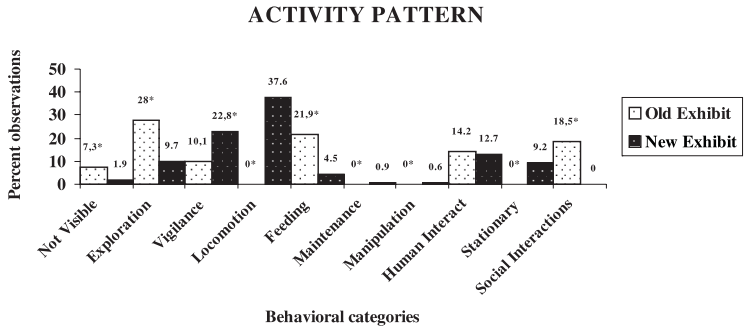

FIGURE 5 Bubu's percentage of activity observations in the two study phases.

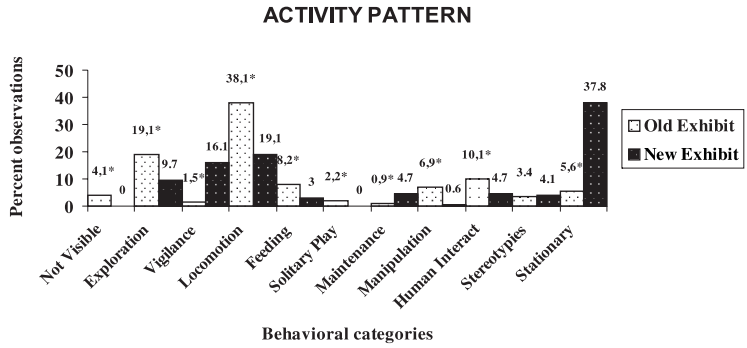

FIGURE 6 Keiko's percentage of activity observations in the two study phases.

TABLE 3
The Value of Pearson's Chi-Square, the Degrees of Freedom and the Significance Level for the Two Brown Bears' Use of Space

	Bubu		*Keiko*	
Statistic	*Front–Back Location*	*Right–Left Location*	*Front–Back Location*	*Right–Left Location*
Pearson chi-square	0.581	29.301	54.368	41.521
df	1	1	1	1
p	.446	0*	0*	0*

*Statistically significant difference.

Bubu's use of the front and back location did not differ significantly in the two phases (see Figure 7). However, her use of the right and left location differed significantly (see Figure 8). Keiko's front and back location differed significantly in the new enclosure (see Figure 7), although he spent significantly more time in the right location during the POE phase (see Figure 8).

The values of the spread-of-participation index for the two classifications of use of space and for the two subjects studied are shown in Table 4. There were no differences in terms of the homogeneity of Bubu's use of the front–back locations. However, homogeneity in the use of the right–left spaces was lost with enrichment. In the case of Keiko, an increase in homogeneity was seen only in the right–left locations.

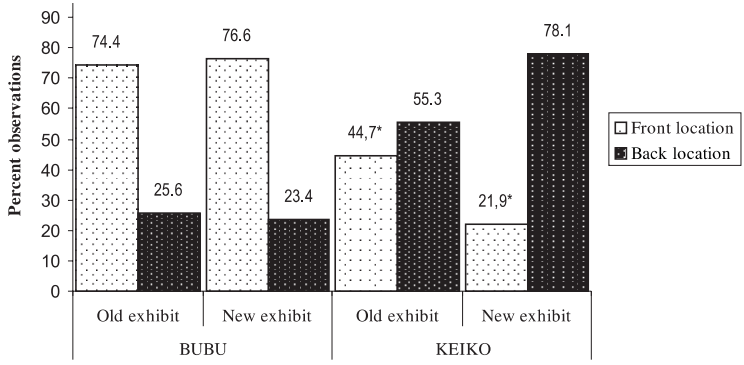

FIGURE 7 Bubu and Keiko's use of the front and back locations in the two study phases.

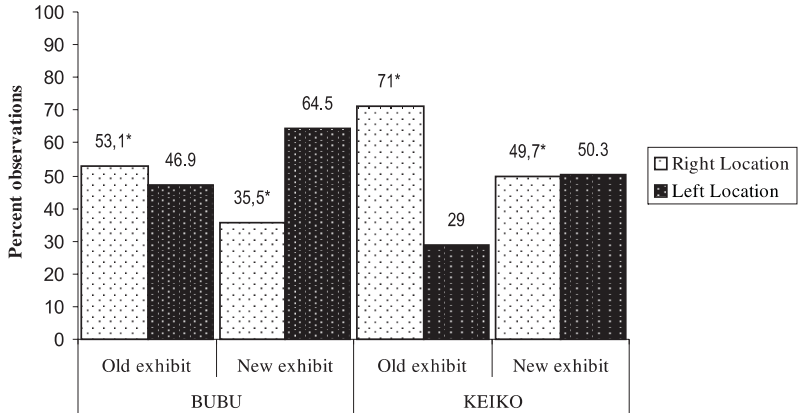

FIGURE 8 Use of right and left location by Bubu and Keiko in old and new exhibit.

TABLE 4
SPI Values for the Two Subjects and for the Two Classifications of Space

	Bubu		*Keiko*	
Location	*BL*	*POE*	*BL*	*POE*
Front–back	0.48	0.53	0.10	0.560
Right–left	0.06	0.29	0.35	0.006

Note. BL = baseline; POE = postoccupancy evaluation.

DISCUSSION

More behavioral categories (solitary play and stereotyped behavior) were observed in the male brown bear than in the female. This may have been due to several factors, such as sex, age of the individuals, and the type of birth (in the wild or in captivity).

Despite the time elapsed between the BL and POE evaluation periods and the death of Bubu's mother, the results show that brown bears spent more time engaged in vigilance, maintenance, and inactivity. The objective of structural enrichment was to attain increases in exploration, manipulation, maintenance, and solitary play.

Increases in exploration and manipulation were due to increased enclosure size and the introduction of new furniture and different substrates. An increase in the manipulation behavioral category was observed only for Bubu. The explore category was not increased with the new enclosure design.

Maintenance is an indicator of well-being because it contributes to controlling physiological functions. This indicator increased in the POE phase for the two subjects.

Solitary play contributes to the development of motor capabilities. The appearance of solitary play could be due to the youth of the male and the link between play and learning (Bekoff & Byers, 1998; Fagen, 1981). This behavior was observed in Keiko only during the BL phase.

The objective of physical enrichment was to attain decreased the following: not-visible behavior, stereotyped behavior, and human interaction.

Not-visible behavior is an indicator of an animal's adaptation to environmental factors such as architectural design and visitors' influence. Keiko's not-visible category was not observed during the POE evaluation because the new exhibit had no places in which Keiko could be out of sight. This was not the case for Bubu.

Stereotyped behavior is an indicator of well-being. Its presence indicates that the physical and physiological necessities of the animals are not fulfilled (Mason, 1991). It is the only behavior that did not change when Keiko's environment was

enriched. It was not observed in Bubu's behavioral repertoire. Shepherdson (1989) stated that more than 10% of stereotyped behavior is not acceptable. In this study, stereotyped behavior was observed only in the male, and the level was within acceptable values.

Human interaction is not desirable because it contributes to unbalancing the animal diet and is not part of the typical behavioral repertoire for this species. It is the only behavior that did not change after Bubu's environment was enriched. This behavior pattern decreased after Keiko's physical enrichment.

The seminaturalization of the exhibit was not enough to provide for both brown bears' well-being. Bubu's levels of inactivity increased only slightly (9.2%). This value was still far from wild brown bears' values. Keiko's well-being increased with the seminaturalistic exhibit because he was less active (42.2%) in the POE than in the BL phase (94.4%). Wild European brown bears have active behavior around 45% to 60% of the time in the summer period (Roth, 1983; Roth & Huber, 1986). Therefore, the physical enrichment program brought the male, captive brown bear's pattern of activity–inactivity closer to patterns of subjects in the wild.

Spendrup and Larsson's (1997a) studies of brown bears and Ames's (1999) studies of polar bears showed the importance of the size of the enclosure to these species. Both studies concluded that habitat size is linked to stereotyped behavior. The increase in the size of the enclosure in the Barcelona Zoo was not sufficient because the male continued to present stereotyped behavior. Therefore, as Spendrup and Larsson (1997a) indicated, other kinds of enrichment programs need to be implemented (food, sensory, and occupational) to improve the well-being of these animals.

Studies of structural enrichment in primates (Brent et al., 1991; Chang et al., 1999; Little & Sommer, 2002; Price, 1992) and its influence on behavior generally revealed a decrease in inactivity and an increase in feeding. In contrast, the exact opposite occurred with the Barcelona Zoo brown bears. Inactivity values were very low during the BL phase. These values increased in the POE phase. Feeding decreased in the POE phase, because the animals were submitted to a program of food enrichment during the BL phase.

The use of space during the two study phases was different for each individual, except in the case of Bubu's front and back locations during enrichment sessions. Keiko increased the use of the back area of her enclosure during the POE phase. There could be several reasons for this:

1. This location is at the greatest distance from the public.
2. It is close to the interior enclosure where the carers are and where there is more food.
3. It is the highest place in the enclosure, where the animal has the best view of the macroenvironment in which she lives.

A more homogeneous use of the space was observed only in the macho for the right–left location during the POE phase. This shows that increasing the size of the Barcelona Zoo's brown bear enclosure led to a decrease in spatial homogeneity, indicating that the bears have preferential areas within their habitat.

Renner and Lussier's (2002) study of the species *Tremarctos ornatus* indicated that structural enrichment increased the diversity of behavior and the use of space in this bear species. However, in our study the structural enrichment program caused an increase in behavioral diversity only in the female. In addition, spatial homogeneity was achieved only for the male in one of the uses of space divisions. This demonstrates that there is a different individual response to environmental enrichment programs, probably due to the sex, age, origin, and rearing conditions of subjects (Hare et al., 2003).

Readers should take into account that the brown bears' old and new exhibits are pits. This type of design influences the bears' well-being because their position is always subordinate to the visitors' position (Coe, 1985). Mammal exhibits must never be designed as pits because captive brown bears dislike a terraced and uneven floor enclosure. In their natural habitat of forests and mountains—where the view is blocked by many obstacles—this would tend to encourage the use of hearing and scent rather than sight (Van Keulen-Kromhout, 1978).

Having a seminaturalized exhibit with increased space is not enough to make a real improvement in captive brown bears' well-being (Beattie, Walke, & Sheddon, 1996). In addition, these two bears were in indoor cages several days a week. Therefore, the results demonstrate that they could not satisfy their daily needs. This type of management decreases the positive effects of structural enrichment. Achieving captive animal well-being is a combination of correct architectural exhibit design and correct daily management (Shettel-Neuber, 1988).

A limitation of this study that could have influenced the results was an excessive delay between the BL and POE phases. In addition, the objectives of the study were different in each of the two phases, so the recording and sampling methods were different. Moreover, the female was initially housed with her mother and subsequently was housed alone.

Future studies on this type of species in captivity should be aimed at improving the animals' well-being through introducing a daily routine that brings the behavioral indicators as close as possible to those of the same species in the wild. Thus, the objective is to boost the typical behavior of the species and to design a diet as similar as possible to the seasonal nature of the same species in a natural habitat.

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ESTUDIO DEL COMPORTAMIENTO DEL OSO PARDO EN CAUTIVIDAD EN EL ZOOLÓGICO DE BARCELONA.

Proyecto *"Carnívoros"*

Grupo etología.

AVAFES.

ETOGRAMA - *Ursus arctos*

Este es el etograma de 3 osos (1 macho y 2 hembras) que hizo el grupo de Etología de AVAFES durante el verano del 1997 en el Parque Zoológico de Barcelona.

Para acceder a la hoja de cálculo con los datos del etograma pinchar aquí.

En la hoja de cálculo, en la columna oso (os) se pueden encontrar 3 valores posibles: el 1 es un macho, y 2 y 3 son dos hembras (Yoga y Bubu), que son madre e hija y conviven en la misma jaula.

En la segunda columna tenemos los datos de las observaciones. En la tercera, la hora en modo continuo (las observaciones se llevaron a cabo cada 10 minutos). En la cuarta columna hay la localización del oso en cuestión en la antigua jaula, y en la quinta, la conducta (en clave de números, que se explican a continuación).

Informaros que la instalación en que se basa nuestro etograma no es la actual, ya que recientemente el zoológico de Barcelona ha modificado la instalación de los osos.

Cualquier persona interesada en él puede utilizarlo para estudiarlo, pero os pediría que en vuestro trabajo se especificase que el etograma lo ha realizado AVAFES, y que nos enviaseis alguna copia.

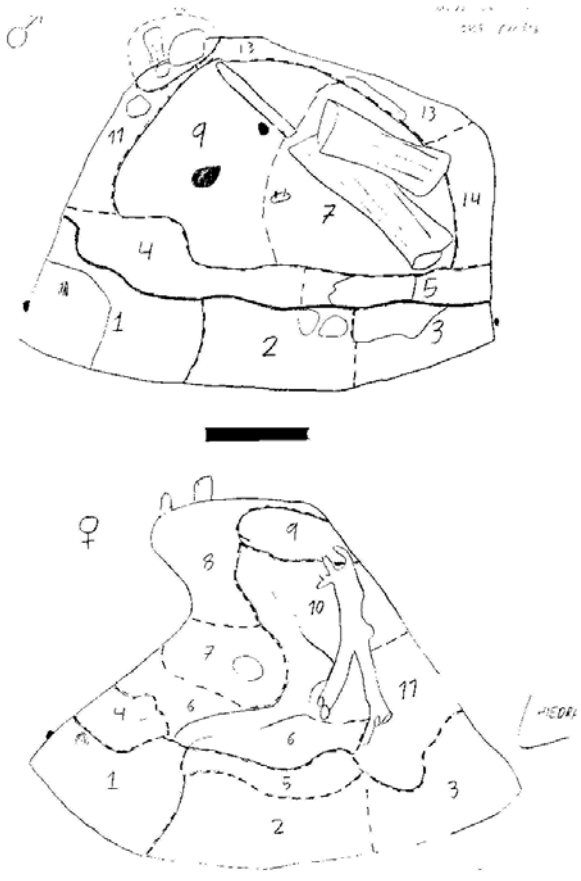
Las claves que se utilizan en el etograma son las siguientes:

1. *Tiempo muerto* (1): el animal está fuera del campo de visión del observador.
2. *Posturas / inactividad*:

***Sentado* (3): apoyado sobre los cuartos traseros, tanto con las manos apoyadas como no.**
***Descanso* (4): decúbito, durmiendo o despierto, ...**
***Estación* (27): el animal está erguido sobre las cuatro patas. Esta conducta se supedita a <u>todas</u> las demás.**
3. *Interacción con el ambiente*:
3.1 *Interacción con el público*.
***Circo* (5): el animal realiza acciones de cara a llamar la atención del público, responde a los estímulos de éste, se yergue, se apoya contra la pared, Apide@ comida.... Esta definición es prioritaria sobre las demás excepto la (6).**
***Chucherías* (6): forma de circo, el animal come golosinas lanzadas por el público, recogiéndolas del agua, atrapándolas al vuelo, ...**
3.2 *Interacción con el mobiliario* (7): rasca, muerde, olisquea el suelo, troncos y paredes.
3.3 *Interacción con compañera*:
***Iniciar agresión* (8): ante la presencia de la compañera, la osa inicia una conducta de agresividad, mostrando los dientes, vocalizando, e incluso acercándose amenazadoramente. Puede hacerlo tanto al acercársele la compañera como para desplazarla.**
***Responder a una agresión* (9): en respuesta a la conducta previa (8), el animal se encara con la compañera, mirándola directamente, y desplegando también una conducta agresiva.**
***Sumisión* (10): en respuesta a una de las conductas anteriores, el animal rehúsa el enfrentamiento y se somete, alejándose, apartando la mirada, bajando la cabeza, ...**
***Iniciar juego* (24):**
***Responder al juego* (25):**
3.4 *Interacción con otras jaulas* (11): el animal introduce la zarpa, el morro, husmea, introduce objetos (piedras), en los desagües posiblemente con el fin de explorar la jaula contigua, aunque también podría ser a modo de entretenimiento o por tratarse de una estereotipia.Convendría marcarla con un asterisco (*) cuando se trate de meter piedras.
3.5 *Husmear* (12): captar estímulos olfativos alzando la cabeza e inspirando aire. Esta conducta es prioritaria sobre las demás y únicamente se supedita a circo(5) y chucherías(6).
3.6 *Interacción con el cuidador* (23): el animal responde a los estímulos producidos por la presencia del cuidador.
3.7 *Erecto* (2): el animal está levantado sobre las extremidades posteriores (salvo cuando esté realizando alguna otra conducta; circo, husmear, ...). Únicamente es prioritaria sobre conductas de inactividad.
4. *Actividad:*
4.1 *Desplazamientos:*
***Paseo intranquilo* (13): se desplaza por la jaula a paso rápido, de manera continua, sin objetivo aparente, siguiendo algunas veces un circuito (recorrido realizado repetidamente).**
***Paseo tranquilo* (14): se mueve por la jaula a un paso lento, hacia un punto concreto de ésta.**

***Ida y vuelta* (15): estereotipia típica; el animal va y vuelve sobre un recorrido fijo, de pocos o muchos pasos, a veces sólo balanceándose alternativamente sobre las patas delanteras.**
***Carrera* (16): el animal arranca a trotar o galopar, en un recorrido generalmente corto, sin sobrepasar en mucho una vuelta a la jaula.**
***Trepar* (26): el oso trepa por los diferentes troncos.**
4.2 *Acciones reflejas*:
***Acicalado* (17): el animal se rasca, se lame, se mordisquea o se restriega contra el mobiliario.**
***Beber* (18): ingerir agua.**
***Coprofagia* (19): estereotipia que consiste en ingerir sus propias heces.**
***Comer* (22): ingestión de pienso o de la comida que deja el público (fuera de la conducta de circo); <u>Siempre</u> es prioritaria la conducta n16 sobre ésta.**
***Mascar* (28): el animal realiza movimientos masticatorios con la boca abierta, como si mascara chicle. Esta conducta es prioritaria sobre todas las demás excepto circo.**
4.3 *Baño* (20): introducirse en el agua, totalmente o sin sumergir la cabeza, excluyendo conductas de entretenimiento (pescar objetos, subirse al tronco...) y de acercamiento al público.
4.4 *Conductas de entretenimiento* (21): incluye perseguir pájaros, introducir objetos en la boca y también pasearlos por la jaula (piedras, hojas, envases, matas de pelo...), pescar objetos de la superficie o del fondo del agua (buceando), jugar con el tronco en el agua, saltar para atrapar la hiedra de la pared...

A continuación hay el esquema de las antiguas jaulas donde se hizo el etograma.



A continuación hay un ejemplo de enriquecimiento en osos.

ENRIQUECIMIENTO AMBIENTAL EN EL OSO.

ALIMENTACIÓN:

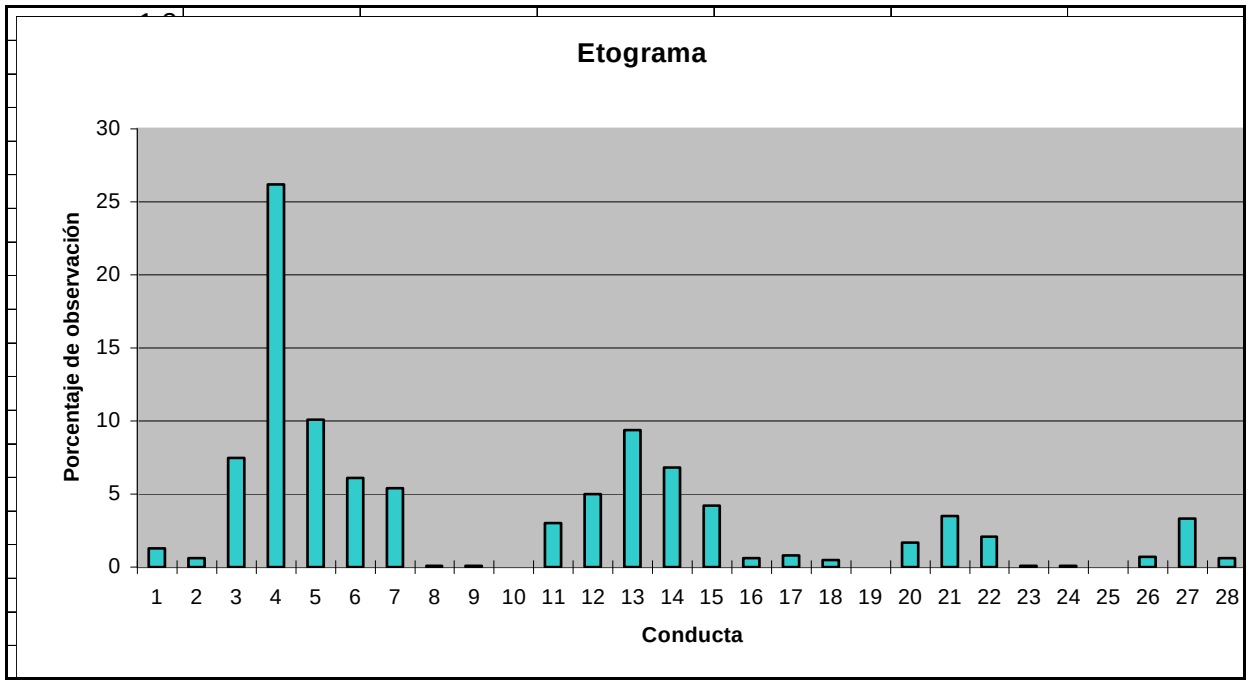
· **Comida en bloques de hielo.**
· **Alimentos dentro de objectos agujereados (miel, escarabajo...). Ej: troncos agujereados con una broca llenos de cacahuetes, mantequilla, miel, mermelada, uvas, nueces, comida de gatos, huevos hervidos, frutos secos, verduras...**
· **Caja agujereada con escarabajos, gusanos de la harina, grillos... que vayan saliendo aleatoriamente.**
· **Alimentación en diferentes momentos durante todo el dia.**
· **Ofrecer peces vivos y ratas vivas. Se puede educar al público para que lo acepten. También se pueden utilizar para otras especies (osos polares, nutrias, mamíferos marinos, felinos, rapaces, lobos...).**
· **Roedores congelados que les cuelgue la cola (como si fuese una asa)**
· **Carcasas enteras de conejos, pollos... en el dormitorio.**
· **Añadir ramas y rocas con agujeros y esconder la comida alli.**
· **En ranuras de troncos ponerle comida.**
· **"Barril" lleno de arena con comida enterrada (para cabar).**
· **Tuberias (con ganchos) enterradas parcialmente con comida dentro.**
· **Ofrecer melones, calabazas, cocos como comida y distracción.**
· **Cañas de maiz, cañas de azúcar.**
· **Frutas atadas a cuerdas.**
· **Huesos con trozos de piel.**
· **Mantequilla de cacahuete congelado, gelatina congelada...**
· **Berenjenas, sandias, tomates, bayas...**
· **Mostaza, ketchup, pimienta picante, ajo, salsas...**
· **Pasta preparada con: harina, agua, dog chow, sangre, miel... y distribuirla por la pared del recinto.**
· **Raices, piñas...**
· **Cañas de bambú con mermelada congelada con sabor a frutas.**

OTROS:

· **Olores diferentes anis, especias, perejil seco, "maggi"(gallina blanca), ajo en polvo...**
· **Hojas de arboles secas, astillas, serrin, cortezas de arboles...**
· **Objetos naturales para interaccionar (fijos y mobiles), rocas, arbustos, arboles...**
· **Ofrecer piel de diferentes animales (oveja, caballos...).**
· **Colgar objetos (con cuerda o sin ella).**
· **Cajas con ramas de pino y comida dentro.**
· **Sonidos naturales, vocalizaciones de otras especies, "música New Age", música melódica...**
· **Arbustos, arboles de Navidad...**
· **Ramas, paja...**
· **Rociar la jaula con agua antes de que entre el animal (rocio).**
· **Cambios de humedad (mangueras), cambios de radiación solar (sombras..).**
· **Duchas de agua.**
· **Pelotas de goma recubiertas con olores, trozos de comida (congelada o no), huesos pequeños, sangre...**
· **Boomer ball ® Activity ball (conec pet products).**
· **Madera parcialmente quemada.**
· **Cuerdas con pesos atados.**
· **Tablones superpuestos.**

· **Juguetes de plástico, conos de circulación, tubos de PVC flexible...**
· **Barriles de cerveza vacios.**
· **Intercambiar la jaula (entre los osos).**
· **Permitir la entrada de otros animales (cabras, conejos...) dentro de la jaula para que dejen olores, defecaciones...**
· **Dejar defecaciones de otros carnivoros, también mechones de pelo...**
· **Lugar vertical (árboles) para rascarse.**

Gráfico de la frecuencia con que se presentaron las conductas en nuestro estudio.



Las conductas menos frecuentes (≤0.1%) son las siguientes: iniciar agresión, responder a esta, sumisión (lógicamente si no hay agresión, no habra sumisión), coprofagia, interacción con el cuidador, iniciar juego, responder a éste.

Estas son las conductas más frecuentes.

Descanso	26.2%
Circo	10.1%
Paseo intranquilo	9.4%
Sentado	7.5%
Paseo tranquilo	6.8%
Golosinas	6.1%

[Datos y gráfica extraidos del estudio realizado por César González]

Estudio coordinado por Quim Marès, con la colaboración del Dr. Xavier Manteca (profesor titular de etología de la Facultad de Veterinaria de la Universidad Autónoma de Barcelona) .

Joaquim Marès (Responsable Etología, AVAFES)

Zoo Biology 22:269–285 (2003)

Activity-Based Exhibition of Five Mammalian Species: Evaluation of Behavioral Changes

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Activity-based management of captive animals involves the training and movement of animals among several exhibits and holding areas. We studied the effectiveness of this system in producing variation in behavior, controlling stereotypies, and eliciting natural behaviors. Twelve animals representing five species of mammals (orangutans, siamangs, tapirs, babirusa, and Sumatran and Siberian tigers) were the subjects of focal observations measuring activity levels, stereotypies, natural behaviors, and space utilization. Statistical analysis was used to assess the association between variation in behavior and the movement among the four exhibits. For several animals, the persistence of behavioral changes was studied over a period of 3 years. We also examined the influence of the previous animal in the exhibit on the focal animal. Moving animals among the exhibits affected activity levels and/or space utilization in all animals in the activity-based management system. In cases for which 3-year data were available, there was evidence of habituation to the novelty of changing exhibits. Stereotypies, usually in the form of pacing, were affected by exhibits, providing the opportunity to manipulate these behavior patterns by exhibit placement. Natural behaviors in the form of urine-spraying by the female tapir and the Sumatran tiger were affected by which animal had previously been in the exhibit. The results support the conclusion that exposure to varying exhibits produces variation in the behavior of the animals and elicits natural behaviors that would be unlikely to occur in a traditional single-species exhibit. Activity-based management provides

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unique opportunities for the behavioral enrichment of captive animals. Zoo Biol 22:269–285, 2003.

Key words: exhibit design; space utilization; natural behaviors; stereotypies; habituation

INTRODUCTION

A substantial body of evidence supports the notion that animals prefer moderate over low levels of arousal [Hebb, 1955; Mook, 1996]. In a natural environment, moderate arousal may be produced by stimuli associated with predators, prey, food, a social group, or a mate. Recent formulations of arousal theory based on human studies distinguish between energizing arousal and tense arousal [Thayer, 1989, 1996]. Energizing arousal results from events such as moderate exercise, feeding, and pleasurable social interactions. In contrast, tense arousal is elicited by aversive situations. Beneficial activation of behavior can occur with low to moderate stimulation that is either appetitive or aversive. An appropriate goal for enrichment of captive wild animals is adequate stimulation that approaches an optimal level of arousal during part of an animal's active period of the day. This can be accomplished in many captive situations through exposure to novelty, including stimuli of predators, prey, and conspecifics.

In the past few decades, the design of captive animal enclosures has increasingly incorporated features that approximate the animals' natural habitats. Activity-based exhibits are a recent example of this trend [Forthman-Quick, 1984; Coe, 1997]. This approach features a naturalistic setting wherein several animals may occupy the exhibits simultaneously or serially. The animals may be moved from exhibit to exhibit within a single day or from one day to the next. Over the course of these movements, the animals encounter a variety of environmental stimuli, including physical variation among the exhibits and the stimuli of previous animals. Movement within the activity-based design requires a structurally complex system of chutes and gates. Animals must be trained to move readily through these areas, providing additional stimulation for the animals. This contrasts with the traditional single-animal exhibit in which movement is limited to travel between holding areas and exhibit areas.

Enrichment through moderate arousal may be accomplished by variation in exhibits, encounters with other animals and their stimuli, and the training required to move through the structure. Training is likely to increase the amount of interaction between keepers and animals. It also elevates the quality of the interaction, as keepers make cognitive demands on the animals.

The benefits of the activity-based design may be decreased when the number of animals rotated through the exhibits exceeds the number of exhibits. In that case, an animal may spend more time in the holding area than it would in a single-species exhibit. Holding areas are typically smaller and have less variety in structure than exhibits. Consequently, the greater holding time may produce a longer period of low arousal than the traditional single-species exhibit. On the other hand, when an animal can spend some time off-exhibit, the efficiency of this method of exhibition can be realized. Eventually, we will need to determine the appropriate balance between increasing the number of animals and decreasing the exhibit time.

The present study was designed to evaluate the behavioral effects of activity-based animal management at the Louisville Zoo's "Islands" exhibit. We derived three predictions from the rationale for activity-based exhibits. First, we expected the differences among the exhibits to affect behavior. A change in behavior across exhibits would indicate that there is sufficient variation in exhibits to alter behavior. Second, we predicted a lower frequency of stereotypic behaviors than with a traditional exhibit. We expected the Islands exhibit to provide a good opportunity for movement and exploration, which would be reflected in the animals' use of space. Third, we hypothesized that the close association with other animals would elicit some species-typical natural behaviors, such as urine-marking, that may be only rarely observed in traditional zoo settings. In addition to these predictions, we also examined the relationship between the behavior of the animals and their time in holding areas and the frequency of training sessions with the keepers.

METHOD

Subjects

The subjects were four orangutans, two Malayan tapirs, two siamangs, two babirusa, and a Sumatran tiger in the Islands exhibit at the Louisville Zoological Garden. Animals were acquired and introduced to the exhibit at different times, as shown in Table 1. As a case study comparison, a Siberian tiger in a traditional single-species exhibit was also included in the study. The placement of animals in exhibits was determined by the keepers, based on training and husbandry considerations. This meant that observers were not able to observe each animal an equal number of times in each location. This report is based only on the cases in which there were sufficient observations for statistical analysis.

Each day in the Islands area, animals were moved to the exhibits before 1000 hr and were usually rotated in the early afternoon. Food was often placed in an exhibit before an animal was moved into it. In the traditional exhibit, the Siberian tiger was moved from the holding area to the exhibit in the morning and not returned until after the zoo closed at 1800 or 2100 hr.

Enclosures

In the Islands exhibit area, the holding enclosures were approximately 3×5 m and consisted of concrete walls on three sides and metal caging on one side. These facilities were relatively barren, with wood shavings in the hoof stock areas, a log in the tiger cage, a rope and hay in the primate pens, and shelves in each location. The orangutan holding areas also had items that could be manipulated by the animals. The hoof stock had restricted access to a separate pen with a pool area and a large ball. Animals were kept solitary in each of the enclosures, except for the siamangs and the two hybrid orangutans. There were chutes connecting the holding cages to the exhibit areas. Each animal was trained to move through these transfer chutes and into the exhibit areas.

There were three outside exhibits (numbers 1–3 in Fig. 1) and one indoor exhibit (number 4 in Fig. 1). The outside exhibit areas were much larger than the holding areas (combined area approximately 3,050 m^2) and were designed to be naturalistic settings, simulating the environment in which the animals would

TABLE 1. Subject information

Animal	Species	Sex	Date of birth	Date introduced to islands
Orangutan 1	*Pongo pygmaeus x abelii*, Bornean/Sumatran orangutan	Female	14 Oct 87	28 Apr 96
Orangutan 2	*Pongo pygmaeus x abelii*, Bornean/Sumatran orangutan	Male	14 Nov 87	28 Apr 96
Orangutan 3	*Pongo pygmaeus abelii*, Sumatran orangutan	Female	1 Jul 84	18 Feb 98
Orangutan 4	*Pongo pygmaeus abelii*, Sumatran orangutan	Male	21 Nov 87	30 Jun 97
Sumatran tiger	*Panthera tigris sumatrae*, Sumatran tiger	Male	28 Feb 91	1 May 96
Tapir 1	*Tapir indicus*, Malayan tapir	Female	29 Aug 94	1 May 96
Tapir 2	*Tapir indicus*, Malayan tapir	Male	4 Jan 95	10 Jun 96
Siamang 1	*Hylobates syndactylus*, Siamang	Female	27 Aug 89	26 Jun 96
Siamang 2	*Hylobates syndactylus*, Siamang	Male	23 Apr 89	20 Mar 97
Babirusa 1	*Babyrussa babirusa*, Babirusa	Female	26 Jun 90	1 Aug 96
Babirusa 2	*Babyrussa babirusa*, Babirusa	Male	2 Nov 93	18 Jul 96
Siberian tiger	*Panthera tigris altaica*, Siberian tiger	Female	30 Sep 85	NA

NA = not applicable.

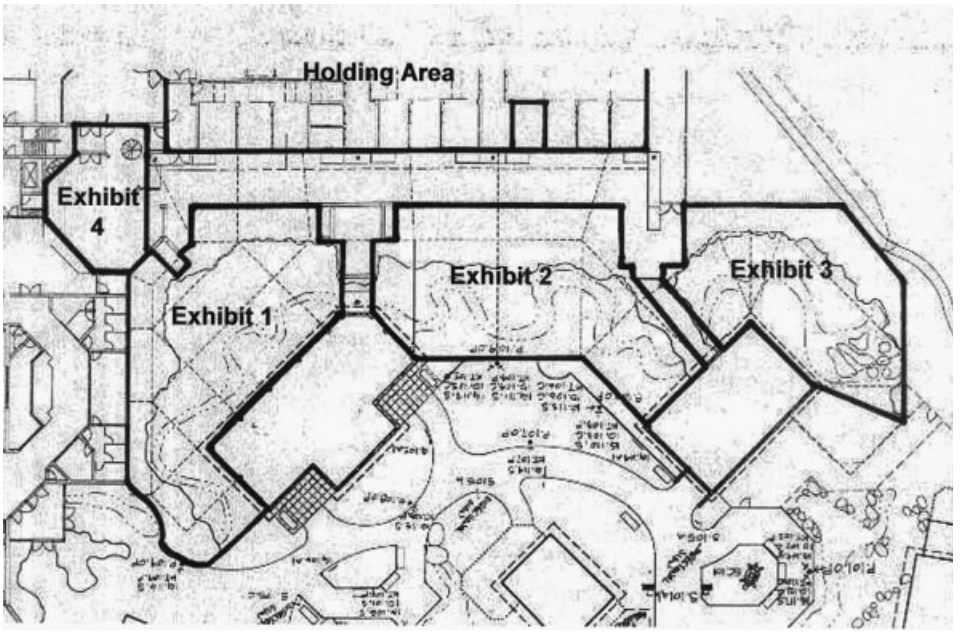

Fig. 1. Diagram of Islands exhibits and holding areas. Exhibits 1–3 were outside enclosures, and exhibit 4 and the holding area were inside.

normally be found. Each exhibit differed in shape, size, and configuration of enrichment items such as rocks, ropes, trees, and logs. A stream ran through each of the outdoor exhibits. At least one side of each of the enclosures consisted of a wall of glass that provided visitors with a view of the animals.

The indoor exhibit (#4) had a floor area of 75 m^2 and a vertical space extending 7.4 m. Large tree branches, ropes, and simulated bamboo provided substrate for climbing and access to a concrete ledge. This space was not available to the animals during the first summer of the study.

The Siberian tiger was housed in a separate exhibit at the opposite end of the zoo. This exhibit, set on a hillside, was approximately 2,590 m^2 and included a large freshwater pool at the bottom. There were also bushes and rocks that provided the tiger with considerable cover.

Observations

Four observers conducted the systematic observations: one during 1996 and two during 1997 and 1998. Focal animal sampling provided a continuous 10-min record of behavior. A total of 1,949 of these observations were conducted over the three summers of the study. The ethogram included mutually exclusive events within the categories of behavioral activity and utilization of the exhibit space (see Table 2 for behavioral categories).

The horizontal plane of each exhibit was divided into thirds from the left to right, and in half from front to back, making six sectors of horizontal space. Vertical space was divided into three categories: terrestrial, middle, and upper. Continuous

TABLE 2. Ethogram of recorded behaviors

Behavior	Definition
Eating	The animal put food in mouth or chewed an edible substance. Eating also included drinking and foraging behavior.
Locomotion	Movement of the animal that resulted in a change of location.
Stationary alert	The animal was motionless with eyes open and alert to surroundings.
Resting	The animal was motionless with its eyes closed.
Object manipulation	Use of any body part to pick up, move, or otherwise manipulate objects in the exhibit, such as sticks, toys, bags, etc.
Stereotypy	Repetitive behaviors that would not ordinarily be seen in the wild, i.e., pacing.
Spray	Urine was sprayed parallel to the ground from posterior of animal. (Recorded only for tigers and tapirs.)
Other	Any behavior exhibited other than those indicated, i.e., grooming, social interaction, etc.
Out of sight	Any time the animal was not visible or if observer was unable to see the specific activity of the animal.

recording provided information on the horizontal and vertical location of the focal animal.

The order for observing animals was randomly determined within the constraint that the observations of each animal were evenly distributed throughout the day. Holding-cage observations were conducted during the summer of 1998 when keepers were present during 2-hr periods of the late morning and middle afternoon. Holding-cage data were not collected for the Siberian tiger. Observations were recorded on Radio Shack model 100 laptop computers, using the Observer 2.0 program (Noldus Information Technology, Inc., Leesburg, VA).

Interobserver reliability tests were performed during the summer of 1998 when two observers worked simultaneously. A mean correlation coefficient of 0.94 (Pearson-product moment) was obtained from the 19 pairs of reliability observations. Only one assessment (0.56) had a correlation coefficient below 0.82. All animals except the female babirusa, and all exhibits were represented in the reliability tests.

We used SPSS for the two-way (summer $\times$ exhibit) analyses of variance (ANOVAs), and Statistix for the one-way ANOVAs and the nonparametric tests. For analysis, individual animals were considered the domain in which observations represented samples of behavior. Our criterion for rejecting the null hypothesis was a probability of 0.05. Space utilization was measured by adapting the spread of participation index (SPI) to the duration of time spent in each of the six horizontal sectors of the exhibits [Dickens, 1955; Shepherdson et al., 1993; Lyons et al., 1997].

RESULTS

Movement Among Exhibits

There were sufficient observations of orangutans 1 and 2 over two exhibits during the 3 years of the study to permit statistical evaluation of the effects of their exposure to activity-based management. In order to examine the role played by

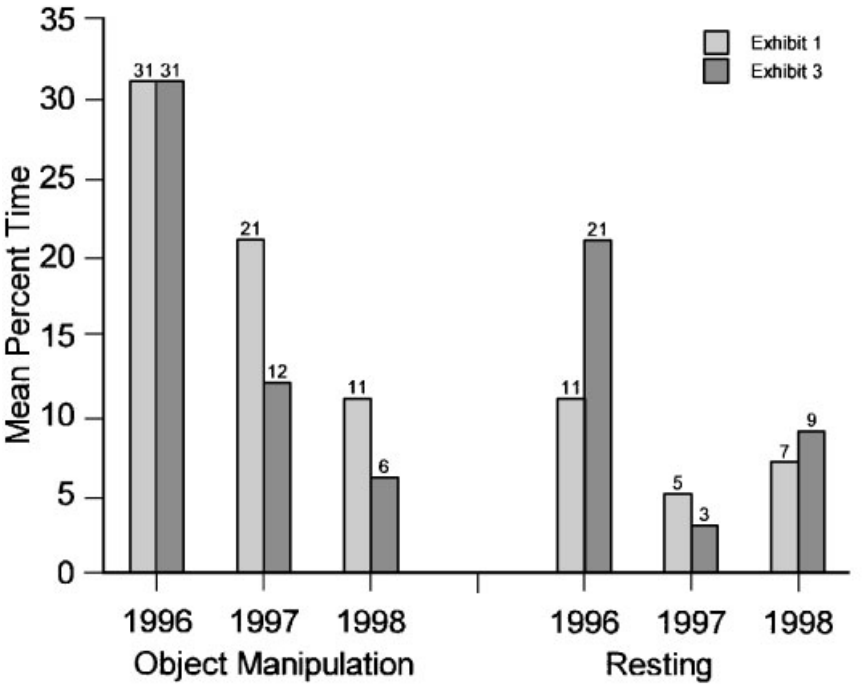

Fig. 2. Mean percent time spent in object manipulation and resting in exhibits 1 and 3 for orangutan 1. The mean is at the top of each bar.

exhibit changes over the 3 years, this analysis was limited to the two exhibits for which we had more than 10 observations during each summer. Orangutan 1, a female, showed a significant decline over the summers in object manipulation ($F(2,180)=5.77$; $P<0.01$) and in time spent resting ($F(2,180)=4.66$; $P<0.05$), but showed no significant differences in these behaviors across the two exhibits (see Fig. 2). Post hoc comparisons (LSD, $\alpha=0.05$) revealed that she manipulated objects more during the first summer than the second, and that she also rested more during the first summer than in both subsequent summers. There were also significant changes in her use of vertical and horizontal space over the three summers (Fig. 3). She was at the middle level, on rocks and ropes, more in the first and third summers ($F(2,180)=7.85$; $P<0.001$). The role of exhibits in producing differences in her vertical location was supported by an exhibit main effect ($F(1,180)=17.22$; $P<0.001$). The influence of exhibits was strongest in the first year and declined afterwards, as indicated by a significant exhibit $\times$ summer interaction ($F(2,180)=4.03$; $P<0.02$). Changes in the use of horizontal space are illustrated on the right side of Figure 3: orangutan 1 varied her behavior across exhibits, as seen in the significant exhibit effect ($F(1,180)=35.1$; $P<0.001$) and interaction ($F(2,180)=3.2$, $P<0.05$).

Orangutan 2, a male, also showed the strongest differences in behavior between exhibits in the first summer of the study. Figure 4 illustrates the mean percent time spent in object manipulation and in use of vertical space. Object manipulation differed significantly across exhibits ($F(1,176)=6.73$, $P=0.01$) and summers

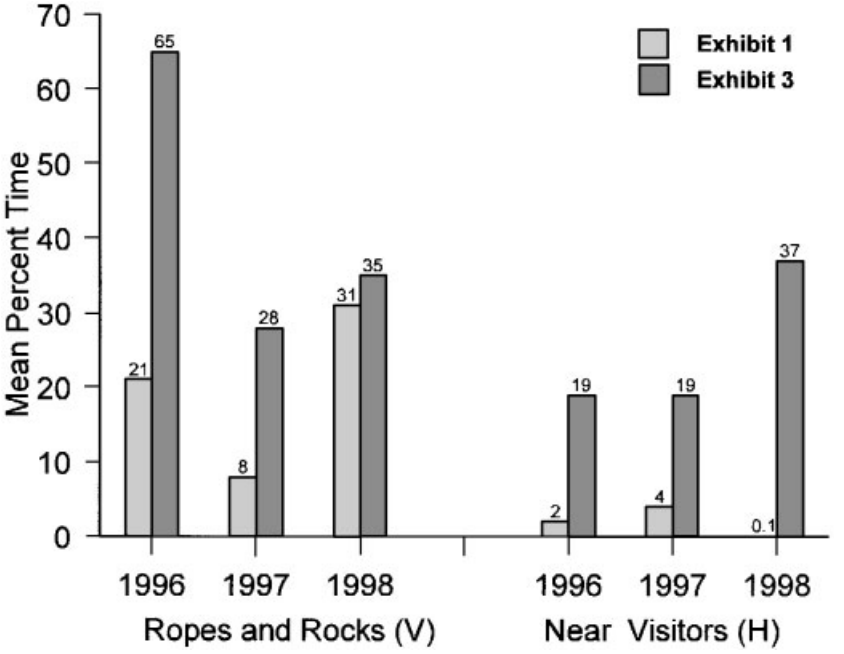

Fig. 3. Space utilization in exhibits 1 and 3 for orangutan 1. Time on rocks and ropes illustrates variation in the use of vertical space (V), and time near visitor areas shows use of horizontal (H) space. The mean is at the top of each bar.

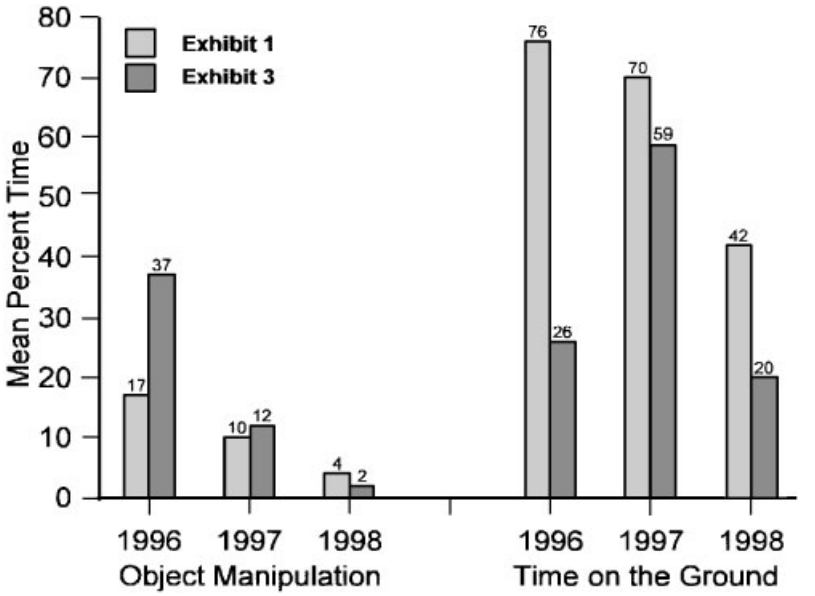

Fig. 4. Mean percent time spent in object manipulation, and time on the ground for orangutan 2 in exhibits 1 and 3. The mean is at the top of each bar.

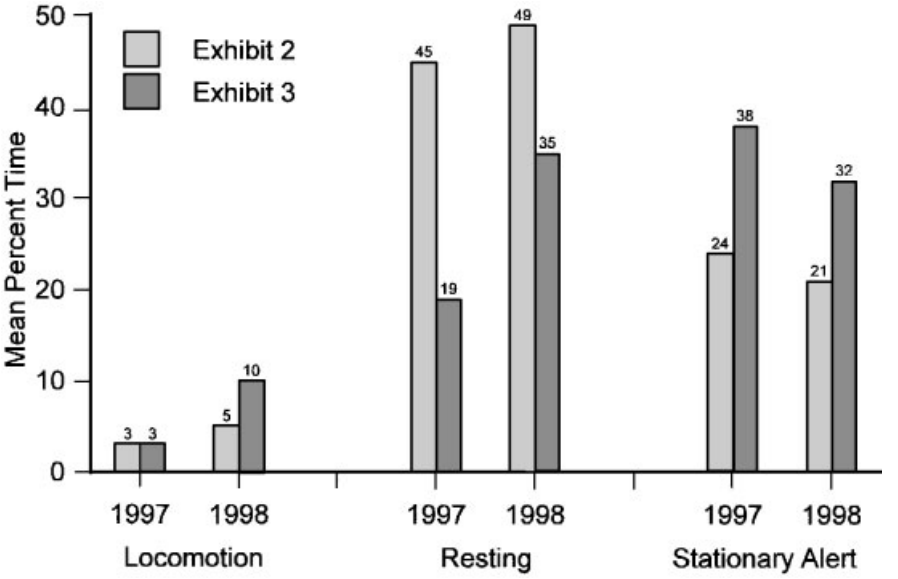

Fig. 5. Behavioral changes across summers and exhibits for the Sumatran tiger. The mean is at the top of each bar.

($F(2,176)=19.88$, $P<0.001$). The exhibit × summer interaction illustrates that the effect of exhibit declined after the first summer ($F(2,176)=3.40$, $P<0.05$). This orangutan also changed his use of vertical space as a function of exhibit and summer of observations. The mean percent time on the ground is shown in Figure 4. Statistically significant decreases were observed over the three summers ($F(2,176)=12.02$, $P<0.001$) and between exhibits 1 and 3 ($F(1,176)=22.43$, $P<0.001$). The summer × exhibit interaction was also significant ($F(2,176)=4.30$, $P=0.015$). Five of the six sectors of horizontal spaces also showed significant changes in use over the three summers and across exhibits (data not shown).

The Sumatran tiger was observed in more than one exhibit during the second and third summers, which allowed us to evaluate the effect of exhibit change on his behavior. This was evaluated with a 2×2 factorial design (summer × exhibit). Locomotion ($F(1,125)=4.60$, $P<0.05$) and resting ($F(1,125)=6.65$, $P<0.05$) showed significant increases from 1997 to 1998 (see Fig. 5). Stationary alert time varied significantly between exhibits ($F(1,125)=4.49$, $P=0.036$) but not across summers. Figure 6 summarizes three of the significant differences in space utilization. The tiger showed variability across exhibits in his time on the ground ($F(1,125)=11.14$, $P=0.001$), in the water ($F(1,125)=6.21$, $P=0.014$), and on the left side of the exhibits distal to the visitors ($F(1,125)=16.99$, $P<0.001$). This latter measure also revealed a summer main effect ($F(1,125)=20.86$, $P<0.001$) and an interaction ($F(1,125)=39.93$, $P<0.001$). Three other horizontal space measurements yielded significant exhibit effects.

Activity-Based Management Compared With Traditional Exhibition

The Sumatran tiger in the Islands area was compared with a Siberian tiger in a traditional single-species exhibit in order to evaluate the effects of activity-based

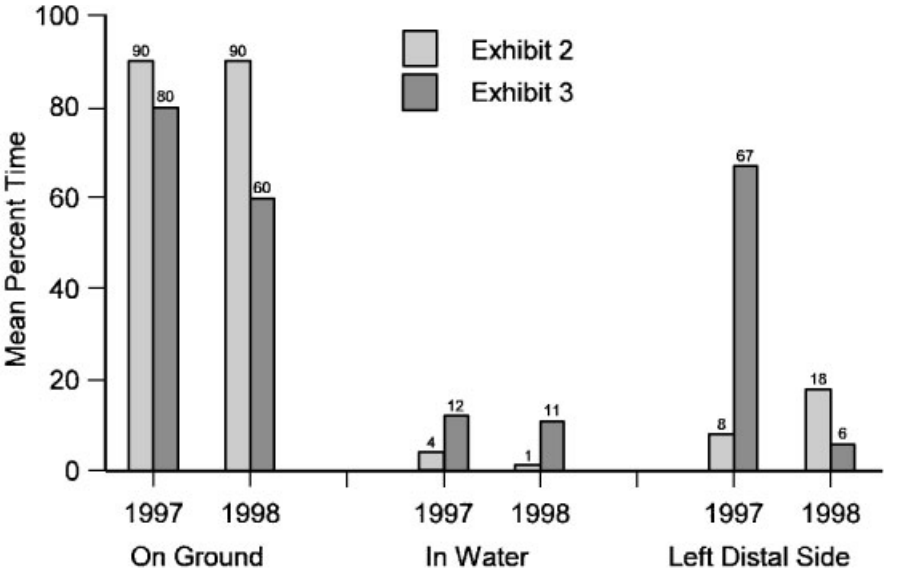

Fig. 6. Variation in space utilization across summers and exhibits for the Sumatran tiger. The mean is at the top of each bar.

management on patterns of locomotion. Although this comparison was confounded by species and sex, we found no differences in the percentage of time spent in most of the behavioral categories (locomotion, eating, and stereotypical pacing). The animals differed in only two categories. Percent time spent resting was significantly higher for the Siberian tiger (mean $\pm$ SD=52.20 $\pm$ 43.2) than the Sumatran (37.31 $\pm$ 41.6; $F(1,341)=9.48$, $P<0.01$). The category of other behaviors, which included species-typical behavior such as spraying, grooming, etc., was higher for the Sumatran (5.67 $\pm$ 13.83) than the Siberian tiger (1.69 $\pm$ 5.20; Kruskal-Wallis=12.53, $P=0.01$).

Natural and Unnatural Behaviors

Urine-spraying, a natural marking behavior for many mammals, was only observed once in 116 observations of the Siberian tiger in its traditional single-species exhibit, but was seen during 36 of 236 observations of the Sumatran tiger in the Islands exhibit. The proportion of observations with spraying was significantly higher with the Sumatran tiger ($Z=3.82$, $P<0.001$). The Sumatran tiger was never observed spraying during the 34 observations when he was the previous animal in the exhibit. However, he did spray during 36 of the 202 observations when another animal was the previous animal in the exhibit. In addition, his spraying was positively associated with his pacing ($\chi^2=63.26$, $P<0.01$, $\phi=0.52$). The Sumatran tiger was only seen spraying in the holding area during one of 26 observations.

The tapirs also sprayed. The female accounted for 78% of the tapir spraying. She did significantly more spraying when the tiger preceded her in the exhibit (mean=2.05) than when she followed another animal (mean=0.96, Kruskal-Wallis=4.84, $P=0.028$). The female tapir sprayed during 60 of 161 observations. Like the Sumatran tiger, the female tapir's spraying was significantly associated with pacing during the same observation. Twenty-five percent (16 of 60) of the spraying

observations included pacing episodes; whereas only 5% (five of 101) of the nonspraying observations included pacing ($\chi^2=15.65$, $P<0.001$). The male tapir did not pace enough for us to determine an association with spraying.

In addition to the tigers, stereotypic movements were observed in the tapirs, orangutans, and babirusa. Only the siamangs were without stereotypy in any location. The pacing of the Sumatran tiger and the tapirs was consistent across the exhibits and the holding area. Orangutans only exhibited repetitive movements while in the holding areas. Pacing by the babirusa was common in exhibit 3, less frequent in the holding area, and almost absent in the other exhibits.

Training and Holding Area

Although there was considerable variation among the animals of the Islands exhibit in the amount of time spent in the holding cages, there were no significant relationships between time spent in holding and the behavioral measures. We considered training sessions to include interactions between keepers and animals during movement among exhibits, and also those occasions when the animal was given a number of commands and reinforced for completion of the commands. No significant correlations were found between the number of training sessions in a day and general activity level, stereotypy, inactive behaviors, or the use of space. A time lag of 1 day also failed to show any relationships between training and other behaviors.

Space Utilization

Table 3 summarizes horizontal space utilization across summers and exhibits for each animal, using the SPI [Dickens, 1955]. The range of values for SPI is 0–1.0. A low SPI means that the activity (in this case the use of space) was widely distributed over the available area. A high score means the animal spent its time in one or a few sectors of its space. Apparently, there was a general decline in the use of space over the 3 years of the study. Pooling across all animals, the index increases from 0.28 in 1996 to 0.60 and 0.55 in the following 2 years. This same trend can be seen for some of the individual animals in specific exhibits (e.g., orangutans 1 and 2 in exhibits 1 and 3). In other cases, particular exhibits had very high scores for specific animals regardless of the year (e.g., tapirs and babirusas in exhibit 3 and the Sumatran tiger in exhibit 4). In contrast, the Sumatran tiger maintained a reasonably low score in exhibit 2 throughout the 3 years. For comparison, the Siberian tiger scored 0.51 and 0.64 for her use of the single-animal exhibit over the last 2 years of the study.

Activity Levels

Table 4 summarizes the mean percent time the animals were active or resting over the 3 years of the study. These values can be compared with the general activity and rest seen in other captive and wild studies of these species. The observation categories of "out of sight," "other," and "stationary alert" were not included in these figures. "Stationary alert" was not used as a separate category in the first summer of the study, when this behavior was included in the "other" category. Only three comparisons across summers were statistically significant. Orangutan 1 reduced her resting time after the first summer, but did not significantly change her activity. Orangutan 2 showed the reverse pattern with a decline in activity across

TABLE 3. Utilization of horizontal space (SPI)

Animal	1996			1997				1998			
	Exhibit 1	Exhibit 2	Exhibit 3	Exhibit 1	Exhibit 2	Exhibit 3	Exhibit 4	Exhibit 1	Exhibit 2	Exhibit 3	Exhibit 4
Orangutan 1	0.12	–	0.24	0.40	–	0.49	0.49	0.44	–	0.51	0.58
Orangutan 2	0.17	–	0.09	0.33	–	0.37	–	0.42	–	0.57	0.48
Orangutan 3	–	–	–	0.29	–	–	0.77	0.32	–	0.43	0.34
Orangutan 4	–	–	–	–	–	–	–	–	–	–	0.63
Siamang 1	–	–	0.50	–	–	0.86	0.84	–	0.79	0.53	0.67
Siamang 2	–	–	–	0.61	0.86	0.75	0.50	0.70	0.42	0.54	0.65
Tapir 1	–	–	–	–	0.18	0.83	–	–	0.30	–	–
Tapir 2	–	–	–	–	0.51	–	–	–	0.32	0.85	0.62
Babirusa 1	–	–	–	–	–	0.93	–	0.45	–	0.88	–
Babirusa 2	–	–	–	–	–	0.88	0.38	0.52	–	0.79	–
Sumatran tiger	–	0.49	–	–	0.40	0.69	0.86	0.47	0.22	0.64	–
Mean	0.20	–	0.37	0.41	0.49	0.72	0.64	0.48	0.41	0.64	0.57

Table 4. Activity levels over three years with results of Kruskal-Wallis (K-W) analysis of variance

Animal	Mean percent time active				Mean percent time resting			
	1996	1997	1998	K-W(*P*)	1996	1997	1998	K-W(*P*)
Orangutan 1 ♀	31.3	26.5	37.1	ns	30.7	17.9	11.8	15.0(0.01)
Orangutan 2 ♂	45.7	34.0	30.7	6.33(0.05)	15.8	10.1	4.9	ns
Orangutan 3 ♀	na	30.7	36.3	ns	na	3.0	4.8	ns
Orangutan 4 ♀	na	na	34.4	–	na	na	4.2	–
Sumatran tiger ♂	40.5	29.3	26.0	ns	50.7	37.6	42.8	ns
Siberian tiger ♀	na	30.5	29.8	ns	na	50.6	52.8	ns
Tapir 1 ♀	na	44.9	43.3	ns	na	25.4	28.9	ns
Tapir 2 ♂	na	26.9	31.8	ns	na	33.4	42.2	ns
Siamang 1 ♂	53.6	15.9	23.9	20.2(0.01)	13.8	6.7	9.0	ns
Siamang 2 ♂	na	20.3	19.5	ns	na	7.5	13.7	ns
Babirusa 1 ♀	na	83.4	78.9	ns	na	1.5	6.1	ns
Babirusa 2 ♂	na	74.9	83.9	ns	na	2.6	3.3	ns

*na = not applicable.
ns = not significant.

summers. The female siamang dramatically reduced her activity level after the first summer when the male was introduced. Her resting time also declined, because the pair spent much of their time embracing each other. These embraces were scored as "stationary alert."

DISCUSSION

Changing Exhibits Changes Behavior

Perhaps the most distinctive feature of activity-based management of wild animals is the movement of the animals among a series of exhibits during a period of hours or days. This movement adds variety and activity to the daily life of the animals. Consequently, it is expected to elicit variation in the behavior of the animals. Results from observations of orangutans 1 and 2 and the Sumatran tiger support the hypothesis that variation in exhibits produces variation in behavior. This was seen in the time the orangutans spent manipulating objects and resting. They also varied their use of space as a function of exhibit. These results indicate that activity-based management is having the intended effect. The ranges of time spent resting and moving were similar to those reported for wild orangutans [Mitani, 1989].

Captive management of orangutans has emphasized environmental conditions that encourage activity, such as providing movable objects that can be manipulated [Tripp, 1985; Perkins, 1992], and even forcing arboreal activity by flooding the floor of an exhibit [Hebert and Bard, 2000]. The Islands exhibit provided the former but not the latter. Although similar types of movable objects were available in the outside exhibits, there was a significant difference in the degree of object manipulation across the exhibits for orangutans 1 and 2. This exhibit difference may have been affected by the structure of exhibit 3, which encouraged closer proximity and greater attention to visitors.

The Sumatran tiger also varied his behavior across exhibits. The indoor exhibit, which did not have realistic representations of a natural habitat, and had the

smallest horizontal surface area, appeared to restrict the range of behaviors of the tiger. While in this exhibit he used very little of the space and spent a large proportion of the time resting. Lyons et al. [1997] reported that larger enclosures produced more movement in cats. Cats have also been shown to be responsive to naturalistic simulations [Gilkison et al., 1997; Shepherdson et al., 1993].

It is important to recognize that much of this variation in behavior declined across the three summers of observation. This was particularly evident in the time the orangutans spent manipulating objects and in their use of space. We have seen habituation after long-term assessment of other types of enrichment manipulations [Gilkison et al., 1997]. A program whereby novelty is introduced on a continuing basis may be necessary to provide optimal levels of stimulation in order to maintain desired behaviors.

Activity-Based Management and Natural Behaviors

The only cases in which similar species could be compared across modes of exhibition were the Sumatran and Siberian tigers. The former was in the activity-based Islands exhibit, and the latter in a traditional single-species exhibit. In spite of the differences in species, sex, and type of exhibit, there were only small differences in behavior. We had expected to see differences in stereotypic behaviors between these animals, but did not detect any in the duration of pacing.

We expected the Sumatran tiger in the apparently more stimulating Islands exhibit to spend less time resting and more time engaging in species-typical behaviors, such as urine-spraying. The results confirmed this prediction. However, the sex difference between the Sumatran and Siberian tigers may be more important than exhibit differences when it comes to urine-spraying. Male domestic cats spray more frequently than females [Bradshaw, 1992]. Female spraying appears to be closely tied to estrus.

The Sumatran tiger's urine-spraying was correlated with his pacing. Both of these behaviors were associated with the fact that another animal previously occupied the exhibit. This suggests that the motivational bases for pacing in the Sumatran tiger may have been different from those in the Siberian tiger. The Sumatran's pacing occurred at times of arousal, when it (apparently) detected the cues from the previous animal in the exhibit. This result is consistent with the expectation that activity-based exhibition can elicit natural behaviors by varying the environmental cues. In this case, the cues appear to be traces of other animals in the exhibits. Olfactory cues related to prey species have been reported to increase activity, social play, and chasing in captive African lions [Powell, 1995]. Environmental "channeling" or displacement [Rushen et al., 1993] may also have contributed to pacing when the tiger was aroused by evidence of previous animals in the exhibits. In contrast, the Siberian tiger's pacing was not associated with any apparent environmental events that might have been arousing.

Urine-spraying is a natural behavior of tapirs that has been associated with annoyance and territorial marking [Terwilliger, 1978]. In the current study, the female tapir's spraying was linked to her pacing and occurred most frequently when she followed the tiger in the exhibit. This type of exposure is likely to have a moderate impact on the arousal of the animal, providing appropriate stimulation for activation of behavior without the detrimental effects of high levels of tension [Thayer, 1996]. Olfactory cues are the most likely sensory evidence that the tiger had

been in the exhibit. The tapir's spraying suggests that she detected the tiger. This result is similar to the changes in behavior of African ungulates when exposed to the visual presence of a lion [Stanley and Aspey, 1984]. As with the African ungulates, the changes in the tapir's behavior occurred in a relatively infrequent behavior and not in the other categories of behavior, suggesting a mild impact on the behavior of the tapir.

Stereotypic behavior in the tigers, tapirs, and babirusa was in the form of pacing in a rigid, repetitive pattern. The Sumatran tiger and the tapirs paced in all settings. Because their pacing was not altered by exhibits or holding areas, and was observed soon after placement in the Islands area, these animals may have had well-developed stereotypies that originated in previous housing enclosures. A wide range of environmental and motivational conditions have been implicated in the development of stereotypies [for reviews see Mason, 1991, 1993; Rushen et al., 1993]. The unique features of the activity-based exhibit may have relatively little influence on well-established and pervasive stereotypies such as those of the Sumatran tiger. In contrast, the pacing of the orangutans and babirusa was highly influenced by the enclosure. Orangutans were only observed making stereotypic movements in the holding area. The babirusa paced frequently when in exhibit 3, but infrequently in other exhibits or the holding area. Of the three outside exhibits, number 3 had the smallest area of level ground. Movement throughout the exhibit required more climbing on rocks and ledges than in the other exhibits. The babirusa paced mainly on the small level space. It is likely that the restriction this placed on movement contributed to the "channeling" of behavior toward pacing [Rushen et al., 1993].

Activity and Space Utilization

Analysis of space utilization revealed the advantage of activity-based exhibition in providing exhibits that encourage wide use of available space and appropriate behaviors. Animals can be exposed to the variety of exhibits in the area and maintained in those that encourage desirable behaviors. For example, the Sumatran tiger used a similar or greater percentage of exhibits 1 and 2 than has been reported for tigers in other studies [Lyons et al., 1997]. However, this animal did not use the space very effectively in exhibits 3 and 4. Exhibit 2 appears to have been optimal for the tiger, given that he used half or more of the space and did not habituate in his use of space over the 3 years of the study. The high level of pacing by the babirusa in exhibit 3 coupled with the low use of space suggests that this exhibit may be inappropriate for the babirusa. The tapirs also used only a small portion of the horizontal area in exhibit 3. On the other hand, exhibit 3 did not appear to adversely affect the behavior of the siamangs. This information is helpful in the management of these exhibits and the design of future exhibits.

The activity level of the animals is often presented as a measure of the adequacy of the exhibit. Our results were similar to those of other studies. The Islands orangutans averaged somewhat lower activity and higher resting than reported by Mitani [1989] for noncaptive animals, but our results were all within 1 SD of the values reported by Perkins [1992] for 29 captive orangutans. The siamangs in the present study showed levels of activity nearly identical to those of the captive animals in Orgeldinger's [1997] study. The Islands tapirs spent slightly less time resting/sleeping, but the amount of time spent in active behaviors was similar to that

in captive South American tapirs [Mahler, 1984]. The babirusa were much more active than their counterparts at the Jersey Wildlife Preservation Trust [Bowles, 1986].

The current activity and space utilization results do not suggest any dramatic departure from the results of other types of exhibits. However, they indicate habituation in several measures to the novel exhibits over a period of 1–3 years. Unfortunately, few studies have conducted long-term evaluations. Habituation may be minimized by the introduction of novel objects and training practices. We found no evidence that the activity-based exhibit had detrimental effects on the animals. As indicated above, several important benefits can be derived from this exhibit design.

CONCLUSIONS

1. Activity-based exhibits increased variability in the behavior of the animals.
2. Activity-based exhibits encouraged the occurrence of natural, species-typical behavior in the form of urine-marking by the Sumatran tiger and the female tapir. There was also evidence for stimulation of object manipulation by orangutans in the first year of the exhibit.
3. Habituation to some changes in behavior occurs over a period of 3 years.
4. Activity-based designs provide a unique opportunity for keepers to select the best exhibit(s) for stimulating desirable behaviors.
5. Activity-based exhibits allow more animals per exhibit area than a traditional exhibit. We found no evidence of detrimental effects from this arrangement, even though it may mean more time spent in holding cages than occurs in a traditional exhibit.

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To Hunt or Not to Hunt? A Feeding Enrichment Experiment With Captive Large Felids

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It is often difficult to promote the successful performance of feeding behaviors in zoos, especially for carnivores. Feeding enrichment provides these opportunities and often improves behavioral indications of an animal's well-being and the experience of the zoo visitor. The effectiveness of two different feeding enrichment techniques was evaluated on five subjects in two species of felids: African lions and Sumatran tigers. The activity budgets of each cat were compared before, during, and after enrichment, focusing on activity levels, frequency and variety of feeding behaviors, and occurrence of stereotypic behaviors. The presentation of live fish increased the variety and frequency of feeding behaviors, while presentation of horse leg bones increased the frequency of these behaviors. Fish reduced the tigers' stereotypic behavior from 60% of scans to 30% of scans on the day of presentation, and this change was maintained for 2 days following enrichment. Bone presentation also reduced stereotypic behavior and increased nonstereotypic activity in both species. Both of these techniques appear to have sustained effects on behavior lasting at least 2 days after presentation, which may indicate their ability to alter the animals' underlying activity patterns. Zoo Biol 22:189–198, 2003. © 2003 Wiley-Liss, Inc.

Key words: environmental enrichment; carcass feeding; live feeding; visitor experience; well-being

According to Maple [1995, p. 24], "zoo professionals take seriously their obligation to minimize animal stress, boredom, trauma and disease." Feeding enrichment is designed to provide animals with an opportunity to use natural foraging strategies to obtain food in captivity. In the traditional zoo, animals were fed scheduled meals once or twice a day [Shepherdson et al., 1993]. While these foods

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had the appropriate nutritional content, proper feeding also includes an opportunity for animals to use their natural feeding behaviors [Holst, 1997; Lindburg, 1998]. In primates, feeding enrichment has been documented to increase foraging time [Chamove, 1981; Chamove et al., 1982; Tripp, 1985; Maple and Finlay, 1986; Bloomsmith et al., 1988; Brent and Eichberg, 1991], decrease aggression [Chamove et al., 1982; Boccia et al., 1984; Bloomsmith et al., 1988; Brent and Eichberg, 1991], and reduce abnormal behavior [Chamove et al., 1982; Gould and Bres, 1986; Bloomsmith et al., 1988; Brent and Eichberg, 1991; Bayne et al., 1992; Bloomsmith and Lambeth, 1995]. Similarly, in bears, the opportunity to work for food in a species-appropriate manner has increased activity [Forthman et al., 1992], as well as reduced passivity [Forthman et al., 1992], agonistic interactions [Markowitz, 1982], and stereotypic behavior [Carlstead et al., 1991; Forthman et al., 1992]. Scientific evaluation of feeding enrichment in felids is needed [Carlstead and Shepherdson, 1994], as the published literature contains mostly anecdotal data [e.g., Bacon, 1992; Hare and Jarand, 1998].

Some simple feeding-enrichment procedures have been documented to change the behavior of felids. For example, in African lions, the provision of ice balls increased standing, locomoting, sniffing, licking, gnawing, and paw manipulation [Powell, 1995]. Several other enrichment studies on cats have revolved around elaborate devices to provide simulated hunting opportunities, and have decreased pacing, instigated hunting behavior, and increased activity, jumping, pouncing, rolling, and visibility to the public [Markowitz and LaForse, 1987; Markowitz et al., 1995]. A fishing cat (*Felis viverrina*) provided live fish showed decreased sleeping and increased hunting behaviors, behavioral diversity, and use of space after fish presentation, and hunting behaviors were still present 7 days later [Shepherdson et al., 1993]. The occasional use of live prey has been recommended as a strategy to reduce stereotypic behavior that is associated with displaced feeding behavior [Dierenfeld, 1987], and anecdotal evidence suggests that tigers, jaguars, and ocelots also perform hunting behaviors when exposed to live fish [Mellen et al., 1998].

Improving animals' well-being has been operationally defined as reducing stereotypic, undesirable, and hyper-aggressive behaviors, and increasing activity and species-specific behaviors [e.g., Markowitz and LaForse, 1987; Bloomsmith et al., 1988; Forthman et al., 1992]. In the current study, neither undesirable (but not stereotypic) behavior nor hyper-aggressive behavior were observed in the animals; therefore, they will not be used as indicators of well-being. A third measure of welfare, increased activity, is more controversial, because it may not be associated with increased welfare in every case [Mason, 1993]. In this study, increased activity as an indicator of well-being had to meet two criteria: it must not be stereotypic, and it must be changing in the direction of the activity budget of the animal's wild counterparts. Stereotypy, activity, and species-specific appetitive behaviors are used here as behavioral indices of well-being.

Appetitive behaviors make up a large portion of the behavioral repertoire of wild felids. The majority of the activity of wild cats revolves around obtaining food [Schaller, 1972; Dierenfeld, 1987], and they seem to be strongly motivated to perform appetitive behaviors [Shepherdson et al., 1993]. Lindburg [1988] divided these appetitive behaviors into four classes: 1) locating, 2) capturing, 3) killing, and 4) consuming prey. In the wild, lions and tigers usually stalk their prey and then rush from a short distance away or lie in wait and ambush prey as it walks by

[Guggisberg, 1975; Seidensticker and McDougal, 1993]. These species usually hunt at dusk or at night, presumably to provide themselves with greater camouflage in their attempts to sneak up on prey [Schaller, 1967, 1972]. Despite spending an average of 21 hr asleep, lions will "readily hunt, mate, and feed at all times of the day" [Sankhala, 1977, p. 120] in the wild, and tigers have also been observed engaged in these activities during daylight hours.

This study aimed to implement two simple enrichment procedures designed to elicit feeding behaviors common in wild cats. The presentation of live fish was tested on Sumatran tigers (*Panthera tigris sumatrae*), and bone provisioning was tested on both African lions (*Panthera leo*) and tigers. Across species, three main goals were manifest: to allow the successful use of appetitive behaviors, to increase activity, and to decrease stereotypic behaviors. We hypothesized that enrichment would increase appetitive behaviors and decrease stereotypic behaviors on the day of provision. We also expected an increase in active behaviors and a decrease in stereotypic behaviors over the day of enrichment and the following 2 days. Finally, we predicted an increase in time spent in areas associated with enrichment and visible to the zoo visitor.

METHODS

Subjects and Their Husbandry

The subjects in this experiment were one male and two female African lions, and one male and one female Sumatran tigers. All resided at Zoo Atlanta and were fed Nebraska Feline (Central Nebraska Packing, Inc., North Platte, NE) diet (ground, processed, whole-carcass horsemeat) 6 days a week. To simulate their irregular eating pattern in the wild, they were not fed on the 7th day of the week, but instead received a horse leg bone with a small amount of meat still attached. From 0900 to 1700 hr, the two tigers were housed separately in outdoor areas where they were on display to the visiting zoo public (hereafter referred to as "on-exhibit"). The three lions were housed in a similar type of outdoor area and in an indoor/outdoor area without public access (hereafter referred to as "holding"). The lions were housed separately by sex, so the male and females spent alternating days in the on-exhibit space. For this reason the lions were observed in both the on-exhibit and holding spaces. During this study, the male lion and tiger had visual and olfactory, but not tactile, access to their female conspecifics.

Experimental Conditions

There were four conditions in this experiment, and each condition was 4 weeks in duration. 1) All subjects were first observed in a baseline condition, prior to any manipulation. This baseline included observations of tigers on exhibit, lions on exhibit, and lions in holding. The experimental manipulations were completed under two conditions, and there were eight presentations of each enrichment to each subject. 2) Bones were supplied to tigers and lions twice per week during the day. Observations were conducted on tigers on exhibit, lions on exhibit, and lions in holding. The bones were placed on exhibit in the area most visible to the public, before the animal came outside for the day. In the case of lions remaining in holding, bones were provided on a concrete surface before the cat was allowed access to that portion of the enclosure. 3) Live fish were supplied twice a week to tigers on exhibit,

in shallow water pools. Fish were placed beside the pools immediately before the cats were allowed access to the exhibit area. Typically, the fish flopped into the water as the cat was entering the exhibit area or shortly thereafter. The decision to place fish beside the pools rather than in them was based on the notion that the fish would go unnoticed in the water, while their movement on the bank would attract the cats' attention. 4) A final post-manipulation baseline condition was conducted for tigers only. This was done to allow assessment of possible behavioral differences associated with change in ambient temperatures from the initial baseline condition.

Preliminary data indicated that interactions of tigers with fish occurred immediately upon presentation and lasted about 10 min. The presentation of fish early in the day and the short duration of the tigers' responses suggested that the value of this form of enrichment might not be adequately represented in the planned data collection. For this reason, an extra 30 min of data were collected when tigers were provided fish, adding 8 hr of data to the dataset. Reaction to bones occurred over the hour after they were presented and lasted at least 45 min, so this was adequately represented in the data.

Data Collection

Each cat was observed for 1-hr sessions with instantaneous scans of the behavior of all individuals in an exhibit at 1-min intervals [Altmann, 1974]. As the cats were usually undisturbed from 0930 to 1630 hr, the data recording sessions were performed at 1000–1200 hr, 1200–1400 hr, and 1400–1600 hr. At least six 1-hr sessions were recorded for each cat in each time interval, location, and condition. These data were collected from the public viewing areas when the animals were on exhibit, and from the side of the enclosure or inside the holding building when they were in holding. Eleven data collectors collected a total of 540 hr of data (for ethogram, see Bashaw, 2000]. An inter-observer index of concordance between the primary observer and each of the others of 88.5% or greater was achieved in 1 hr of simultaneous data collection [Martin and Bateson, 1986].

Data Analysis

In all tests, the $P<0.05$ criteria was used to establish statistical significance. Data from the two baselines collected on tigers were compared using within-subjects *t*-tests, and combined for subsequent analysis. Then, data from all cats were used to assess changes in behavior in each enrichment condition compared to baseline data. Because the data did not appear to be normally distributed, the number of subjects was small, and a repeated-measures design was used, nonparametric statistics were employed [Runyon and Haber, 1984]. The level of nonstereotypic activity was computed by calculating the number of scans in which cats were either locomoting or engaged in active behavior. The Friedman's test, the nonparametric equivalent of a repeated-measures analysis of variance (ANOVA), was used to evaluate differences in activity, visibility, and levels of stereotypic behavior under each condition, as well as to determine whether graphically apparent differences in behavior were significant. Wilcoxon signed-ranks tests, which evaluate the difference between two samples based on the magnitude and sign of the differences between each pair of scores in a correlated sample, were used to evaluate differences between baseline data and the day of enrichment presentation. Wilcoxon tests were also used to compare

morning baseline data to the morning session in which enrichment was provided [Runyon and Haber, 1984].

RESULTS

Although visual trends were apparent in much of the data, few significant differences were detected, perhaps in part because of the low power inherent in the small sample size. Comparing baseline, treatment day, and each of the two subsequent days, no statistically significant differences were found for fish presentations (see Fig. 1), though graphs reveal an approximately 50% reduction in pacing maintained across the 2 days following treatment for these two animals. With only two animals, we can not claim statistical significance (P=0.308), but had we observed six animals, and all had shown a similar decrease, such results would be significant at the 0.05 level. For bone presentations, data for all cats reveal no

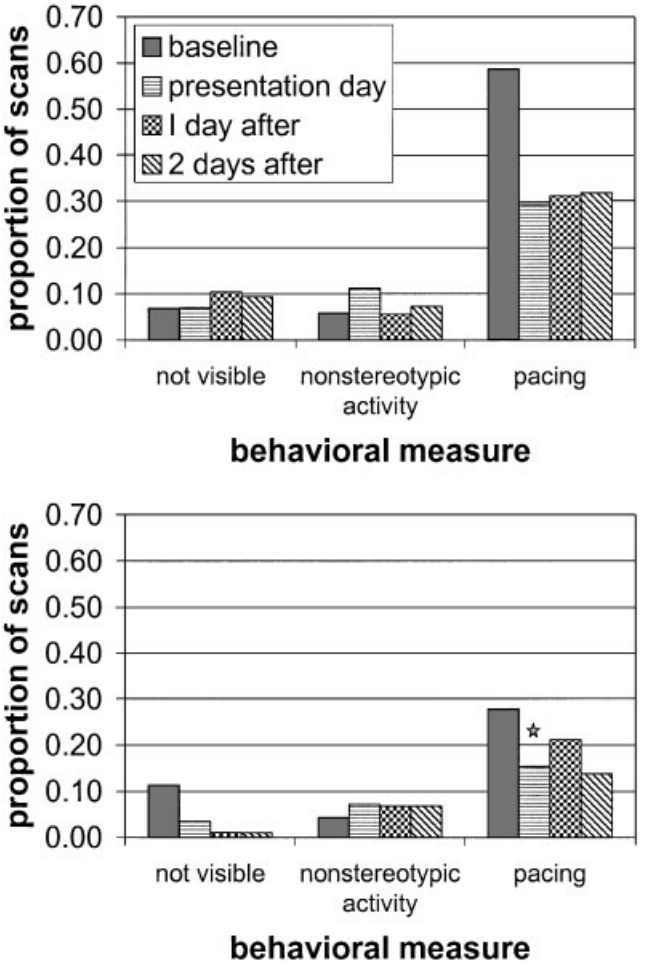

Fig. 1. Effects of provision of live fish to tigers (top), and bones to lions and tigers (bottom) on behavior. Stars represent significant differences from baseline.

significant differences (see Fig. 1), although trends toward effects on stereotypy (P=0.095) and nonstereotypic activity (P=0.077) were apparent. Data for the lions only showed decreased resting the day of presentation (from 38% of scans in baseline to 30%), followed by increased resting the next 2 days (44% and 50% of scans, respectively, P=0.042). Lions also showed increased nonstereotypic activity (from 3% in baseline to 9% the day of presentation and 5% each of the next 2 days, P=0.045) and a nonsignificant trend toward a difference in consumption (3% of scans on presentation days, never observed on other days, P=0.082). When data for the day of presentation were isolated, fish had no effect, whereas bones significantly reduced stereotypic behavior (Fig. 1, P=0.043). On the morning of presentation, bone presentation increased the proportion of scans spent resting but awake (from 38% to 65%, P=0.045), increased standing (5% to 14%, P=0.045), and increased consumptive behavior (from none to 3%, P=0.045), but fish caused no significant change in overall behavior patterns. Morning fish sessions, however, saw the occurrence of several appetitive behaviors never observed in the other conditions: crouching, pouncing, swiping, and biting. Watching, holding, and eating, which were not observed in the baseline, were seen in both bone and fish morning observations. In addition, carrying was observed with bones but not with fish or in the baseline.

DISCUSSION

Providing bones and live fish successfully elicited behavioral changes in captive lions and tigers. Consumptive behaviors increased with bone provision, and live fish presentation elicited capturing, killing, consumptive, and caching behaviors on the morning of presentation. There was also a nonsignificant trend toward reduced pacing with both fish and bone presentations, and a trend toward an increase in nonstereotypic activity with bone presentation. Although these findings did not reach statistical significance, changes were as much as 50% from baseline values. The trend toward an increase in time spent visible to zoo visitors with bone presentation may be large enough to have practical significance for the visitor experience. The enriched conditions had a few long-term effects, including a significant effect on resting in lions when they were given bones. Nonsignificant long-term trends were also present in stereotypic behavior (for both species and both conditions), in visibility (for both species and both conditions), in activity (for both species in the bone condition), and in consumption (for lions in the bone condition).

These effects corroborate and extend the results of several other enrichment procedures evaluated on felids. First, they emphasize that although they spend much of their time sleeping or engaged in stereotypic behavior, big cats do benefit from enrichment opportunities. Two advantages of these techniques are their small demand on keeper time and the lack of a mechanical apparatus, which obviates the need for repairs or maintenance by keepers on a tight schedule [Hutchins et al., 1984]. The presentation of bones and fish in this experiment also allowed the appetitive behaviors expressed to be rewarded with feeding opportunities. The increase in appetitive behaviors over those observed in baseline indicates that our enrichment procedures provided the cats with an opportunity to successfully express appetitive behaviors. The presentation of live fish was the more effective of the two techniques at increasing the variety of appetitive behaviors performed. These empirical data on the response of tigers to live fish, previously only anecdotally

described [Mellen et al., 1998], suggest that the presentation of live fish should be evaluated in a larger population to increase the generalizability of the results.

This study provides an example of the importance of evaluating the long-term effects of enrichment. In addition to studying the reaction of an animal to the enrichment procedure or device when it is present, evaluation of behavioral changes that occur in the animals' overall activity budgets is also important. In this study, the increase in feeding behaviors constitutes a reaction to the physical addition of the enrichment, but the changes in stereotypic behavior, used in part to monitor welfare, were not limited to periods in which the enrichment was present. Without evaluation at times when enrichment is not present, it is impossible to distinguish between procedures that cause a temporary behavior change only while they are present and those that cause sustained change outside the time at which enrichment is present. Forthman and colleagues [1992] identified an example of a temporary enrichment effect when Kodiak and polar bears provided with ice blocks and "fishcicles" showed dramatic behavior changes during enrichment, but no effect 5 hr later. However, Moodie and Chamove [1990] identified a sustained effect: brief presentations of predator silhouettes or removal of a group member resulted in changes in tamarins' behavior for the remainder of the day. In the current study, bone provision is an example of a more sustained and generalized enrichment effect, as the resulting changes in resting and trends in stereotypic pacing, nonstereotypic activity, consumption, and visibility over the 3-day period of observation suggest that bone provision altered the underlying behavior pattern of the cats.

Long-term evaluation is rarely performed because it is very time-consuming and frequently reveals little effect. Schapiro and colleagues [1995, 1996] collected 4,700 hr of data to discover a lack of overall behavioral effect from the presence or absence of enrichment over a 3-year period. However, important differences in behavior, including differences in mother–infant behavior in rhesus macaques under varying levels of foraging demand [Rosenblum and Paully, 1984] and increased locomotion/exploring behavior when leopard cats were fed multiple hidden meals [Shepherdson et al., 1993], would not have been revealed had the sustained effects of enrichment not been evaluated. Because behavior is never altered in isolation, future studies should continue to document the effects of enrichment outside of the time in which it is presented.

Enrichment in zoos must strike a balance between the optimal living conditions of the animals and the quality of the visitor experience. The effect of enrichment projects must therefore be evaluated on both of these scales. Stereotypic behavior and inactivity may indicate compromised animal well-being and produce a compromised visitor viewing experience. The decrease in stereotypic behavior and the trend toward increased nonstereotypic activity in our study should affect both sides of this balance. It has been suggested that stereotypies arise in environments that do not allow the performance of a highly motivated behavior pattern to reach its endpoint [Hughes and Duncan, 1988]. If stereotypies result from a lack of connection between an animal's behavior and its environment, it is not surprising that creating an environment in which the reward of eating is contingent upon hunting behavior (as in nature) reduces the performance of these stereotypies.

The increase in variety and occurrence of appetitive behaviors with the presentation of fish, and the increase in frequency of appetitive behaviors with the presentation of bones are also positive changes for the animals' well-being. Many of

the anecdotal accounts of carnivore enrichment have highlighted the feeding of whole- or partial-carcass meat [e.g., Hare et al., 1996]. The physiological consequences of feeding only processed meat diets include reduced influence of the jaw and neck muscles on skull shape in development [Duckler, 1998], greater gingival health problems, greater plaque formation, and more focal palatine erosion [Fitch and Fagan, 1982; Lindburg, 1988]. All of these problems are alleviated by carcass feeding opportunities. Carcass feeding has been demonstrated to increase feeding behaviors and decrease stereotypic behavior [McPhee, 1998], increase approaching, feeding, exploring, and processing food [Bond and Lindburg, 1990], and increase feeding duration and produce a wider variety of feeding behaviors [e.g., Ziegler, 1995; Hare et al., 1996]. Considering the similarity of these behavioral results to those obtained with bone presentation in this study, bones may function as a simplified and convenient form of carcass feeding.

Although the changes associated with bone provision are beneficial, the behaviors elicited by this opportunity, much like those elicited by carcass feeding, have all been associated with the consumption of food [Lindburg, 1988]. It would be more desirable to elicit behaviors from other categories of appetitive behavior, as accomplished by presentation of live prey, such as the live fish used in the present experiment and in other anecdotal reports [e.g., Hare et al., 1996; Hammond, 1998]. Providing live food may also be more educational for the public, who would get an opportunity to see carnivores engaged in the hunting and consumption of prey.

The time the animals spent in areas visible to zoo visitors in this study may have increased because the on-exhibit manipulations all rewarded the cats for going to the area of their exhibit where they were most easily seen. In fact, the intermittent nature of the presence of the stimuli may have resulted in a greater increase in visibility than continuous reinforcment for being in the same area would have. That the trend toward increased visibility was present even with bone presentation is especially interesting, since the bones were not restricted to visible areas of the exhibit. The cats could easily have picked up the bones and moved them to a different resting place, but anecdotal observation suggests that the animals spent most of their day where the enrichment was placed.

The results of this study support prior investigations into the role of feeding enrichment in improving the psychological well-being of animals and the visitor viewing experience. Carnivores in zoos should continue to be provided with their food in ways that allow the successful expression of a variety of appetitive behaviors to promote more naturalistic behavior. This naturalistic behavior will help educate the public about how these animals interact with their environment in the wild, thereby promoting conservation of not only the animals, but also their habitat [Maple, 1995]. In addition, maintaining a more complete behavioral repertoire is a contribution to preserving behaviorally competent animals in zoos, in case these animals should be needed to reinforce the wild population [Foose, 1987; Castro et al., 1998].

CONCLUSIONS

1. Bone presentation increased the performance of consumptive behaviors in lions and tigers, and its effects on behavior extended beyond the time when bones were present.

2. The presentation of live fish to tigers increased the frequency of a variety of appetitive behaviors in all categories, and also may have had sustained behavioral effects.

3. Long-term evaluation of enrichment can be used to distinguish between temporary effects from enrichment and procedures that result in sustained and generalized behavioral changes that affect an animal's overall activity budget.

4. Feeding enrichment for lions and tigers improves both the well-being of the cats and the experience of the zoo visitor.

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The Effects of Physical Characteristics of the Environment and Feeding Regime on the Behavior of Captive Felids

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The behavior of captive felids is influenced by enclosure design and management regime. The behavior of nine felid species housed in 11 enclosures was recorded using instantaneous scan sampling. Stereotypic pacing was observed in 15 out of 19 individuals. Size of enclosure did not affect pacing behavior, but edges of enclosures were found to be used specifically for pacing behavior. Cats in relatively larger enclosures had a higher level of apparent movement, but only about 50% of enclosure space was used. Raised areas such as tree branches were found to be preferred sites in enclosures, particularly for observation of surroundings. The feeding regime was found to affect stereotypic pacing levels. Cats fed on a 3 day cycle paced more on fast days than on days they were fed. Although not statistically significant, 6 out of 7 of these cats paced more in the hour after feeding, whereas the cats fed daily paced more in the hour before feeding. Further research is required to understand the relationship between feeding and stereotypic behavior. Zoo Biol 16:71–83, 1997.

Key words: stereotypic behavior, activity, enclosure utilization

INTRODUCTION

Keeping animals in restricted environments affects their normal behavior patterns through the absence of appropriate eliciting stimuli or functional consequences (Markowitz, 1982; Wilson, 1982). Abnormal behavior patterns not seen in the wild are well documented (Meyer-Holzapfel, 1968; Shepherdson, 1989) and suggest that modern enclosures are still inadequate, even when compared to the barren and sterile cages of the past (Hancocks, 1980).

Abnormal activity patterns seen in captive animals may include self mutilation, copraphagy, lethargy, and stereotypies (Meyer-Holzapfel, 1968; Poole, 1987; Shep-

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herdson, 1989). Stereotypies are rigidly repeated behavior patterns with no apparent function or goal (Mason, 1991; Odberg, 1978). They may involve parts of the body such as head weaving in stabled horses *Equus caballus* (Kiley-Worthington, 1983) or the whole body, such as the pacing common in carnivores in captivity (Carlstead and Siedensticker, 1991; Shepherdson et al., 1993). The mechanisms involved in the development and maintenance of stereotypies are varied (reviewed by Mason and Turner, 1993). For captive animals they are thought to be a response to being housed in a suboptimal or stressful environment where they are unable to influence their surroundings (Carlstead, in press).

Aspects of enclosure design such as size and complexity influence the performance of stereotypic behavior (Draper 1963; Odberg, 1987). In this study, we determined how much of enclosure space was used, and the relationship between pacing and cage size. The potential importance of edge areas of enclosures was also examined. The edges of a captive environment constitute an enforced territorial boundary. It is also the source of several forms of stimulation. These may include a view of the surroundings and the public, as well as the approach of keeping staff for feeding and cleaning purposes. It was predicted that edges of enclosures may be used proportionally more than non edge areas, and that they were used specifically for pacing activity.

An important facet of the captive environment is its feeding regime. Animals that are fed restricted amounts of food have been documented to perform a wide range of stereotypies. Examples include sows (*Sus scrofa*) chewing at bars and chains (Lawrence and Terlouw, 1993) and the excessive preening, drinking, and pecking at non food objects by broiler hens *Gallus g. domesticus* (Savory et al., 1992). The association between feeding and stereotypies arises from the powerful motivation for animals to seek out and consume food. Hughes and Duncan (1988) discuss ethological "needs", where an animal finds the process of performing appetitive (foraging) behavior to be rewarding, as well as the actual consumption of food. Carnivores devote a large amount of time and energy to hunting behavior in the wild (Shepherdson et al., 1993), and under atypical circumstances, may also hunt beyond requirements (Kruuk, 1972). In captivity, there is little opportunity to express hunting behavior, while the strong motivation remains (Shepherdson et al., 1993).

Stereotypic pacing in captive carnivores is thought to be a result of this high level of motivation to express appetitive behavior, particularly in the pre-feeding period (Mason, 1991). Law et al. (1990) described a reduction in stereotypic pacing in polar bears, *Ursus maritimus,* when they were fed early in the day instead of in the evening. Shepherdson et al. (1993) found reduced pacing in small felids when hidden food was provided at varied times. This technique helps to satisfy the need to express foraging behavior as well as more general information gathering, by prompting exploration.

In this study, two feeding regimes currently used at Edinburgh Zoo were examined to compare any visible effects upon pacing behavior in captive felids. It was predicted that a 3-day feeding regime which incorporated fast days would result in higher levels of pre-feeding stereotypic pacing.

METHODS

Nine species of felids in 11 enclosures were studied at the Scottish National Zoological Park (Edinburgh Zoo) in Edinburgh, United Kingdom (Table 1). Individ-

TABLE 1. Felids at Edinburgh Zoo observed in this study

Common name	Scientific name	Sex	Age (yrs)
Cheetah	*Acinonyx jubatus*	m[a]	6
Cheetah	*Acinonyx jubatus*	f[a]	4
Jaguar	*Panthera onca*	m[a]	4
Jaguar	*Panthera onca*	f[a]	19
Jungle cat	*Felis chaus*	f[a]	11
Leopard	*Panthera pardus*	m*	15
Lion	*Panthera leo*	m[a]	7
Lion	*Panthera leo*	f[a]	15
Persian leopard	*Panthera pardus saxicolor*	m[a]	8
Persian leopard	*Panthera pardus saxicolor*	f[a]	7
Siberian lynx	*Felis lynx wrangell*	m[a]	6
Siberian lynx	*Felis lynx wrangell*	f(a)[a]	6
Siberian lynx	*Felis lynx wrangell*	f(b)[a]	2
Siberian tiger	*Panthera tigris altaica*	m[a]	11
Siberian tiger	*Panthera tigris altaica*	f(a)[a]	6
Siberian tiger	*Panthera tigris altaica*	f(b)[a]	2
Snow leopard	*Panthera unica*	m[a]	3
Snow leopard	*Panthera unica*	f(a)[a]	3
Snow leopard	*Panthera unica*	f(b)[a]	11

[a]All felids were captive born. m = male, f = female. a and b identify different individuals.
* = hand reared.

uals of the same species were housed together with the following exceptions: 2 jaguars, female snow leopard (b), and the cheetahs. The separation of the cheetahs into adjacent parts of their enclosure for part of the observation period allowed comparison of behavior under the two different conditions. Observations were made during February and March, 1994.

The felids were fed under two established feeding regimes. One group was fed every day: the cheetahs were fed every morning and evening, the jungle cat every morning, and the lions and lynx every evening. This routine was constant, but occasionally the cheetahs were fed only once a day, and the lynx were periodically not fed for a day. The other group (tigers, jaguars, leopards, and snow leopards) were normally fed every third day, generally in the morning. This practice was intended by the zoo, to mimic wild feeding habits for the large cats which may eat large amounts at a single meal. The meals varied in type and preparation, depending on availability. Meat "on the bone", chicks, and chicken carcasses were provided regularly. Surplus food, and occasional batches of eggs were sometimes used for supplementary feeds. With the exception of the lynx, jungle cat, and the cheetahs, cats were locked up while food was scattered in varying locations within the enclosures.

Activity and location were recorded using instantaneous scan sampling (Martin and Bateson, 1986). Data were recorded during four 1-hr sessions each day. The enclosures were visited on a fixed route with each enclosure sampled approximately every 15 min; the results obtained in each sample are considered independent. The observation sessions began at 07:45, 10:30, 14:30, and 16:30. These times were chosen to sample behavior throughout the day, and were designed to record pre/post feeding behavior for morning and/or evening meals. Five hundred and sixty scans were made on each enclosure.

For every scan the location of each animal was recorded on a map of the enclosure divided into 2 × 2m grid subdivisions, except for the enclosure edges where the grid subdivisions were 2 × 1m and followed the contours of the enclosure walls. Symbols indicated the identity of each individual, and whether the felid was on the ground or in an elevated location, such as a ledge or the branch of a tree.

Behavior was recorded in one of 14 different categories, but later condensed into the following 6 categories: 1) *Locomoting:* generalized movement within the enclosure such as walking or climbing. 2) *Stereotypic pacing:* repetitive, apparently functionless movement, usually on a fixed route within the enclosure (after Odberg, 1978). 3) *Observing:* looking at an object, person, or location. 4) *Resting:* either in a prone or upright posture with the eyes closed. 5) *Other:* a category which included many important behavior patterns rarely seen during scan sampling, such as grooming and social interactions. 6) *Not visible:* either due to crypsis within the enclosure or by moving into the holding cages, most of which are out of the public's view.

The apparent movement of each individual was recorded by noting how far to the nearest meter that individual had moved since the previous scan sample in the same 1-hr recording session. Apparent movement was not recorded in the first scan of each observation session, or if the animal had been previously out of sight. Other data recorded during each scan included notes on general weather conditions. Additional information on feeding days/times of the subject animals was provided weekly by the carnivore keepers.

The quality of view of the horizon from enclosures was assessed by photographing the horizon from the rear ledge of each enclosure. The rating given to the view was dependent on how much of the horizon was obscured (for example, by trees, walls or other enclosures). A rating of '1' was a poor view (80–100% of view obscured) and '5' was a good view (0–20% of view obscured). The high variability in local weather condition meant that there were changes in the visibility of the horizon from the enclosures. These changes in visibility were recorded as: fair horizon = clear day, horizon in view; moderate; or poor = low cloud, horizon obscured. Each enclosure was rated for access to elevated locations based upon the availability of structures and formations which could be used by the cats. These included platforms, tree trunks, branches, and ledges.

Analysis

A Spread of Participation Index (SPI) was calculated for each animal, to give a measure of space utilization (Traylor-Holzer and Fritz, 1985; Shepherdson et al., 1993). The formula for SPI is:

$$SPI = [M(n_b - n_a) + (F_a - F_b)] / 2(N - M)$$

where N = total number of observations of the subject; M = mean frequency of observations in all of the enclosure grid subdivisions (N divided by number of grid subdivisions in enclosure); n_a = number of grid subdivisions with frequencies greater than M; n_b = number of grid subdivisions with frequencies less than M; F_a = total number of observations in grid subdivisions with frequencies greater than M; F_b = total number of observations in grid subdivisions with frequencies less than M. The calculated value of SPI varies between 0 and 1; 0 indicates all grid subdivisions within the enclosure were used equally, and 1 indicates that the subject animal spent all of

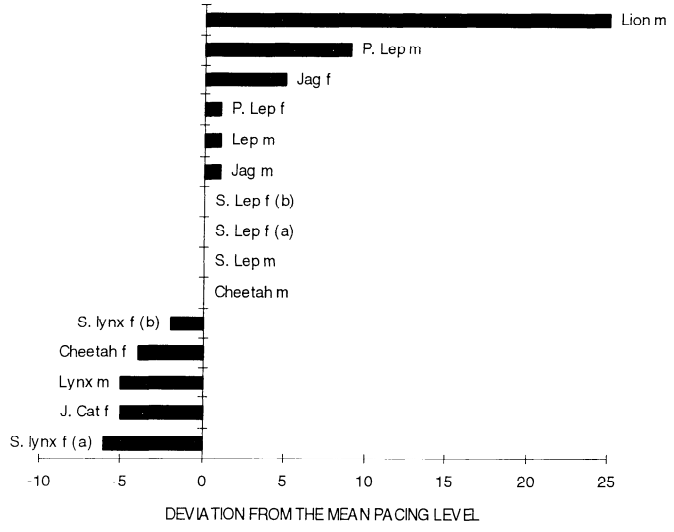

Fig. 1. Percentage deviation from mean stereotypic pacing level.

the observed time in one grid subdivision. Shepherdson et al. (1993) used the SPI to test the same animal under different conditions of live food presentation. In this study the SPI index was used to compare enclosure utilization for a range of species.

RESULTS

Pacing

Stereotypic pacing was recorded at various levels in 15 out of 19 cats (79%), the levels varying between 1% and 32% of scans. Using the figures for each individual, the cats were categorized according to their deviation from the mean (7%). The results, showing positive and negative deviations from the mean, are displayed in Fig. 1, and show three broad categories. Average and near average pacers (snow leopards, male cheetah, male jaguar, male leopard, and male persian leopard); above average pacers (female jaguar, male persian leopard, and male lion); and those that paced well below the average (lynx, female cheetah, and jungle cat). Tigers did not pace at all.

Pacing and Enclosure Size

The percentage of time each animal spent pacing was compared to the total enclosure area in m^2 (Table 2). The data suggested that animals in smaller enclosures paced more, but this was not statistically significant. The values for pacing in the cheetahs (7% male, 3% female) were not included in the calculation, as the animals were separated and then reunited during the course of observations. Almost all their observed bouts of pacing took place while they were kept separate. During the initial observation period the cheetahs were never observed to pace, but when the enclosure was divided they frequently paced on opposite sides of the fence at the same time.

TABLE 2. Values for scans spent on edge of enclosure, amount of edge area in enclosure, scans spent pacing, index of enclosure utilisation, and total size of enclosures

Species	% on edge	% edge area	% spent pacing	% on edge % edge area	Total area (m^2)
Jaguar f[b]	9	38	2	1.03	148
Jaguar m[a]	31	30	12	0.45	148
Jungle cat f[b]	14	31	8	0.24	90
Leopard m[a]	45	40	8	1.13	94
Lion f[b]	25	35	0	0.71	136
Lion m[a]	44	35	32	1.26	136
Persian lep f[b]	17	36	8	0.47	116
Persian lep m[a]	44	36	16	1.22	116
Snow leopard f(a)[c]	19	29	7	0.66	170
Snow leopard f(b)[c]	19	32	7	0.59	152
Snow leopard m[a]	48	29	7	1.66	170
Siberian lynx f (a)[c]	10	37	5	0.27	108
Siberian lynx f (b)[c]	18	37	5	0.49	108
Siberian lynx m[a]	16	37	2	0.43	108
Siberian tiger f(a)[c]	18	21	0	0.86	318
Siberian tiger f(b)[c]	24	21	0	1.14	318
Siberian tiger m[a]	23	21	0	1.10	318

[a]m = male,
[b]f = female,
[c]a and b identify different individuals.

When they were reunited after approximately two weeks the male was never observed pacing and the female was observed to pace only four times.

Edge Utilization

Analysis of the percentage of scans that the felids spent on the periphery of their enclosures and the percentage of total area that was edge area (Table 2) showed no significant correlation ($r = 0.05$, $P > 0.05$). An index of edge utilisation was calculated by dividing the percentage of scans spent in edge areas by the percentage of total edge area (Table 2). Values <1 indicate that edge areas were used proportionately less than central areas, values >1 indicate that the felids were using the edge areas proportionately more than central areas. The index values were varied and no particular trends were apparent. Six animals spent proportionately more time on the edges, with only the male snow leopard doing so to any great extent. Only the female jaguar used the edges in direct proportion to the amount of edge area in the enclosure. The remaining animals apparently used the edges less than core areas of the enclosures. These figures were also correlated to the observed levels of pacing, but were not statistically significant.

There was a significant correlation ($r = 0.57$, $P < 0.01$) between the percentage of scans spent on the edges of enclosures and the percentage of scans spent pacing (Fig. 2), indicating that edges of enclosures are specifically used for pacing. The percentage of sampled time the cheetahs spent on the edge of their enclosures was compared under two conditions, while they were housed together and while they were housed in adjacent, smaller enclosures. While housed together the values for male and female cheetahs were 30% and 31%, respectively. The values when housed separately were 29% and 30%.

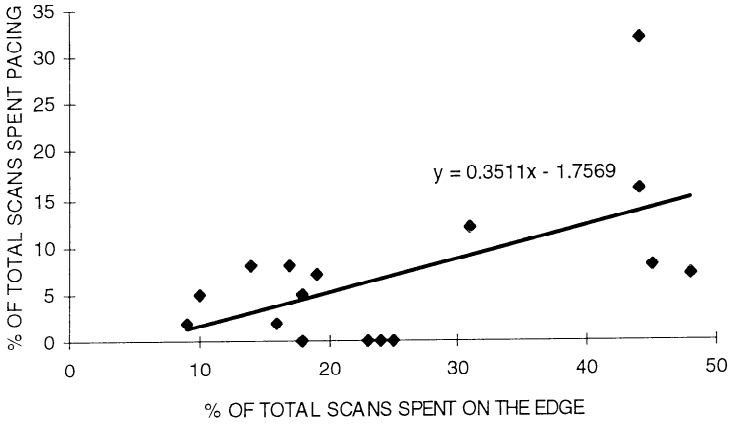

Fig. 2. The relationship between pacing and edge utilization.

Movement and Enclosure Utilization

To assess the movement of the felids within their enclosures, apparent movement was recorded between subsequent scans and the mean apparent movement calculated for each individual. It was predicted that cats in relatively larger enclosures would show higher levels of average apparent movement. To control for body size, the total enclosure area was divided by total body length (data from Kitchener, 1991). The resulting correlation between relative enclosure size and average apparent movement was found to be significant ($r = 0.79$, $P < 0.01$). Fig. 3 graphically presents this relationship. The point which represents the male cheetah appears to be an outlier (top right of figure), however, if the value is omitted the correlation between the variables remains significant ($r = 0.47$, $P < 0.01$).

The results for the Spread of Participation Index (SPI) are plotted in ascending order in Fig. 4, and suggest three different categories of felid. The results are those with indices lower than 0.5, which are apparently using the greater part of their enclosures; those with indices around 0.5, which are only using half of the space available to them; and those which have indices above 0.5, and utilize only a small area of their enclosure. There are no values for the cheetah owing to manipulation of enclosure size.

View Quality

The felid enclosures at Edinburgh Zoo provide varying degrees of opportunity for the animals to climb and to rest above ground level. In all enclosures where elevated locations were provided, they were used predominantly for resting and observation. There was a statistically significant correlation between access to elevated locations and time spent in elevated locations (Spearman rank correlation coefficient $r_s = 0.47$, $P < 0.05$, two tailed, $N = 19$).

The quality of view for each enclosure was ranked and then correlated with sampled time spent off the ground (Table 3). This was found to be statistically significant (Spearman rank correlation coefficient $r_s = 0.673$, $P < 0.01$, two tailed,

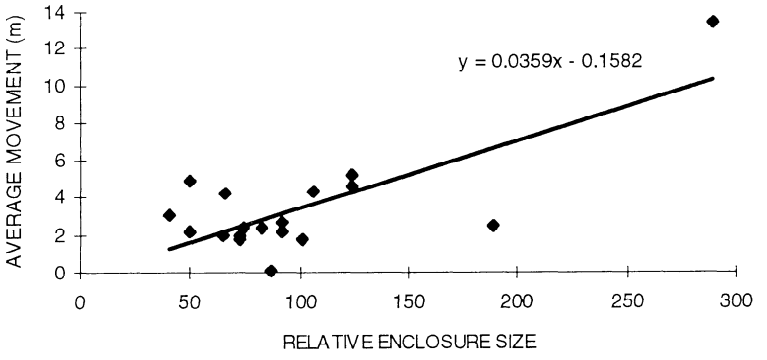

Fig. 3. The relationship between relative enclosure size and average apparent movement between scans.

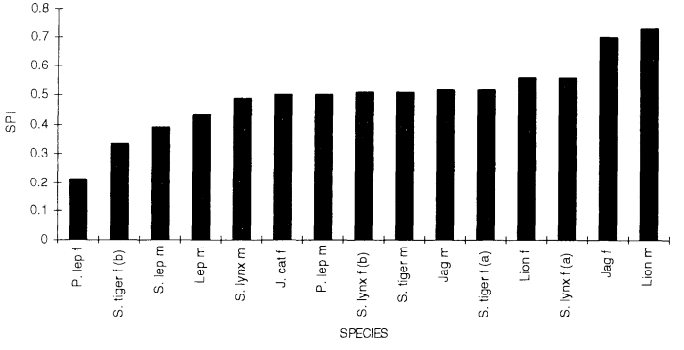

Fig. 4. Values for the Spread of Participation Index (SPI) Analysis.

N = 19) suggesting that the enclosures that had better horizons influenced the behavior of felids by prompting them to use the elevated vantage points more often.

The felids were also observed to use other features of their enclosures to maximize view quality. In the case of the lynx, jaguars, leopards, and snow leopards, this involved moving to the back of the enclosure where they were seen to spend long periods of time observing their surroundings. Their enclosures were built into a steep slope from the rear of which the horizon could be seen as clearly as from the various elevated vantage points. This may explain the particularly low levels of observed time spent in elevated locations recorded for the snow leopards.

Climatic Conditions

Weather conditions were highly variable during observations, and the effects of climatic conditions on enclosure utilization could not be analyzed. However, a Friedman analysis was conducted to see if changes in the visibility of the horizon from enclosures had any effect upon the time the animals spent observing while off the ground. This was found to be not significant.

The Effects of Feeding Regime

For the species normally fed every three days, Fig. 5 displays the different levels of pacing on feeding and non-feeding days. In every case for animals that

TABLE 3. Percent of scans sent off the ground, access to off ground locations and view quality

Species	% Scans spent in elevated locations	Rank of access to elevated locations	Rank of view quality
Lion m[a]	0	1	3
Lion f[b]	0	1	3
Cheetah m[a]	4	2	4
Cheetah f[b]	1	2	4
Siberian tiger m[a]	11	3	2
Siberian tiger f(a)[c]	6	3	2
Siberian tiger f(b)[c]	4	3	2
Jungle cat f[b]	6	4	1
Siberian lynx m[a]	9	4	4
Siberian lynx f(a)[c]	17	4	4
Siberian lynx f(b)[c]	22	4	4
Jaguar m[a]	28	5	5
Jaguar f[b]	7	5	5
Leopard m[a]	6	5	5
Persian leopard m[a]	22	5	5
Persian leopard f[b]	35	5	5
Siberian leopard m[a]	9	5	5
Siberian leopard f(a)[c]	2	5	5
Siberian leopard f(b)[c]	2	5	5

Ranks assessed under conditions outlined in Method. Species listed in ascending order of access to off ground locations.
[a]m = male,
[b]f = female,
[c]a and b identify different individuals.

paced, pacing levels were higher on non feeding days than on feeding days, a result which was highly significant (Wilcoxon Matched Pairs Test, $N = 8$, $Z = 2.52$, $P < 0.002$).

Pre- and post-feed pacing levels were analyzed for cats on both feeding regimes. Pre-feed pacing was classified as pacing observed in the recording hour prior to food being placed into the enclosure; post-feeding pacing was recorded in the session after the animals had eaten. For the cats fed daily the pacing levels are shown in Fig. 6. Six out of the 7 cats that paced, paced more in the hour before they were fed than in the hour after, (not significant, Wilcoxon Matched Pairs Test $P > 0.05$, non-pacers excluded). The 3-day feeders showed considerable variation (Fig. 6). The female Persian leopard and both of the female snow leopards did not pace at all in the time preceding feeding, and showed high levels of pacing after they had been fed. The median levels of pacing were compared, using the Wilcoxon test, but were not significant at $P < 0.05$.

DISCUSSION

The measurement of stereotypies has been suggested as an indicator of reduced welfare (Broom, 1983; Wiepkema, 1983), but some authors consider that this conclusion is not always justified (Carlstead, in press). Mason (1991) suggests that as stereotypies become established they may decrease the sensitivity with which they

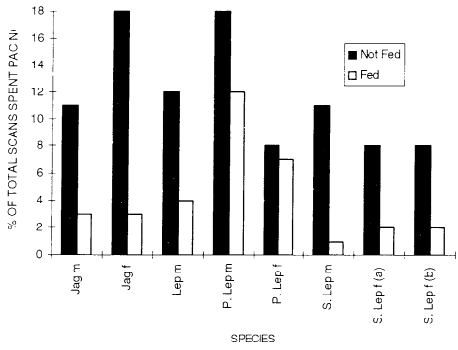

Fig. 5. Pacing in species normally fed every three days: the effect of feeding and non-feeding days.

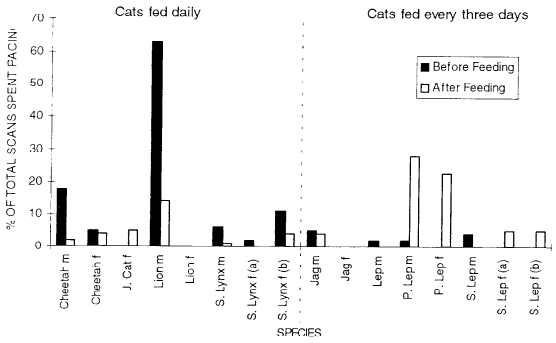

Fig. 6. Pre- and post-feed pacing in cats fed daily and cats fed every three days.

reflect states of reduced welfare. Thus, the subject remains a contentious one, particularly as there is no agreed definition of "welfare". If pacing is accepted as an indicator of reduced welfare, then it is possible to divide animals into categories. By displaying pacing as a deviation from the mean level of 7%, different categories were defined (Fig. 2). If the welfare of the non-pacers and below average pacers was compromised, it was probably not so critical. The male cheetah and snow leopards were average pacers, and along with the male jaguar, female Persian leopard, and leopard may have found their environments lacking, but to a lesser degree than those that paced much more than average. The latter were the female jaguar, male Persian leopard, and male lion. Expressing the results in this way highlights individuals which may benefit the most from revised management and environmental enrichment techniques.

Enclosure size can influence abnormal behavior patterns (Draper et al., 1963), but the total size of enclosures was not found to be a major factor in pacing activity. The complexity of the environment is more likely to be important in affecting behavior (Mellen, 1991; Wilson, 1982). The separation of animals from conspecifics has been implicated in the occurrence of abnormal behavior (Mason and Turner, 1993). In this study, separation of the two cheetahs stimulated bouts of simultaneous

pacing along the dividing barrier for the duration of their separation. The presence of conspecifics in an adjacent enclosure was also potentially stressful to female snow leopard (b). She was seen to pace at the separating door or at the top of the dividing wall between the snow leopard enclosures where she could see into the adjoining enclosure. If conspecifics are to be separated, then keeping them out of sight of, or communication with each other may reduce stress.

The presence of conspecifics can be included in the list of stimuli which originate at the edges of enclosures. It was predicted that as a result of these stimuli, the edges of enclosures were used proportionally more than central areas. This was not found to be true, but edges were used specifically for pacing activity.

Felids can be notoriously inactive exhibit animals (Shepherdson et al., 1993) and there is an emphasis on quality of enclosure in order to stimulate natural behavior patterns. But it is still important to determine how total size of enclosures relates to the activity of confined animals. We found that cats in relatively larger enclosures had higher levels of average movement. The Spread of Participation Index (SPI) demonstrated a trend for cats to use only 50% of their enclosures, with the lions, the female lynx, and the female jaguar using significantly less. The cats which used more than 50% of their enclosures—the female Persian leopard, female tiger (b), and the male snow leopard—were also recorded as having comparatively high levels of average movement. Thus, the cats in relatively larger enclosures made better use of them and were more active.

Elevated locations were used where available, and more raised locations generally meant more time spent off the substrate, particularly if there was a good view of the horizon. This demonstrates that the inclusion of elevated locations in cat enclosures can act as a simple method of environmental enrichment, allowing cats to rest, view their surroundings, and watch potential prey. This can have positive effects upon their behavior. Tigers (*Panthera tigris*) at Glasgow zoo showed an increase in stalking behavior when they were provided with a viewing platform from which they could watch activity in a local horse riding school (Law, pers. comm.).

The feeding method had significant effects upon pacing behavior. The 3-day regime resulted in more pacing on days when food was not provided (fast days) than on feeding days. If the established 3-day feeding regime was intended to reduce abnormal behavior by simulating wild feeding habits, then it was not successful. The level of pacing in these animals may be lower if they are fed daily. Mellen (1991) found that fast days were inappropriate for smaller cats and the evidence here suggests that the practice of feeding larger cats every third day needs reviewing.

The analysis for pre- and post-feeding stereotypic pacing yielded variable and somewhat contradictory results for the animals on the two feeding regimes. Some 3-day feeders paced much more after feeding, but 6 out of 7 daily feeders paced more before feeding. It can be argued that the daily feeders were on a more predictable regime, and the pre-feed pacing was in anticipation of the arrival of the meal (Staddon et al., 1971; Anderson et al., 1977; Mason, 1994), or frustration of appetitive behavior (Lawrence and Terlouw, 1993). The post-feed pacing in some 3-day feeders does not fit this prediction. It may be that the pacing here is due to other eliciting factors, such as the frustration of consumatory behavior by the meal being completed too quickly (Savory et al., 1992). This study has demonstrated that there are limitations to current feeding practices and that the relationship between pre- and post-feed pacing and the factors determining these need to be examined more precisely.

CONCLUSIONS

1. Size of enclosure did not affect stereotypic pacing.
2. Edges of enclosures were specifically used for pacing activity.
3. Cats housed in relatively larger enclosures showed higher average movement.
4. Results from the Spread of Participation Index (SPI) suggested that the cats made use of about half of their enclosures.
5. Cats utilized aspects of enclosures such as elevated platforms to view their surroundings.
6. Cats fed every third day paced at a higher level on non-feeding days than on feeding days.
7. Some cats fed every third day paced much more after feeding, whereas daily feeders paced more before feeding.

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RESEARCH ARTICLE

Comparison of Several Types of Enrichment for Captive Felids

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Enrichment can increase the complexity of the captive environment and possibly enhance captive animals' well-being by stimulating active behaviors and reducing stereotypical behaviors commonly seen in zoo felids. In this study, three different enrichment items were added to outdoor enclosures of felids at the Montgomery Zoo to test their effects on activity levels and stereotypic pacing. Bones, frozen fish, and spices (cinnamon, chili powder, and cumin) were presented over a 3-month period to six species of felids: cheetah, cougar, jaguar, lion, ocelot, and tiger. Proportion of time spent engaging in active behaviors and stereotypic pacing were compared before, during, and after treatments. All treatments resulted in a significant increase in activity level from baseline (bones: +15.59%; frozen fish: +35.7%; spices: +12.38%). Effects of enrichment items on activity levels were not sustained 7 days after removal. Proportion of time spent pacing significantly decreased during presentation of spices (−21.25%) and frozen fish (−26.58%), but not with the addition of bones. However, only the effect of frozen fish on stereotypic behavior was sustained 7 days after removal of the enrichment item. In conclusion, bones, spices, and frozen fish are inexpensive and easy-to-administer enrichment items that may be used to increase active behaviors of captive felids. Zoo Biol 26:371–381, 2007. © 2007 Wiley-Liss, Inc.

Keywords: scents; bones; frozen treats; activity; stereotypies

INTRODUCTION

The literature is replete with information pertaining to the effects of captive life on animal welfare [Hediger, 1955, 1964; Carlstead, 1996; Mench and Kreger, 1996;

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Poole, 1998]. Historically, captive animals have been housed in restrictive enclosures without stimuli prevalent in nature [Mench and Kreger, 1996], such as those associated with predators, prey, social groups, mates, and environmental stochasticity [White et al., 2003; Wielebnowski, 2003], although much is currently being done to make improvements in care programs [Hutchins, 2006]. In natural populations, complexities in the environment place physical and cognitive demands on animals [Swaisgood et al., 2003] and motivate them to perform behaviors necessary for survival [Shepherdson et al., 1993]. Static conditions in captivity and lack of appropriate stimuli may result in boredom, an inability to cope with ordinary stressors, lack of motivation, lack of opportunity to perform natural species-specific behaviors [McPhee, 2002], and development of inactive, abnormal, or repetitive behaviors [Swaisgood et al., 2003].

Environmental enrichment is one of many tools used by zoo staff to create a more stimulating and complex environment that promotes psychological and physiological improvements of animals in captivity. Enrichment generates opportunities for animals to exhibit a diverse array of behaviors [Carlstead and Shepherdson, 1994; Shepherdson, 1998], encourages social interactions by reducing aggression and initiating play, reduces abnormal behaviors, and improves health, all of which may influence reproductive success [Carlstead and Shepherdson, 1994]. By encouraging species-specific behaviors, enrichment facilitates normal development [Carlstead and Shepherdson, 1994] and may increase the probability of survival when captive animals are reintroduced into the wild [Shepherdson, 1998]. Enrichment also enhances the experience of visitors to the zoo, not only because more interest is generated by watching active felids [Margulis et al., 2003], but also because visitors learn more about the animals by seeing them in a more naturalistic setting, displaying behaviors that would be seen in the wild [Shepherdson, 1998; Jones et al., 2005].

Most wild animals spend a considerable amount of time acquiring and consuming food [Bond and Lindburg, 1990; Gilchrist et al., 2005], but many animals in captivity are fed preprocessed diets that do not require natural foraging tactics, energy expenditure, or much use of appendages such as limbs, jaws, and teeth to capture, kill, and process food [Lindburg, 1988; Bond and Lindburg, 1990]. Therefore, unnatural food items may inhibit expression of appetitive behaviors involved in the acquisition of food [Lindburg, 1988], resulting in aberrant behaviors [Shepherdson et al., 1993], deterioration of oral health [Fitch and Fagan, 1982; Vosburgh et al., 1982; Haberstroh et al., 1984; Bond and Lindburg, 1990], and alteration of skeletal morphology [see the review O'Regan and Kitchener, 2005]. Supplementing the diet with more natural foods is a form of enrichment that can promote natural foraging strategies [Lindburg, 1988], may prevent physiological and morphological changes in captive animals [O'Regan and Kitchener, 2005], and can reduce abnormal behaviors [Shepherdson et al., 1993].

Although scent enrichment has been less studied and documented than feeding enrichment, it may also encourage display of natural behaviors. While scent is not the primary sense used by felids to locate prey [Kitchener, 1991], odors can have psychological effects on animals and are important cues used to identify conspecifics and assess their reproductive status and quality, and to maintain territories [Ewer, 1973; Rich and Hurst, 1998]. Boredom, in captive situations, may be alleviated by adding novel stimuli, such as odors, to the enclosure [Powell, 1995].

Here we present the results of a 3-month study to document the response of captive felids to presentation of horse bones, frozen fish, and three types of spices. We predict that these feeding and scent enrichments will diminish stereotypic behaviors and increase the amount of time the felids are engaged in active behaviors. While the objects used in this study have been implemented in enrichment studies on felids at other zoos, few studies have examined sustained effects on behavior following enrichment provisioning [but see Shepherdson et al., 1993; Bashaw et al., 2003].

METHODS

Subjects and Husbandry

The subjects in this experiment were 14 individuals representing six species of felids (*Panthera tigris*, *Leopardus pardalis*, *Panthera onca*, *Puma concolor*, *Acinonyx jubatus*, *Panthera leo*) at the Montgomery Zoo in Montgomery, Alabama. We observed three tigers, two ocelots, one jaguar, three cougars, two cheetahs, and three lions. All the animals were fed Nebraska Premium Feline diet (Central Nebraska Packing Inc., North Platte, NE), except the cheetahs, that were fed Qual Pet (National By-Products, LLC, Des Moines, IA) once a day, 7 days a week. A female cheetah and male ocelot were also given less than 0.45 kg of chicken daily in addition to their normal diet. From 0800 to 1700 hr, animals are on exhibit in their outdoor enclosures. Individuals of each species were displayed together in their respective outdoor enclosures, except for tigers. For the first 2 months of the study, the male and one of the female tigers were placed on display together, and rotated with the other female tiger every second day. For the last month of the study, all the tigers were placed on display singly.

Experimental Conditions

This experiment consisted of baseline, three enrichment treatments (bones, spices, and frozen fish), and post-enrichment observations. Before enrichment treatments, all enrichment items (i.e., Boomer balls, bowling pins, barrels, etc.) currently in the felids' outdoor enclosures were removed. Baseline data were then recorded on all felids for 4 weeks.

For the three enrichment treatments, items were given to the felids daily for ≥ 4 days. All items were placed on land and in areas of the enclosure visible to the public before the animals were placed on exhibit. The remainders of the enrichment items were removed from enclosures before provisioning for the next day. Two weeks of no enrichment occurred between each treatment to allow behavior to return to baseline and to avoid cumulative effects of multiple treatments.

With the bone enrichment treatment, each animal received one horse knuckle or shank bone (Central Nebraska Packaging Inc., North Platte, NE) daily, for 7 consecutive days, except tigers, that received bones for 4 consecutive days because of their daily rotation. The jaguar was not given this form of enrichment because he cracks the bones, creating splinters that become lodged in his palate. The two ocelots were given one bone in total due to veterinary concerns that the male, which had a urinary tract infection, would not eat his antibiotic infused meat if he ate the bones given during enrichment.

For the scent treatment, 30 ml of cinnamon, chili powder, and cumin were sprinkled on the ground, rocks, and logs of the enclosures daily. Spices were placed ≥ 10 m apart and the location of each spice was changed every day. All species received spices for 9 consecutive days, except for the tigers, that received spices for 5 consecutive days.

Frozen treats were made by freezing six small trouts (SR Trout, LLC, Sandy, UT) in a 2-l soda bottle filled with water. The treats were supplied to the animals daily, immediately preceding observation. All species received frozen treats for 8 consecutive days and tigers received frozen treats for 5 consecutive days.

Data Collection

Data were recorded in 10 observation periods over 4 weeks during baseline and on day 1, day 2, and the last day of enrichment provisioning for each of the three enrichment treatments, and on the 7th day following the last day of enrichment. Each cat was observed for two 30-min sessions between 0800 and 1230 hr using instantaneous scan sampling at 1-min intervals [Altmann, 1974]. A total of 300 observations for each species during baseline, 180 observations during each treatment, and 28 post-enrichment observations were made. During each scan, behaviors of all animals in the exhibit were recorded, according to a list of behaviors (Table 1) developed from observing felid activities prior to the start of the project. These 14 behaviors were then categorized as active or inactive. Active behaviors included feeding, social interactions, locomoting, playing, rolling, swimming, alertness, scent-marking, and vocalizing. Inactive behaviors included sleeping, lying down with eyes open, sitting, grooming, and urinating/defecating. Stereotypic behaviors were also noted. Stereotypic pacing was defined as locomoting along a definite path for more than 3 min, such as along the wall of the exhibit or around a fixture in the exhibit. The only stereotypy observed was pacing.

If animals were exhibiting two behaviors simultaneously, only the active behavior was recorded. An animal was considered to be interacting with the treatment if it was within 0.30 m of the item. Observations were made from public-viewing areas while animals were on exhibit. The specific time of observation for each species within the 4.5-hr observation period was changed during observation days so that each species was observed at different times throughout the morning. The order in which species were observed was chosen randomly. However, on some days we were not able to observe species at the time intended due to the zookeepers' schedules. Two observers collected a total of 238 hr of data. Thirty minutes of simultaneous data collection yielded an inter-observer index of reliability $>88.5\%$ [Martin and Bateson, 1986].

Data Analysis

Counts were totaled for each animal across all observation days. A mean value for the proportion of scans categorized as active behaviors (excluding scans when animals were pacing) and the proportion of active behaviors classified as stereotypic for each treatment was calculated for all subjects, which were then used in the analyses. Counts where animals were out of sight were removed from the data set and not analyzed. Analyses were performed using SPSS 11.0.0 for Windows statistical software (2001). The level of significance for all tests was $\alpha = 0.05$, unless noted otherwise.

TABLE 1. List of felid behaviors

Active behaviors	
Feeding	Eating, drinking, chewing, or licking edible substances.
Social interactions	Engaging in any affiliative or aggressive behavior with another, including allo-grooming.
Locomotion	Walking, running, climbing or pacing.
Playing alone	Engaging in playful activities alone.
Rolling	Animal on one side and completely rotates to the other side while laying down.
Swimming	Any activity when the animal is in the water.
Alert	Animal disengages from all other activities with eyes open and aware of surroundings.
Scent marking	Animal releases spray from posterior toward an object.
Vocalize	Animal makes noise with the mouth.
Other	Any active behavior that does not fit the above behaviors.
Inactive behaviors	
Sleeping	Laying down with eyes closed.
Laying down	Laying down with eyes open and not vigilant.
Sitting	Sitting down and not vigilant.
Grooming	Animal licking or scratching itself.
Urinating/defecating	Any projection of bodily fluids (except scent-marking), includes vomiting.
Others	Any inactive behavior that does not fit the above behaviors.

The Bartlett test of sphericity was significant ($\chi^2 = 41.09$. $df = 9$, $P < 0.001$), violating the assumption of independence between measures of the dependent variable. As we had a small sample size, and because our data were neither normally distributed nor independent, nonparametric tests were employed. Owing to the small sample sizes within species, data were pooled among species for examining treatment effects. The nonparametric repeated measures analysis (Friedman's test) was used to compare treatment effects on activity and stereotypic levels as well as residual effects the week after enrichment. If the Friedman's test was significant, a Wilcoxon signed-rank test was performed to determine significant pair-wise relationships, corrected for multiple comparisons with a Bonferroni correction (dividing the *P*-value by the number of comparisons). Significance level after the Bonferroni correction was $\alpha = 0.02$.

RESULTS

Activity Level

Although a small sample size within species precludes statistical analysis of species differences, observations seem to suggest that changes in activity level and stereotypic behaviors following enrichment may differ among species. All the species exhibited an increase in active behavior when provisioned with bones and frozen fish compared to baseline (Fig. 1). Ocelots and tigers had the greatest increase in activity of all the species during the bone treatment (% change $\pm$ SE; ocelot: $25.78 \pm 6.78\%$;

tiger: 25.67 ± 11.69%), and frozen fish treatment (ocelot: 55.49 ± 18.49%; tiger: 57.89 ± 10.82%). Five of the six species of felids had an increase in active behaviors when provisioned with spices (Fig. 1). Tigers exhibited the highest increases in active behaviors with the addition of spices to their enclosures (tiger: 22.33 ± 8.03%).

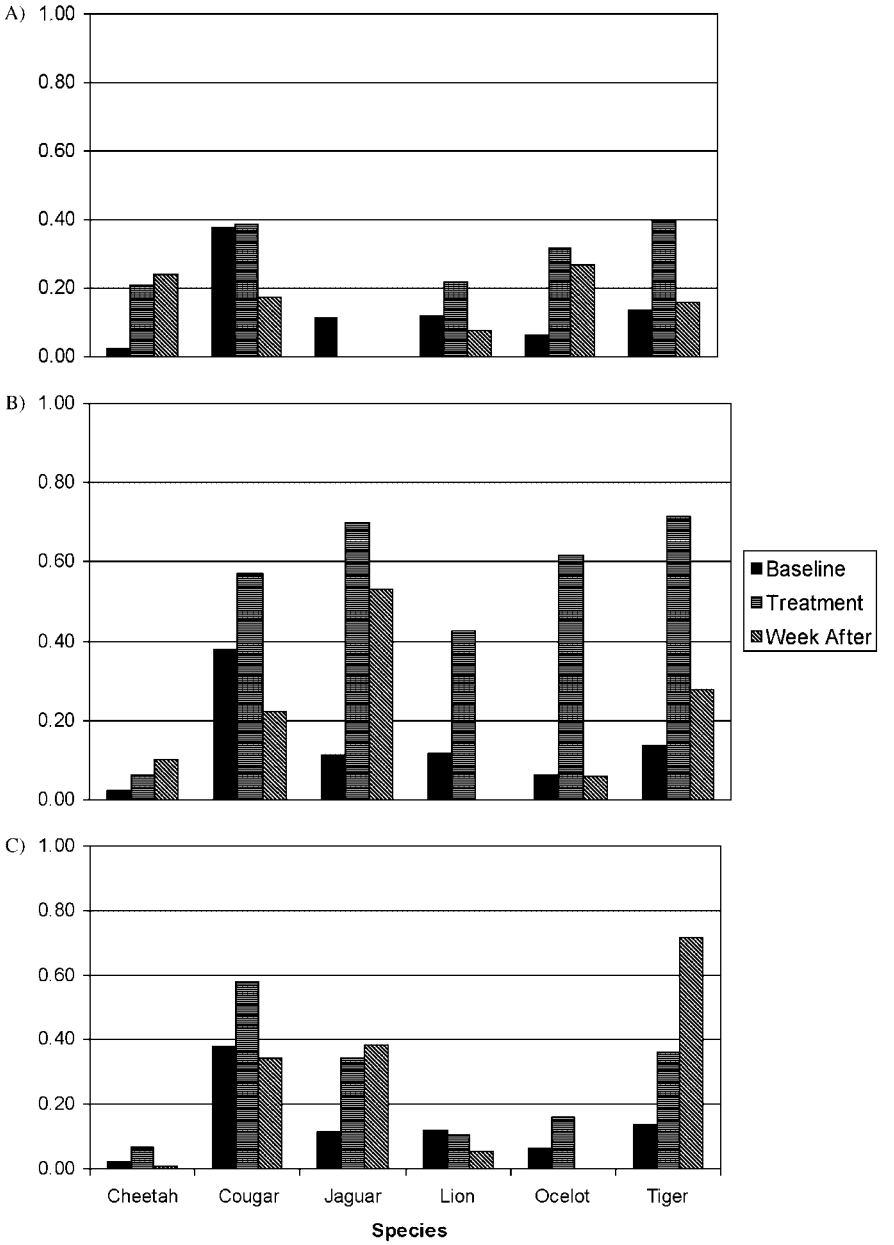

Fig. 1. The proportion of behaviors classified as active averaged among individuals for each species of felid for each treatment: (A) bones, (B) frozen fish, and (C) spices. The jaguar did not participate in the bones treatment.

TABLE 2. Activity and stereotypic levels with results of Wilcoxon signed-rank tests (comparisons between enrichment and baseline)

	Active behaviors			Stereotypic pacing		
Treatment	Mean % active (±SE)	Wilcoxon Signed-rank test (z)	P	Mean % stereotypic (±SE)	Wilcoxon signed-rank test (z)	P
Baseline	15.64±3.88			26.8±7.60		
Bones	31.23±4.80	−2.41	0.02*	32.11±3.48	−1.96	0.05
Fish Frozen in Ice	51.34±6.74	−3.30	<0.01*	4.12±1.98	−2.50	0.01*
Spices	28.02±6.69	−2.73	<0.01*	10.85±4.58	−2.67	<0.01*

*Statistically significant at the $P = 0.02$ level (due to Bonferroni correction for multiple comparisons).

A significant difference in the proportion of behaviors classified as active was observed across the four treatments ($\chi^2 = 19.80$, $df = 3$, $P < 0.01$). For all treatments, significant differences in activity levels were found between baseline and treatment (Table 2). Overall, activity levels increased by 22.92±7.83%. Increased activity levels due to treatments were not maintained 7 days after the removal of treatment objects (bones: $z = -0.25$, $P = 0.81$; frozen fish: $z = -0.91$, $P = 0.36$; spices: $z = -0.16$, $P = 0.88$).

Stereotypic Behavior

When provided with enrichment, a decline in stereotypic behaviors was seen for all species that exhibited stereotypies during baseline observations (Fig. 2). During the study, cheetahs were the only species that did not exhibit any stereotypic behaviors. Both ocelots and tigers had the greatest decreases in the proportion of active behaviors that were stereotypic with the addition of bones and spices (bones: ocelot 26.77±21.05%, tiger 23.98±1.29%; spices: ocelot 47.82±3.61%, tiger 32.85±23.49%). However, with the fish frozen in ice treatment, jaguar and ocelots exhibited the greatest decrease in amount of stereotypic pacing (jaguar: 56.52%; ocelot: 47.82±16.67%).

A significant difference in stereotypic pacing was observed across treatments ($\chi^2 = 11.13$, $df = 3$, $P = 0.01$). Both the addition of frozen treats and spices to the enclosures of felids resulted in significant decreases in percentage of stereotypic pacing exhibited when compared to baseline observations (frozen treats: $z = -2.50$, $n = 13$, $P = 0.01$; spices: $z = -2.67$, $n = 13$, $P = 0.01$; Table 2). Bones did not result in a significant decrease in stereotypic pacing compared to baseline ($z = -1.96$, $n = 12$, $P = 0.05$). Overall, stereotypic behaviors decreased by 21.25±7.33%.

The amount of stereotypic pacing a week after enrichment was similar to that exhibited during baseline observations, except after the addition of frozen fish (bones: $z = -1.96$, $n = 12$, $P = 0.05$; fish frozen in ice: $z = -2.29$, $n = 13$, $P = 0.02$; spices: $z = -1.89$, $n = 13$, $P = 0.06$). With the frozen fish treatment, four of the six species did not exhibit any stereotypical pacing 7 days after removal of the enrichment item. Only one species (jaguar) displayed an increase in the percentage of active behaviors that were stereotypic (+31.95%) one week after the enrichment treatment.

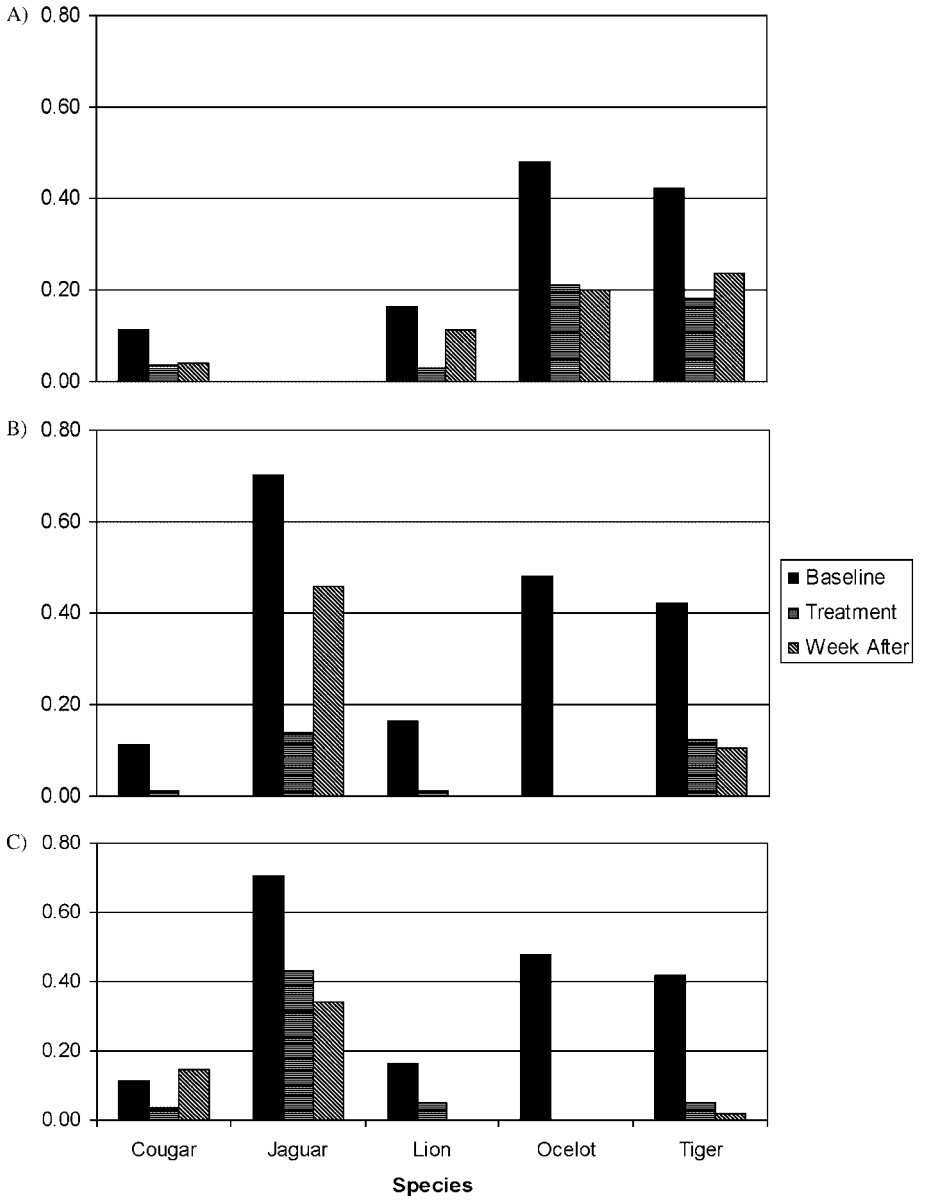

Fig. 2. The proportion of active behaviors that were considered stereotypic averaged among animals for each species of felid for each treatment: (A) bones, (B) frozen fish, and (C) spices. The jaguar did not participate in the bones treatment. Cheetahs did not exhibit any stereotypic pacing during the course of the study. With the addition of spices and frozen treats, no stereotypical pacing was recorded for ocelots.

DISCUSSION

Environmental enrichment has been often used to reduce stereotypic behaviors, enhance activity, and even reduce aggression in several species of captive

animals [Bloomsmith et al., 1988; Carlstead et al., 1991; Forthman et al., 1992; Shepherdson et al., 1993; Powell, 1995; McPhee, 2002; Bashaw et al., 2003]. Although we could not statistically test species-specific changes in activity levels and stereotypic behaviors due to the small sample size, observations appeared to reflect differences in behavioral patterns among species after enrichment. Ocelots and tigers had the highest increase in activity when bones were added to the enclosure. This may have occurred in the ocelots because only one bone was given to be shared between the two animals, which resulted in more interactions between the two as they fought over custody of the single bone.

All three enrichment items resulted in a lesser amount of time spent pacing compared to baseline for all species in the study, except cheetahs, which showed no stereotypies during baseline (Fig. 2). Cheetahs also had the highest percentage of inactive behaviors during baseline, which in part explains the lack of stereotypic behaviors. When cheetahs were active, they were either alert or walking to find a new resting area. Ocelots showed a complete cessation of stereotypic pacing following provisioning of spices and frozen treats.

When species data were pooled, a significant increase in activity level from baseline occurred with all enrichment treatments. This lends support to other studies that have found dramatic changes in felid activity when provisioned with similar treatment items. Bashaw et al. [2003] found an increase in activity, specifically in consumptive behaviors, when lions were provisioned with bones and Powell [1995] found that sniffing and flehman behaviors significantly increased when adult lions and cubs were given spices. In addition, inactivity decreased when lions were given cinnamon, chili powder, ginger, and zebra dung [Schuett and Frase, 2001].

Examining effects of a treatment after the item has been removed is important in studies of enrichment because only long-term changes are indicative of an improvement in underlying behavioral patterns [Bashaw et al., 2003]. In this study, activity levels were still higher than baseline 7 days after removal of enrichment items, but were not significant (bones: +1.66%; fish: +1.14%; spices: +11.14%). No significant difference in the proportion of time spent pacing was found a week after treatment with bones or spices. However, the amount of time spent pacing was significantly different from baseline levels a week after provisioning with frozen fish. In fact, four of the six species showed no stereotypic pacing a week after the frozen fish treatment.

Since different enrichment items in this study resulted in different changes in behaviors, it may be most beneficial to the animals to provide them with various enrichment items at the same time. For example, in this study, cats showed a decrease in stereotypic behaviors with spices and an increase in activity with all treatments. Perhaps addition of spices and one of the other treatment items would result in a reduction of stereotypic behaviors and enhanced activity concurrently. Also, providing animals with a variety of enrichment objects may decrease habituation to those items [Carlstead et al., 1991].

This study shows that providing captive felids with inexpensive, easy-to-administer enrichment objects can have profound effects on activity and stereotypic behaviors. Several studies show that animals express more natural behaviors when given the opportunity [Bond and Lindburg, 1990; Carlstead et al., 1991; Powell, 1995; McPhee, 2002]. Promotion of natural behaviors is another goal of enrichment that was fulfilled in this study. Enrichment items elicited appetitive behaviors that

might be seen in the wild, such as rubbing and rolling with addition of spices, and object manipulation and searching when provisioned with bones and fish. While not all enrichment objects resulted in sustained effects, all enrichment items used show the importance of introduction of novel objects to change behavioral patterns.

CONCLUSIONS

1. Easy to administer novel objects impacted behavior patterns of felids.
2. Provisioning with bones, frozen fish, and spices resulted in greater activity levels.
3. Addition of spices and frozen fish caused a decrease in stereotypic pacing.
4. Changes in activity levels were not sustained a week after removal of treatment items.
5. Changes in stereotypical behavior were sustained a week after removal of frozen fish.

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Zoo Biology 21:573–584 (2002)

Effect of Feeding Boxes on the Behavior of Stereotyping Amur Tigers (*Panthera tigris altaica*) in the Zurich Zoo, Zurich, Switzerland

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The stereotyped pacing shown by the two Amur tigers in the Zurich Zoo was hypothesized as being caused by permanently frustrated appetitive foraging behavior. Several electrically controlled feeding boxes were installed and access to each box was possible only twice a day for 15 min at semi-random times. The boxes had to be opened actively by the tigers. Two trials were carried out: one with solitary confinement, and one with paired confinement. During box feeding, the female's stereotyped pacing was significantly reduced from 16% (solitary confinement, conventional feeding) and 7% (paired confinement, conventional feeding) to 1% (solitary confinement) and less than 0.01% (paired confinement) of the daily observed time. The female's sleeping increased significantly in both solitary and paired confinement. The male only showed a significant reduction in stereotyped pacing behavior when kept with the female (conventional feeding: 10%; box feeding: $<0.01\%$ of the daily observed time). On days with a box-feeding regime in paired confinement, the male spent 25% (83 min) of the observed time with active behavior at the feeding boxes. The results support the hypothesis that permanently frustrated appetitive foraging behavior causes stereotyped pacing in adult tigers. Zoo Biol 21:573–584, 2002.

Key words: foraging; frustration; pacing; random feeding; predictability

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INTRODUCTION

Stereotyped pacing is common in carnivores in zoological gardens. Stereotypies are considered as behavioral disorders, and their appearance may point to present or previous suboptimal captive conditions [Mason, 1991]. They can develop, for example, in stress situations [Appleby et al., 1989; Bildsoe et al., 1991; Dantzer, 1991; Savory et al., 1992; Cabib, 1993; Carlstead et al., 1993; Ladewig et al., 1993; Marriner and Drickamer, 1994; Shepherdson, 1994] or in cages without external stimuli [Hughes and Duncan, 1988; Dantzer, 1991; Mason, 1991; Van Roijen, 1991; Marriner and Drickamer, 1994; Shepherdson, 1994; Wechsler, 1995; Williams et al., 1996], and often seem to be used as a coping strategy for a suboptimal environment [Mason, 1991; Savory et al., 1992; Rushen, 1993; Wechsler, 1995]. Ödberg [1978] and Mason [1991] defined stereotypic behavior as 1) repetitive and invariant, 2) spatially restricted, and 3) apparently functionless behavior. As Mason [1991] postulated, the development of a stereotypy is a continuous process from "natural" to "unnatural" behavior. Mason [1993] supposes that locomotor stereotypies such as pacing may develop from appetitive foraging behavior. According to McFarland [1989, p. 250], appetitive behavior is "an active search for an appropriate external stimulus; if this stimulus is found, the consummatory act (e.g. eating or drinking) can take place." If the active search is not successful, however, the animal stays in an appetitive condition and therefore still searches for the terminating stimulus [Dantzer, 1991; Wechsler, 1995]. Free-living carnivores are able to perform successful appetitive behavior such as looking for prey, stalking, capturing, and killing. If, in an artificial environment such as a zoo (with fixed feeding times), the appetitive behavior is permanently unsuccessful and frustrated, the behavioral regulation system cannot function and the affected animals presumably start stereotyping.

In free-living carnivores, behavioral elements such as looking for prey, capturing, and eating form a big part of their daily activity rate [Shepherdson et al., 1993; Lyons et al., 1997]. As a consequence, many studies regarding foraging with different behavioral approaches have been performed in zoological gardens. Markowitz and LaForse [1987] studied the effect of artificial prey and acoustic signals on two servals (*Felis serval*). Shepherdson et al. [1993] provided a fishing cat (*Felis viverrina*) with live fish, and leopard cats (*Felis bengalensis*) were fed several times a day, even combined with hidden food. Baumann [1997] and Kilchenmann [1997] tested a spatial and temporal irregular feeding regime in European otters (*Lutra lutra*) and Mongolian wolves (*Canis lupus chanco*), respectively. Whereas the Mongolian wolves reacted to the new feeding regime with increased foraging in the entire enclosure, the European otters showed no significant behavioral changes. Hartmann [1998] developed electronic feeders and tested them with European wildcats (*Felis s. silvestris*). Wildcats exposed to the electronic feeders showed significantly more overall alertness than the traditionally-fed wildcats, and none of the wildcats exposed to the electronic feeders exhibited any behavioral disturbances. Williams et al. [1996] studied the effect of moving bait on the behavior of cheetahs (*Acinonyx jubatus*). The moving bait significantly increased sprinting and the time spent performing observations, and it significantly decreased time spent in affiliation and feeding. Forthman et al. [1992] provided a Kodiak bear (*Ursus arctos middendorffii*)

and two polar bears (*Ursus maritimus*) with plain ice blocks as well as food-containing ice blocks. During the first observation period, the animals were significantly more active, less passive, and engaged in fewer abnormal behaviors under the enriched conditions compared to the unenriched conditions. During a second observation period 1 year later, differences between the two conditions were no longer significant.

The Amur tigers (*Panthera tigris altaica*) in Zurich Zoo (Zurich, Switzerland) show stereotyped pacing. Each day they spend a lot of time (up to 1.5 hr during 6 hr of observation) pacing along the enclosure borders. Except on fasting days, the tigers are fed meat at the same place and time. In this artificial situation, if a tiger is motivated to forage, all its foraging strategies will end up unsuccessfully. One cause of the stereotyped pacing of the two tigers could hence be permanently frustrated appetitive foraging behavior. Another explanation for the development of stereotyped pacing is that this behavior can be considered as an active waiting strategy. In the zoo, this active waiting strategy ends with the artificially given feeding time and is shown most frequently during pre-feeding time. Shepherdson et al. [1993] and Lyons et al. [1997] explained the distinct stereotyped pacing during pre-feeding time by a high motivation for foraging. There is no behavioral strategy by which the animal can improve its foraging success because the meat is delivered at the same time, no matter what the animal does. This permanent failure may lead to the abandonment of practiced foraging strategies. Because the motivation of foraging for food remains, the tigers stay active and confine themselves to pace at certain places in the enclosure. If foraging is unsuccessful on some occasions and successful on others, it is expected that the tigers will show adaptive consecutive behaviors, such as continuing to forage or rest, or to kill and eat, respectively. But if foraging is permanently unsuccessful (other than at the feeding time), it may be that the tigers adapt their behavior according to the artificial situation, and start stereotyping in the enclosure.

The aim of the Zurich Zoo is to improve the conditions of the animals in its exhibits, in order to prevent stereotypies. To make successful foraging possible in enclosure conditions, a new feeding method with several time-regulated feeding boxes was developed. In contrast to the conventional feeding method, the temporal availability of food was varied, and the availability of food was related to the tiger's behavior. It was expected that this feeding method would enable successful foraging and thus prevent those stereotypies that are caused by permanently unsuccessful foraging. The stereotypies that originate from other unsuccessful appetitive behavior, such as permanently frustrated looking for a mate, should not be influenced by this experiment. If, on the other hand, stereotyped pacing represents an active waiting strategy, it was expected that the tigers would still spend a large amount of time exhibiting locomotion or pacing behavior because it is still possible they are actively waiting for the opening times of the feeding boxes.

The tested feeding boxes are appropriate for tigers because this species is an opportunistic feeder [Matjushkin et al., 1977]. In the wild, tigers catch a wide variety of prey, of varying sizes (even as small as hares) [Karanth and Sunquist, 1995]. With the new feeding method, the tigers have to look for relatively small prey several times each day (that is, to check the feeding boxes regularly).

METHODS

The two focal animals were a 10-year-old female Amur tiger and a 2-year-old male Amur tiger. The trials were conducted in a 215 m^2 outdoor enclosure in the Zurich Zoo, structured with stones and tree trunks. The first trial with the two tigers in solitary confinement took place from 25 February to 10 July 1998. During solitary confinement, the male tiger was not yet sexually mature and was considered a juvenile. The second trial with the two tigers in paired confinement took place from 12 October to 27 November 1998. This was after they had mated, and therefore the male was considered an adult.

Several feeding boxes (Fig. 1) were installed at different places in the outdoor enclosure. Before 0900 hr, a sufficient amount of meat was distributed to all feeding boxes (in the absence of the tigers), and the boxes were closed by a sliding door with a strong magnet. When the magnet was switched on, the tiger could not open the door. Each magnet was switched off during two 15-min periods, semi-randomly spread over the period of 0900–1730 hr. This happened without any associated noise, and the sliding doors did not move or open by themselves. After 1730 hr, all the magnets were switched off and the boxes could be opened. Over a 3-week initial phase, both animals had learned to easily open the sliding doors and take out the meat. To get to the meat, the tigers had to investigate the feeding boxes regularly.

In the first trial, three feeding boxes were installed in the outdoor enclosure. The effect of the feeding method on the behavior of both tigers in solitary confinement was recorded. For each repeat of the experiment, the focal animal was fed according to three 3-day feeding regimes. First, a 3-day baseline period was conducted that guaranteed an identical situation before every replication. The baseline consisted of 2 days on which the tigers were fed at 1430 hr, and 1 fasting day occurring on either the first or second baseline day. During baseline, the tigers were not observed. The second regime was conventional feeding at 1430 hr for 3 days, and the third regime was box-feeding for 3 days (Fig. 2). On the third day of each feeding regime, after 2 days of habituation, the focal animal was observed directly. Direct observation time lasted 360 min (6 hr) between 0900 and 1730 hr, and the total durations of the five behavioral categories ("stereotyped pacing," "locomotion,"

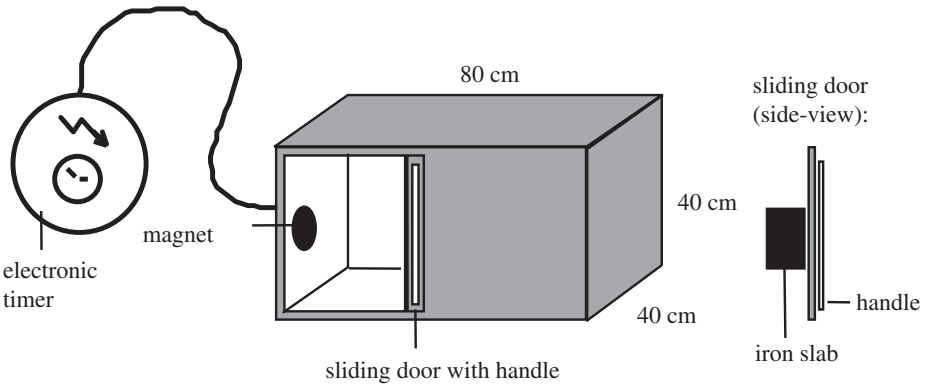

Fig. 1. Feeding box ($80 \times 40 \times 40$ cm) with sliding door and magnet, connected to an electronic timer.

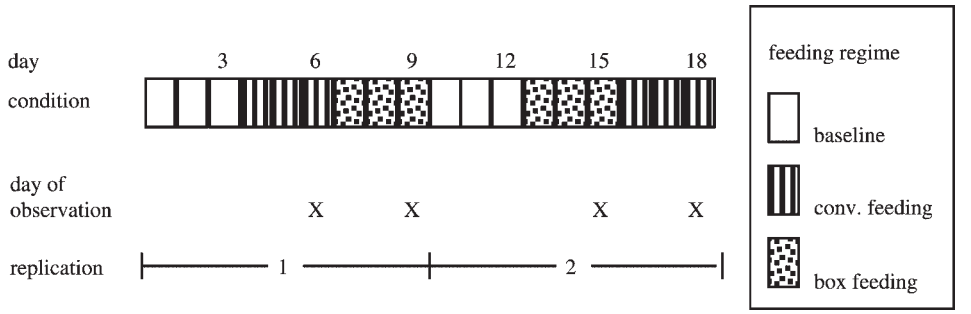

Fig. 2. Experimental design for solitary confinement. Eight replications were carried out. One replication lasted 9 days, always starting with a 3-day baseline, followed by 3 days with conventional feeding and 3 days with box feeding. The order of the two observed feeding regimes was reversed for each replication.

"resting," "sleeping," and "others") during this time were recorded. Stereotyped pacing was defined as "locomotion on a distance to and fro, immediately after this distance has been paced once in both directions," and was recorded separately from "normal" locomotion. The behavioral category "others" included, among other things, all the behavioral elements at the feeding boxes. Temporally related observation days, as for example days 6 and 9, were counted as dependent pairs. Eight replications were carried out for each tiger.

In the second trial, a fourth feeding box was installed in the outdoor enclosure. With a slightly changed observation design, the behavior of both tigers in paired confinement was tested for differences. As the tigers knew immediately after release into the outdoor enclosure which feeding method was being used (feeding boxes closed and filled, or opened and empty), the days of habituation used in trial 1 could be left out. The feeding regime was changed every day, and after each baseline day (feeding at 1430 hr) a fasting day was added (Fig. 3). Because of the shorter day length at this time of year, the daily observation time decreased to 330 min (5.5 hr). The second trial was set up to test the newly generated situation of competition, and

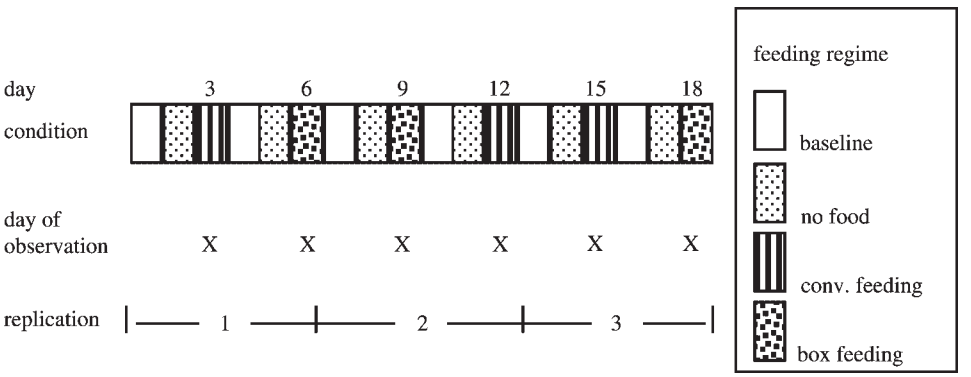

Fig. 3. Experimental design for paired confinement. Eight replications were carried out. One replication lasted 6 days, always starting with a baseline and a fasting day ("no food"), followed by 1 day with conventional feeding or box feeding, respectively. The order of the two observed feeding regimes was reversed for each replication.

to obtain possible clues as to the social causes of stereotypies. Eight replications also were carried out in trial 2.

During the last five of the eight replications in paired confinement, a newly developed behavioral element was noted and analyzed separately: vertical scratching of feeding boxes. The tigers, mostly the male, scratched the feeding boxes continuously with their paws, visibly removing the boxes' paint. Before this, mainly horizontal movements were noted. These were behavioral elements which enabled the tigers to open the feeding boxes, as this way they could catch hold of the door handle with their paws. However, vertical scratching of feeding boxes was not appropriate for opening the sliding doors of the boxes.

Because the data are not normally distributed, the five categories of behavior during conventional feeding and box feeding were compared with the nonparametric Wilcoxon matched-pairs test.

RESULTS

The results are presented in Table 1. In solitary confinement, stereotyped pacing of the female tiger was significantly reduced during box feeding ($P=0.02$), whereas sleeping was significantly increased ($P=0.01$). The behavioral category "resting" remained unchanged in both feeding regimes. The female spent significantly less time with locomotion during box feeding than during conventional feeding ($P=0.02$). The behavioral category "others" did not show significant changes between the two feeding regimes.

TABLE 1. Influence of feeding regime on the behavior of the two tigers

Behavioral categories		Sterotyped pacing	Sleeping	Resting	Locomotion	Others
Female solitary	Conv. feeding	16%	25%	16%	18%	25%
	Box feeding	1%	48%	15%	10%	26%
	P	0.02[a]	0.01[a]	0.67	0.02[a]	0.67
	Z	−2.38	2.52	−0.42	−2.38	−0.42
Male solitary	Conv. feeding	3%	40%	22%	14%	21%
	Box feeding	3%	47%	20%	11%	19%
	P	1.00	0.09	0.41	0.21	0.09
	Z	0.00	−1.12	−0.84	−1.26	−0.42
Female paired	Conv. feeding	7%	13%	23%	26%	31%
	Box feeding	<0.01%	25%	19%	13%	43%
	P	0.01[a]	0.03[a]	0.21	0.01[a]	0.04[a]
	Z	−2.52	−2.24	−1.26	−2.52	−2.10
Male paired	Conv. feeding	10%	15%	27%	20%	28%
	Box feeding	<0.01%	9%	16%	7%	68%
	P	0.01[a]	0.09	0.03[a]	0.02[a]	0.01[a]
	Z	−2.52	−1.68	−2.24	−2.38	−2.52

Conventional (conv.) feeding and box feeding data are represented in percentages of mean values, not referring to the statistical values. Eight replications for each tiger and feeding regime were carried out (n=8).

[a]Indicates significant difference at $P<0.05$.

In solitary confinement, the male tiger showed no behavioral differences between conventional feeding and box feeding for any of the five behavioral categories (Table 1). Stereotyped pacing was observed during only 3% of the 360 observed minutes in both feeding regimes.

In paired confinement, stereotyped pacing of the female tiger was significantly reduced during box feeding (P=0.01), whereas sleeping was significantly increased (P=0.03, see Table 1). The behavioral category "resting" remained unchanged in both feeding regimes, and locomotion was significantly reduced during box feeding (P=0.01). In contrast to solitary confinement, the behavioral category "others" increased significantly during box feeding (P=0.04). The active behavior at the feeding boxes was solely responsible for this increase.

In paired confinement, stereotyped pacing of the male was reduced significantly during box feeding (P=0.01; Table 1). No significant difference was observed in the behavioral category "sleeping." The male showed significantly less resting (P=0.03) and locomotion (P=0.02) during box feeding. In contrast to solitary confinement, the behavioral category "others" increased significantly during box feeding (P=0.01). As noted for the female tiger, the active behavior at the feeding boxes was responsible for this effect.

During the last five of the eight replications, vertical scratching of feeding boxes and horizontal scratching of feeding boxes were noted separately. Further analysis showed that the female spent 36 min, and the male spent 83 min (25%) of the daily observed time (330 min) with active behavior at the feeding boxes (n=5, Fig. 4). It was noted that 8 min of the female's and 60 min of the male's active behavior at the feeding boxes consisted of vertical scratching of feeding boxes, which was not appropriate for opening the sliding doors of the boxes.

In solitary confinement, the female tiger managed to open more than half of the boxes at the first opening time (Table 2). The male tiger opened most of the boxes at the second opening time or after 1730 hr, when all the boxes could be opened.

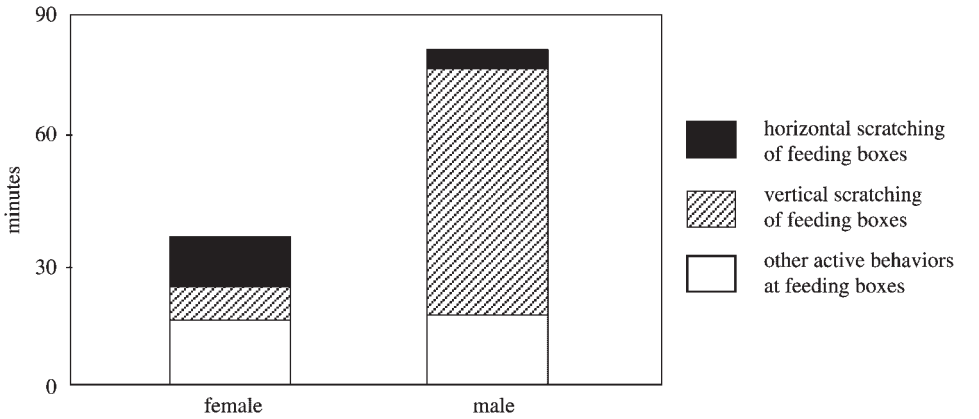

Fig. 4. Active behavior at the feeding boxes of the female (total of 36 min) and the male (total of 83 min) tigers during the daily 330 observed minutes in paired confinement; mean values over the last five replications.

TABLE 2. Times, at which the two tigers opened the feeding boxes

Opening times:	1st op. time	2nd op. time	After 17:30 hrs	Not opened	Total
Female solitary	13	5	6	0	24
Male solitary	3	9	8	4	24
Female paired	16	0	0	0	16
Male paired	13	1	2	0	16

The 1st and 2nd opening (op.) time were situated between 9:00 and 17:30 hrs, after 17:30 hrs all the boxes could be opened. When a box was still closed the morning after an experiment, it was designed "not opened."

In paired confinement, the tigers opened the feeding boxes at 29 first-opening times of a total 32 feedings (Table 2). The meat was divided equally between the female and the male tiger. Each tiger managed to open 16 feeding boxes during the eight replications of the experiment (Table 2).

DISCUSSION

The female tiger reduced stereotyped pacing significantly during box feeding compared to conventional feeding, in solitary as well as in paired confinement (Table 1). Furthermore, the female increased sleeping significantly in both solitary and paired confinement. The male only showed a significant reduction in stereotyped pacing when kept with the female. During box feeding in paired confinement the male spent a large amount of time with active behavior directed to the feeding boxes. The results support the hypothesis that permanently frustrated appetitive foraging behavior could be the main reason for stereotyped pacing. The feeding method with the electrically controlled feeding boxes seems to produce a foraging situation wherein successful foraging behavior is possible several times a day. Regularly checking the feeding boxes does not replace foraging behavior in the wild. Nevertheless, it provides the tigers the opportunity to control their environment by having responsibility for access to the meat in the boxes. The explanation that stereotyped pacing can be considered as an active waiting strategy has to be rejected for the tigers in this exhibit, because both tigers (except the juvenile male during solitary confinement) reduced their locomotor activities significantly during the box-feeding regime.

According to Shepherdson et al. [1993], a certain unpredictability of food availability is desirable for animals living in captivity, but a certain degree of control and modification by the animals should be possible nevertheless. They proposed that an environment in which an animal can find food by means of foraging increases the welfare of the animal. The tested feeding-box regime allowed for both unpredictable times at which the feeding boxes could be opened, and the possibility of active control of the feeding boxes by the tigers.

In both solitary and paired confinement, the female switched from high locomotor activity—frustrated appetitive foraging behavior (stereotyped pacing)—during the conventional feeding regime to an adaptive, relaxed waiting strategy (sleeping) during the feeding box regime.

It is difficult to understand why stereotyped pacing of the male in solitary confinement was not affected by the feeding-box regime. Most probably the problem for the juvenile male was not foraging, but missing contact with conspecifics. Until he was moved to Zurich, the male was kept with his mother and his brothers and sisters. Presumably, the separation from his family, the new environment, and the isolation from conspecifics represented a stressful situation for the male. Nevertheless, the daily amount of time spent pacing in the enclosure was relatively small (3% during both feeding regimes in solitary confinement; Table 1). According to Ruiz-Miranda et al. [1998], experimental separations of two pairs of two male cheetahs (*Acinonyx jubatus*) resulted in higher walking rates. These results indicate that increased activities indeed can be caused by stressful conditions. Paired with the female, the male increased stereotyped pacing to 10% during conventional feeding. This increase could be caused by the newly created situation of competition for food. However, the adult female tiger decreased stereotyped pacing during conventional feeding from 16% (solitary confinement) to 7% (paired confinement), which shows that she was able to cope with the competition situation without increased stereotyped pacing (Table 1).

As the results presented in Table 2 clearly show, the two tigers displayed different feeding patterns, which depended on the presence or absence of the other individual. However, because these data are of a qualitative nature, they are not discussed any further.

In paired confinement, both tigers spent little time with stereotyped pacing during the feeding-box regime ($<0.01\%$ for each tiger; see Table 1). The male spent 83 min with active behavior at the feeding boxes, such as continuously scratching the feeding boxes with his paws (Fig. 4). In contrast, the female spent only 36 min with active behavior at the feeding boxes. It is possible that the male reacted to the competition situation during paired confinement with forced activity and presence at the feeding boxes. A total of 60 min of the active box-directed behavior consisted of vertical scratching of feeding boxes, which was not appropriate for opening the sliding doors of the boxes. The described behavior had no obvious function, was repetitive, and was spatially restricted to the feeding boxes—all factors that define stereotypic behavior [Ödberg, 1978; Mason, 1991]. It seems that the male, in the short term, experienced too many unsuccessful foraging situations during the feeding-box regime, and thus started to manipulate the feeding boxes out of frustration. As Weinberg and Levine [1980] pointed out, total predictability as well as total unpredictability can have negative effects on animals. Additionally, the consequences of predictability or unpredictability on the behavior of an individual animal strongly depend on how the stimuli are presented [Van Roijen, 1991]. It is possible that the relatively short opening times of 15 min on two occasions each day for each feeding box represented a situation of total unpredictability for the male. Only long-term observations can show if vertical scratching of feeding boxes will develop into a stereotypy or will disappear with age.

The tested feeding-box method works without any reliable (e.g., visual or acoustic) signals that could show the tigers whether the boxes can be opened or not. Several authors have proposed that acoustic signals are important for felines during foraging [Markowitz and LaForse, 1987; Hartmann, 1998]. Carlstead [1986] discussed the "safety signal hypothesis" of Seligman [1968], which says that an

animal needs a reliable signal to reduce uncertainty in its environment by identifying "safe" periods when intense stimulation is not likely to occur. It seems that the male tiger did not have enough certainty over the feeding box regime, in combination with the presence of the female in the same enclosure. Perhaps a reliable signal, such as a small lamp fixed next to each feeding box, visually indicating the opening times (but not visible from a distance) would prevent the activities toward the boxes. With a visual signal, the regular physical manipulation with the paws would no longer be necessary.

With the design of the presented experiments, it remains unclear whether temporally random feeding by keepers would show the same effects obtained with the feeding boxes. As Shepherdson et al. [1993] showed, multiple feedings of hidden food compared to feeding once a day (non-hidden food) reduced the duration and bout length of stereotyped pacing in four leopard cats (*Felis bengalensis*). How ever, they did not examine multiple feedings of non-hidden food, and therefore it is not known whether hiding the food was an important factor in these results [Shepherdson et al., 1993]. Two experimental follow-up studies in the Zurich Zoo with two snow leopards (*Unica unica*) and two margays (*Leopardus wiedii*) compared the conditions "temporally random feeding by keepers" and "temporally random feeding by feeding boxes," and showed no differences in stereotyped pacing and glucocorticoid levels of the observed animals [Burgener, 2000; Gusset, 2000]. These results indicate that random feeding by keepers can have an effect on the behavior of the animals similar to that of the feeding-box regime.

As it is not clear yet which factor (daily single vs. multiple feeding, temporal random vs. non-random feeding, or feeding boxes vs. keeper) is responsible for which behavioral change in the animals, further research in the Zurich Zoo will focus on these questions in detail. At present, feeding boxes in the Zurich Zoo are installed in the enclosures of the tigers and snow-leopards, and in an enclosure specially designed for experimental research. Long-term observations will provide more information about the development of new stereotypies and the establishment of adaptive behavioral changes in the observed animals.

CONCLUSIONS

1. Electrically controlled feeding boxes can reduce stereotyped pacing in tigers.
2. The female replaced stereotyped pacing with sleeping, in solitary as well as in paired confinement.
3. The young male showed no reaction to the feeding-box regime in solitary confinement, possibly because the problem for the juvenile male was missing contact with conspecifics, rather than lack of foraging.
4. During paired confinement, the male developed intense activities directed toward the feeding boxes that were not appropriate for opening the feeding boxes, which could represent or develop into a new stereotypic behavior.
5. If several animals are kept together, the opening hours of the feeding boxes must be adjusted in such a way that each animal can cope with the proposed feeding regime without stress.
6. For the prevention of activities directed toward the feeding boxes, the use of a reliable signal, such as a small lamp (not visible from distance), indicating the opening times of the feeding boxes should be considered.

7. Further research is needed to clarify whether random feeding by the keeper could be an equivalent alternative to the feeding-box regime, and whether the active control and opening of the feeding boxes by the animals are necessary factors for the reduction of stereotyped pacing.

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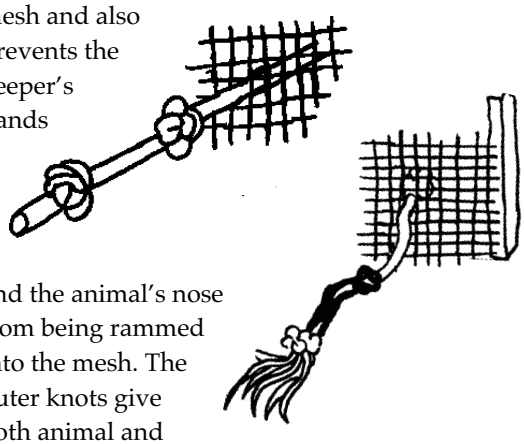
A Quarterly Source of Ideas for Environmental and Behavioral Enrichment

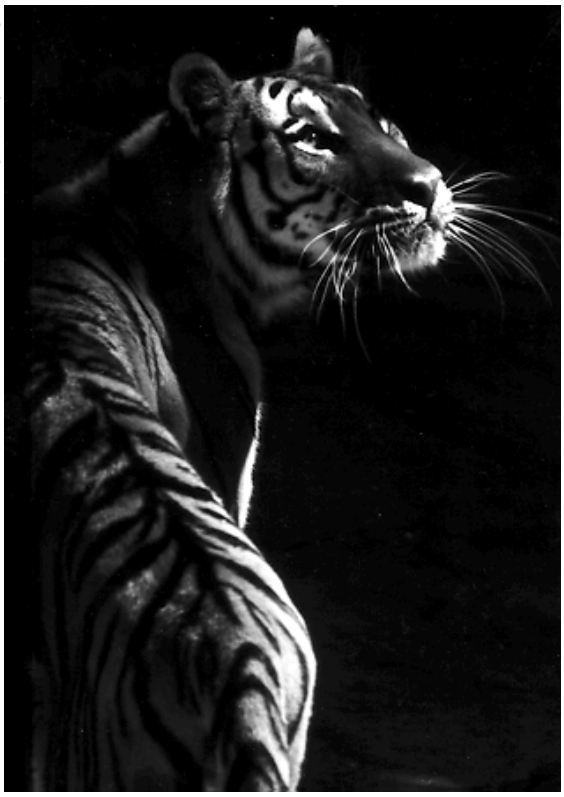
Got a Tiger By the Tug

By Else Poulsen and Larry Miller, Keepers, Calgary Zoo, Alberta, Canada

People in Calgary have named the 1995-96 winter season "the winter that wouldn't go away," with extreme cold and deep snow for many months. How cold was it? It was so cold that even our zoo's Siberian tigers *(Panthera tigris altaica)* chose to stay in their warm building for much of the season. Because our cats were spending so much time indoors, senior cat and bear keeper Larry Miller saw an increased need for indoor enrichment. As an addition to the usual barrels and bones, Larry invented the tiger tug. The concept is simple, but its versatility is limited only by one's imagination.

The idea is to pull a piece of one-inch hemp rope, about six to eight feet long, through the wire mesh panel of the exhibit when the cats are elsewhere. Half of the rope is in the animals' enclosure and half is dangling in the keeper area. Tie two big knots about one foot apart on both ends of the rope (see diagrams). When the animals are returned to the enclosure, you simply play tug-of-war. The inside knot on either end keeps the rope from slipping through the mesh and also prevents the keeper's hands and the animal's nose from being rammed into the mesh. The outer knots give both animal and keeper something to hang on to.





Siberian tiger (Panthera tigris altaica)

Although the tiger tug seems very simple, it has been an extremely successful enrichment tool. We have found that a keeper who plays with the tiger greatly improves his/her relationship with that tiger. Animals that normally do not acknowledge the arrival of the keeper get off their platforms to greet the keeper. This is especially true if you make the play a daily event. Our tigers do not seem to tire of this activity, and they actively solicit play with the rope from us. The whole scenario is reminiscent of playing tug-of-war with a pet dog (which never seems to tire, either!). We have found that it is important to always let the tiger "win" the event. If the animal is successful in getting the tug from you, he/she continues to seek the activity. We believe that it creates a sense of accomplishment for captive animals.

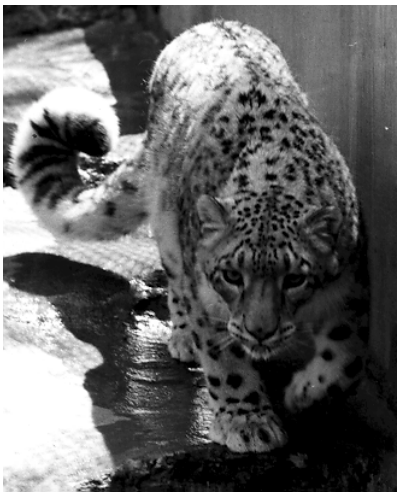
The tiger tug has been so successful between animal and keeper that we decided to make one between two tigers. We have two males, a father

and son, that cannot be put together. These two have visual access to each other, separated only by heavy mesh. We have not observed a tug-of-war between the two, but we have found evidence of it. The ends of the rope were chewed, mangled, and then eventually destroyed.

Animals will also play with the tug by themselves, trying to pull the tug through the mesh.... Another possibility is to weight the keeper's end of the rope to help develop muscle tone for animals that do not normally get a great deal of exercise.

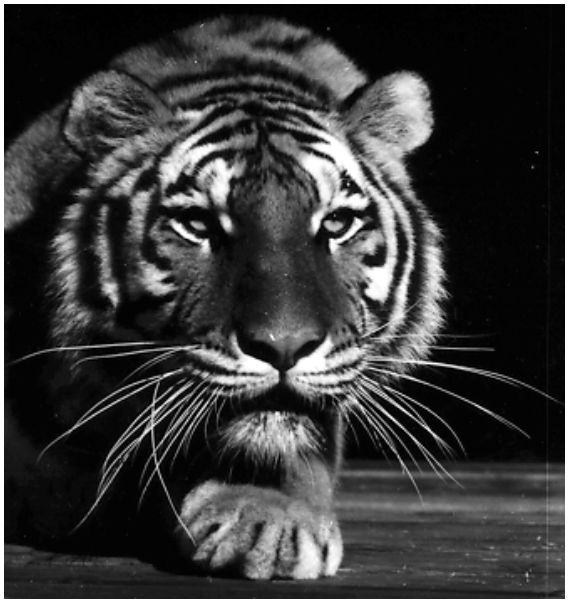
We tried the tiger tug with our snow leopards *(Panthera uncia)*. First we showed the animals how the game works. They caught on very quickly and now play with each other. Animals will also play with the tug by themselves, trying to pull the tug through the mesh. One must assess whether or not the mesh can take the weight of the animal pulling on it, and the welds of the panels should be checked regularly (extra strapping might be beneficial).

If you have bars and not mesh, you can tie a stick to either side to keep the rope from slipping through. We specifically chose a natural fiber rope that can be destroyed and go through the gut if accidentally swallowed. Putting in extra knots or fraying the ends—or leaving them frayed after the animals have been at them—provides varied textures and opportunities, but the animals may chew on the ends, the knots, or the rope. Our tigers have not purposely eaten the hemp. When the tug is destroyed, which happens often, we simply replace it. It is not expensive, it takes about one minute to make, and putting it in place can be incoporated into your daily shifting routine.



Snow leopard (Panthera uncia)

Siberian tiger (Panthera tigris altaica)



Our imaginations have since run wild with ideas. We will be trying this with other carnivore species and with primates. Another possibility is to tie weights to the keeper's end of the rope to help develop muscle tone for animals that do not normally get a great deal of exercise. The counterweight will also provide a challenge for the animal when the keeper is not there to play. We think this would be an excellent tool to interact positively with animals that fear keepers, are aggressive, have been previously abused, or are subordinate and reluctant to interact. In our opinion, the most valuable part of the tiger tug is the opportunity to develop a more positive relationship with an animal. ✧

Busy Bettongs

We gave our brush-tailed bettongs (Bettongia pencillata) *dried leaves, camel and llama hair, whole pumpkin, sphagnum moss, and leaves scented with earthworm scent oil. The leaves kept them busy digging and chewing for a few days, until the leaves crumbled. This was also a good substrate to hide mealworms and crickets. The camel and llama hair clumps were a big hit—they carried the clumps around in their tails and eventually used them as nesting material. The pumpkins were chewed and scratched for about 20 minutes. After an intial investigation, the moss and earthworm scent were ignored.*

Also, we filled a black food/water tub with bark chips, sticks, rocks, or leaves. Sometimes we hid food or nesting materials in the substrate. The bettongs enjoyed digging in the tubs even when no food or nesting material was hidden and would chew on the bark, sticks, and leaves. We recommend removing the tub and changing its contents frequently.

—Judy Swanson and Judy Urwin, Brookfield Zoo, Illinois

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Intact Carcasses as Enrichment for Large Felids: Effects on On- and Off-Exhibit Behaviors

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Reducing stereotypic behaviors in captive animals is a goal for zoological institutions worldwide, and environmental enrichment is one tool commonly used to meet that end. Behavioral needs associated with feeding, however, are often neglected in large carnivores. To address these needs, I tested the effects of calf carcasses as enrichment for large felids. Over 14 weeks, I provided nine animals with up to seven intact carcasses. The cats were housed at Toledo Zoo, Potawatomi Zoo, and Binder Park Zoo. Animals were observed off and on exhibit for changes in feeding, natural, stereotypic, active, and inactive behaviors. I compared treatment behaviors with behaviors observed during a baseline period in which the animals were fed traditional processed diets. For these nine cats, carcass provision decreased off-exhibit stereotypic behaviors but had little impact on on-exhibit behaviors. Zoo Biol 21:37–47, 2002. © 2002 Wiley-Liss, Inc.

Key words: feeding behavior; stereotypic behavior; carnivores

INTRODUCTION

Over evolutionary time, the behaviors of wild animals have taken shape in response to spatial and temporal variability and the selective pressures associated with that variability. Captivity can adversely affect animal behavior due to different selective pressures and a lack of environmental stochasticity [Hediger, 1964; Price, 1984; Tudge, 1992; Carlstead, 1996; Seidensticker and Forthman, 1998]. In a captive environment, an animal may not have the motivation, opportunity, or need to display the range of behaviors necessary to succeed in its natural habitat.

Large carnivores in particular are often deprived of natural behavioral opportunities associated with feedings. Captive felids in North American zoos are fed pri-

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marily a diet of processed meat that offers few behavioral opportunities and takes moments to consume [Fernandes, 1996; Carlstead, 1998; Lindburg, 1998]. Continuous feeding of such a diet has physiological and behavioral consequences. For example, Duckler [1998] found that, as compared to those of wild individuals, the principal muscles operating the jaws and neck of captive-reared tigers (*Panthera tigris*) had a greatly reduced influence on the shape of the skull during development. This change is likely due to excessive grooming and lack of appropriate feeding opportunities [Duckler, 1998]. Studies have also shown that animals fed whole-prey items vs. those fed processed meat suffered fewer gingival health problems, less plaque formation, and less focal palatine erosion [Lindburg, 1988].

In addition, prolonged exposure to an environment without appropriate external stimuli or selective pressures can elicit aberrant, stereotypic behaviors, which are possibly 1) redirections of behaviors (especially appetitive behaviors) with no natural outlet in captivity, or 2) mechanisms to cope with the lack of stimulation [Mason, 1993; Rushen et al., 1993; Carlstead, 1996]. Aberrant behaviors such as pacing, head swinging, and excessive licking are commonly described in a number of mammalian carnivore species (e.g., polar bear (*Ursus maritimus*) [Markowitz, 1982; Tudge, 1991], tiger (*Panthera tigris*) [Markowitz, 1982; Tudge, 1991], leopard (*Panthera pardus*) [Markowitz, 1995], caracal (*Felis caracal*) [Hancocks, 1980; Hutchins et al., 1984], and ocelot (*Felis pardalis*) [Hutchins et al., 1984]). An environment that offers appropriate stimuli for eliciting wild behavior is likely to reduce the probability of such behavioral changes [Hancocks, 1980; Frankham et al., 1986; Maple and Finlay, 1989; Tudge, 1992; Newberry, 1995; Carlstead, 1996].

The use of environmental enrichment provides animals with a variety of valuable stimuli [e.g., see *The Shape of Enrichment*]. Enrichment decisions, however, are often based on item availability and cost, not the animals' behavioral ecology. Here I propose that whole-prey items be tested as enrichment for large carnivores. Studies have shown that: 1) the method of food provision and the level of stereotypic behaviors are linked in carnivores [Carlstead, 1998; Mellen et al., 1998], and 2) provision of whole prey directly addresses the animals' behavioral ecology [Bond and Lindburg, 1990].

METHODS

To test this approach, I asked the following questions: Does the behavior of captive cats change significantly with the provision of intact carcasses? Specifically, does the mean number of samples in which the animal displayed natural vs. stereotypic, and active vs. inactive behaviors change over time? Of special interest was the change in stereotypic behaviors.

To answer these questions, I observed behavior under two scenarios: 1) off exhibit—the behaviors observed off exhibit for the first 2 hr immediately following provision of intact calf carcasses, and 2) on exhibit—behavior observed on exhibit throughout the 2 weeks between carcass provisions.

Against a null hypothesis that behavior would not change after carcass provision, I predicted that off-exhibit, stereotypies would decrease and that natural and feeding behaviors would increase. For behavior on exhibit, I predicted that stereotypic and active behaviors would decrease after carcass provision, and that natural and inactive behaviors would increase.

Subjects/Carcasses

Not all cats received the same number of carcasses, nor were all cats involved in both parts of the study. Nine cats were fed carcasses, and eight cats were observed on exhibit. Cats were housed at Potawatomi Zoo (PZ), South Bend, Indiana; Toledo Zoo (TZ), Toledo, Ohio; and Binder Park Zoo (BPZ), Battle Creek, Michigan. All cats were born in captivity and had received intact carcasses (though not calf) at some point in their life (Table 1).

For both portions of the study, animals were observed and behaviors were clearly defined prior to the official data-collection period. Definitions were based on work by Curio [1976], Leyhausen [1979], Taylor [1989], Bailey [1993], and Mason [1993] (Table 2).

Protocol

Behavior off exhibit

The protocol for behavior off exhibit is separated into two sections: 1) provision (carcass procurement, preparation, and provision), and 2) data collection (how the data were collected).

Provision

Each treatment animal received one carcass per 2-week cycle. For each of the zoos, carcasses were purchased from local farmers. At the request of participating veterinarians, carcass preparation included evisceration.

Four days prior to provision, carcasses were removed from the freezer and placed in a refrigerator to thaw. The morning of provision, the carcasses were set out to reach room temperature. Carcasses were weighed and then provided to the animals between 1630 and 1700 hr on scheduled days.

Data Collection

To record feeding behavior, I placed a videocamera on a tripod, and recording began immediately prior to provision. Behaviors were recorded for a 2-hr period.

Before the first carcass provision, baseline data were taken on cats feeding on their regular diet (PZ and BPZ: Nebraska® feline diet (Central Nebraska Packing, Inc., North

TABLE 1. Demographic information for each subject*

Cat	Zoo	Species	Sex	Age	Years at institution	Hand raised/ mother reared
$L1_{p7}$	PZ	African leopard	0.1	19	19 (all)	HR
$L3_{p2}$	PZ	African leopard	0.1	22	22 (all)	HR
$L12_{t7}$	TZ	African leopard	1.0	21	10+	Unknown
$N2_{p5}$	PZ	Lion	1.0	7	2	HR
$N13_{t5}$	TZ	African lion	0.1	13	10+	Unknown
$S7_{b2}$	BPZ	Snow leopard	0.1	9	1	MR
$S8_{b2}$	BPZ	Snow leopard	1.0	11	1	MR
$S9_{t7}$	TZ	Snow leopard	0.1	6	6 (all)	MR
$S10_{t7}$	TZ	Snow leopard	0.1	6	6 (all)	MR

*To designate subjects, uppercase letter = species; uppercase number = unique identification number; subscript letter = zoo; and subscript number = number of carcasses fed (uppercase letters: L = leopard, N = lion, and S = snow leopard; subscript letters: p = Potawatomi Zoo, b = Binder Park Zoo, and t = Toledo Zoo).

TABLE 2. Behavioral definitions and categories in which each behavior was considered*

Behavior	Definition	F	N	S	A	I
Walk	Ambulatory movement in a specific direction with an apparent goal; a symmetrical gait in which each foot is on the ground more than half the time [Taylor 1989]		X		X	
Pace	Repeated walking, without an apparent goal [Mason 1993]; walking became pacing as soon as the animal completed two rotations of the movement pattern			X	X	
Jump	Moving from a lower point to a higher point, or vice versa, in one motion		X		X	
Drag	Move a portion of an item, with the mouth beside or between the cat's front legs, from one location to another without lifting it off the floor [Leyhausen 1979]	X	X		X	
Stalk	Slow, walking movement, with all legs slightly bent, and eyes focused on specific item	X	X		X	
Lick	Stroke object with tongue	X	X			X
Bite	Placing the mouth around an item and exerting force	X	X		X	
Chew	Grind an object, usually with the carnassials	X	X			X
Carry	Pick an item (or portion thereof) off of the floor and move from one location to another		X		X	
Stretch	(a) Hind legs straight out behind the body, front legs straight but still under the body (b) Front legs straight out in front of body, back legs straight but still under the body		X			X
At rest	Relaxed, calm; in a sitting position		X			X
Vigilant	Alert, attentive; either standing or sitting		X			X
Maintenance	Eating, drinking, urinating, grooming		X			
Plucking	Excessive grooming; focuses on a specific spot, versus area, and continues for several minutes oftening resulting in visible loss of hair at that spot			X		X
Other	Any behavior that did not fit any of the above categories	X	X	X	X	X

*F = feeding; N = natural; S = stereotypic; A = active; I = inactive.

Platte, NE); TZ: Nebraska® canine diet (Central Nebraska Packing, Inc.)). For baseline and treatment data, behaviors were noted in 12 instantaneous scan samples [Altmann, 1974] per hour taken at 5-min intervals, totaling 24 samples per subject per night.

Behavior on exhibit

To examine behavior on exhibit, data were collected four times a day on specified days. Each day was divided into four 1-hr 15-min rounds: 1000–1115, 1145–1300, 1,330–1445, and 1515–1630 hr. I determined exhibit order within a round with a random number generator. Per each round, one 10-min observation was made of each exhibit, and each 10-min observation consisted of 10 instantaneous scan samples [Altmann, 1974] to be collected on the minute. Again, prior to the first carcass provision, data were taken on the cats on their routine diet of processed meat. These data served as the baseline against which behaviors with carcasses were compared. The treatment schedule was staggered to allow observations throughout the 2-week cycle.

Analysis

To address behavioral change as a function of intact carcass provision in the off-exhibit and on-exhibit studies, I looked at overall change for all cats pooled, as well as for individual cats. Because the data were ultimately analyzed as count data

(i.e., comparing numbers of scans observed), I used Poisson regression [P] [SAS Software Release 6.12] to determine the significance of change for groups of pooled cats. Because not all cats received the same number of carcasses, I compared treatment to baseline on three different levels of analysis: 1) cats that received carcasses 1 and 2 pooled (n = 6); 2) cats that received carcasses 1–5 pooled (n = 5); and 3) cats that received carcasses 1–6 pooled (n = 3) (Table 3).

Given the small sample size and strong dependence among observations, I analyzed change for individual cats using a bootstrapped two-sample independent t-test [B] [Bradley and Tibshirani, 1993]. The lack of variance and the small sample size rendered traditional statistical methods inappropriate for individual cats. The bootstrap is a repeated sampling technique that compensates for these problems. Using SAS [SAS Software Release 6.12], I programmed a computer to resample the data 1,000 times for each cat. Based on these trials, SAS calculated a probability that the sample means were different. This test assumed equal variances, and there were few serious departures from homogeneity (using the Brown-Forsythe test for homogeneity). However, 12% of the cases did violate the assumption, which indicates that the results should be interpreted with moderate confidence. Because the baseline data for cats $S7_{b2}$, $S8_{b2}$, and $S9_{t7}$ were incomplete or missing, I substituted $S10_{t7}$'s baseline data ($S10_{t7}$ was the only conspecific). There is no confirmation that the cats' behaviors were similar enough to warrant the substitution, so these results should be interpreted with caution. I compared all statistical results against an $\alpha = 0.05$.

RESULTS

Behavior Off Exhibit

Feed behaviors

Do big cats exhibit more feeding activity with a carcass than with processed diet? At first this seems to be an uninteresting question, with an obvious answer: of course they do. However, this study found that while overall increases were significant, not all cats responded with increased feeding activity.

Overall, there was a significant increase in feeding behaviors at all three levels of analysis (level 1 [P] $P = .0045$; level 2, [P] $P = .0002$; level 3, [P] $P < .0001$; Table 4). On an individual basis, one cat ($L3_{p2}$) experienced a significant overall decrease in feeding behaviors ([B] $P = .027$) and only three cats ($L1_{p7}$, $L12_{t7}$, and $N13_{t5}$) experienced a significant overall increase ([B] $P = .008$, .0001, and .0001, respectively; Table 5).

TABLE 3. Levels of analysis

Analysis level		n
Off-exhibit behavior		
1	Carcasses 1 and 2 pooled	6
2	Carcasses 1 through 5 pooled	5
3	Carcasses 1 through 6 pooled	3
On-exhibit behavior		
1	Carcasses 1 and 2 pooled	8
2	Carcasses 1 through 5 pooled	5
3	Carcasses 1 through 7 pooled	4

TABLE 4. Significance values for overall change in behaviors for all cats pooled (for levels of analysis, see Table 3)

Treatment	Behavior	Level of analysis	P value*	Direction of change (if significant)
Off exhibit	Feed	1	.0045	+
		2	.0002	+
		3	<.0001	+
	Natural	1	.1353	+[a]
		2	.3798	+[a]
		3	.2576	+[a]
	Stereotypic	1	.3160	–[a]
		2	.0968	–[a]
		3	.0822	–[a]
On exhibit	Natural	1	.3021	
		2	.6435	
		3	.5355	
	Stereotypic	1	.8205	
		2	.5132	
		3	.5551	
	Inactive	1	.7104	
		2	.8305	
		3	.8858	
	Active	1	.4934	
		2	.1025	
		3	.1401	
	Hiding	1	.0470	+
		2	.0053	+
		3	.0087	+

*P values based on Poisson regression and compared to an α of .05.
[a]Poisson regression is not significant, but comparison of proportions indicates change did occur.

Natural vs. stereotypic behaviors

The first question asked by managers of enrichment programs is usually, Does the enrichment decrease stereotypic behavior? Initially, it appears that carcass provision produces no significant overall change in either natural or stereotypic behaviors for animals off exhibit (Table 4).

A factor that potentially masks significance for natural and stereotypic behaviors, however, is hiding behaviors (periods in which the focal animal retreated from the observer's view). Given that, I also considered proportionate data to normalize for time out of sight. This normalization showed that, for all cats pooled, the percentage of samples in which natural behaviors were observed significantly increased at all three levels. For level 1, natural behaviors increased from 72% at baseline to 92% for all carcasses pooled. At level 2, the increase was from 66% to 95%, and level 3 increased from 62% to 97%.

Patterns for individual cats were more varied (Table 5). Only one cat ($L1_{p7}$) experienced an overall increase in natural ([B] $P = .0001$) and decrease in stereotypic behaviors ([B] $P = .0001$). Natural behaviors also increased for $N13_{t5}$ ([B] $P = .0002$) and $S8_{b2}$ ([B] $P = .021$), and $L3_{p2}$ experienced an overall decrease in stereotypies ([B] $P = .021$).

TABLE 5. Significance values for behavior change in individual cats pooled (for definition of coding see Table 1)

Treatment	Behavior	Cat	P value*	Direction of change
Off exhibit	Feed	$L3_{p2}$	.0270	–
		$L1_{p7}$	.0080	+
		$L12_{t7}$	.0001	+
		$N13_{t5}$	.0001	+
	Natural	$L1_{p7}$	.0001	+
		$S8_{b2}$	.0210	+
		$N13_{t5}$	.0001	+
	Stereotypic	$L1_{p7}$	.0001	–
		$L3_{p2}$	.0210	–
	Hiding	$S8_{b2}$	.0210	+
		$N13_{t5}$	.0001	–
On exhibit	Natural	$L1_{p7}$	.0010	+
		$S10_{t7}$	.0210	–
		$N13_{t5}$	.0001	+
	Stereotypic	$L1_{p7}$	.0007	–
		$S10_{t7}$	.0130	–
	Active	$L1_{p7}$	.0050	–
		$S10_{t7}$	.0080	–
	Inactive	$L1_{p7}$	.0030	+
		$S10_{t7}$	.0440	–
	Hiding	$S10_{t7}$	.0040	+

*P values based on bootstrapped two-sample independent *t*-test and compared to an α of .05.

Behavior On Exhibit

Natural vs. stereotypic behaviors

Due to anticipated public reaction and perception, enrichment's effect on on-exhibit stereotypic behaviors is generally of greater concern than that of behaviors off exhibit. As a function of carcass provision, there was no significant overall change in natural or stereotypic behaviors on exhibit at any level (Table 4). Again, the effect of hiding behaviors must be considered. Even normalizing for time out of sight, there was no change in time spent in active and stereotypic behavior.

Individually, overall natural behaviors significantly increased ([B] $P = .001$) and stereotypic behaviors significantly decreased ([B] $P = .007$) for cat $L1_{p7}$. For $S10_{t7}$, natural behaviors and stereotypies decreased when overall change was considered ([B] $P = .021$ and .013, respectively) (Table 5).

Inactive vs. active behaviors

For big cats, inactivity is naturally the predominant state. At no level was there a significant overall change in inactive or active behaviors (Table 4).

For cat $L1_{p7}$, overall active behaviors significantly decreased ([B], $P = .005$) and inactives increased ([B], $P = .003$), whereas cat $S10_{t7}$ experienced a significant overall decrease in active and inactive behaviors ([B], $P = .008$ and $P = 0.44$, respectively) (Table 5).

Hiding

Animal visibility is an issue of concern for curators and managers of public institutions. Overall, there was a significant increase in hiding on exhibit at all three

levels of carcass provision (level 1, [P], $P = .047$; level 2, [P], $P = .0053$; level 3, [P], $P = .0087$; Table 4).

DISCUSSION

Behavior Off Exhibit

Overall, the provision of carcasses had a positive effect on behavior off exhibit. For cats on baseline diet (Nebraska®), feeding behaviors comprised 5% or less of the 2-hr time period immediately following diet provision. With the provision of a carcass, that proportion increased to as much as 52% (for level 3, n = 3).

In addition to positive changes in feeding behavior, carcasses also caused an increase in natural behaviors and a decrease in stereotypic behaviors for animals in the off-exhibit area. Although the changes were not statistically significant, change could have been masked by hiding behaviors. Considering the proportion of natural to stereotypic behaviors, however, natural behaviors increased and stereotypies decreased.

Not all cats observed in the off-exhibit study reacted as predicted to carcass provision. Some animals experienced sporadic change, no change at all, or changes in directions opposite from those predicted. One cat ($L3_{p2}$) actually experienced a decrease in feeding behaviors, although other associative behaviors, such as guarding, increased. In fact, a Siberian tiger (*Panthera tigris altaica*) at Potawatomi Zoo was removed from the study after two carcasses because he appeared to experience extreme stress when a carcass was present. Toledo Zoo's snow leopards ($S10_{t7}$ and $S9_{t7}$) consistently dragged and stashed carcasses out of the camera's view, and probable feeding activity was not recorded. Therefore, potentially significant changes were masked due to the method of data collection and analysis. The question then becomes, Why did certain cats respond and others did not? For the few cats involved in this study, there is no clear answer. Response to carcass provision, however, was not a function of institution, species, sex, age, or temperature. A larger sample size could provide more insight into this question.

Behavior On Exhibit

The provision of carcasses had little impact on behaviors on exhibit. There was no overall change in natural, stereotypic, active, or inactive behaviors, but hiding did increase in conjunction with carcass enrichment. Whether or not this increase is in fact due to carcass provision remains to be seen. More work is necessary to explore that relationship adequately.

In this study, carcass provision was not an effective deterrent to on-exhibit stereotypic behavior. More change might have been visible in the on-exhibit study if the subjects had displayed more stereotypies in their daily activity budgets. These cats were generally behaviorally healthy, which made positive change unlikely. For better understanding of on-exhibit behavioral changes as a function of carcass provision, studies should be conducted with more cats with well-defined aberrant behavioral patterns.

Implications

Large carnivores are evolutionarily adapted to capture, and consume large vertebrate prey [Curio, 1976; Leyhausen, 1979; Sunquist and Sunquist, 1989; Taylor,

1989; Van Valkenburgh, 1989; Caro and Fitzgibbon, 1992; Alexander, 1993; Bailey, 1993; Seidensticker and McDougal, 1993; Biknevicius and Van Valkenburgh, 1996]. Currently, however, environmental enrichment programs for captive mammalian carnivores are not often based on the animals' behavioral ecology. Instead, they are based on item availability and ease of provision. Given this, I proposed that the provision of whole-prey items be tested as enrichment for large carnivores.

The present study has myriad limitations: multiple species, institutions, and data collectors; small sample size; and cats that showed extreme variability in behavior, ranging from immediate and complete consumption to extreme disinterest, bordering on fear. Despite all of these complications, the results strongly indicate that carcass provision has a positive impact on behaviors off exhibit—carcass provision decreases the number of stereotypic behaviors that occur off exhibit. However, the study did not find that whole-prey provision consistently decreased on-exhibit aberrant activity in captive carnivores, probably because of problems associated with the research being conducted at multiple institutions and on a small number of cats.

There have been few formal studies of this kind. Bond and Lindburg [1990] examined feeding behavior in cheetahs and demonstrated that cats fed carcasses spent more time feeding, exploring, and processing than those fed processed diets. Despite the primary role feeding plays in a carnivore's behavioral repertoire, however, carcass provision is not usually considered due to cost, labor, and potential public outcry.

A great deal of work is still needed for an understanding of how to accommodate the behavioral needs associated with feeding in large carnivores. Without a template or model, this research has laid the foundation for future work in this area. Mason [1993] indicated that stereotypic behaviors are species-typical, thus suggesting that reactions to enrichment could be species-typical as well. Given this, I suggest a study of at least 20 conspecifics with documented aberrant tendencies. This would provide solid, basic information on the effects of carcass provision on aberrant behaviors. Beyond that, an even larger sample size would be needed to explore the relationship of age and sex to carcass enrichment. No matter what the sample size, I suggest collecting more baseline data for the off-exhibit study and modifying either the enclosures or equipment to maximize the observer's ability to view individuals.

Even though carcass provision did not curtail aberrant behaviors on exhibit, it strongly enriched the animals' holding area. The effects of carcass provision did not persist over multiple days, so provisions should occur as often as each institution's budget and diet regime allow. Overall, carcass provision is an important enrichment technique that directly addresses the animals' behavioral ecology, morphology, and natural history.

CONCLUSIONS

1. For cats housed at Potawatomi Zoo, Toledo Zoo, and Binder Park Zoo, carcass provision decreased the number of stereotypic behaviors observed off exhibit.

2. Carcass provision did not consistently decrease stereotypic behaviors observed on exhibit in these captive carnivores, probably due to problems associated with the research being conducted at multiple institutions and on a small number of cats.

3. Carcass provision elicited an overall increase in feeding behaviors.

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