CONVENCIÓN SOBRE EL COMERCIO INTERNACIONAL DE ESPECIES
AMENAZADAS DE FAUNA Y FLORA SILVESTRES

Vigésimo novena reunión del Comité de Fauna
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Cuestiones específicas sobre las especies

Especies terrestres

Serpientes (Serpentes spp.)

CONSERVACIÓN, USO SOSTENIBLE Y COMERCIO DE SERPIENTES

1. Este documento ha sido presentado por la Secretaría y fue preparado por la Unión Internacional para la Conservación de la Naturaleza (UICN). El informe de la UICN que figura en el Anexo del presente documento se presenta en cumplimiento de la Decisión 17.279.

Recomendación

2. Se invita al Comité de Fauna a examinar la orientación relativa a la formulación de dictámenes de extracción no perjudicial para el comercio de serpientes incluidas en el Apéndice II que figura en el Anexo del presente documento y a formular recomendaciones al Comité Permanente según proceda.

Versión 1.2

Julio de 2017

Dictámenes de Extracción no Perjudicial para las serpientes: Guía para las Autoridades Científicas CITES

Grupo de Especialistas en Boas y Pitones de la CSE-UICN

Daniel Natusch, Tomas Waller, Patricio Micucci y Victoria Lichtschein

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i) Agradecimientos

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Finalmente, esta guía se benefició de aportaciones proporcionadas por diversos participantes de un Taller de expertos sobre la formulación de Dictámenes de Extracción no Perjudicial para las serpientes incluidas en el Apéndice II de la CITES, celebrado en Kuala Lumpur, Malasia, en mayo de 2017.

Afiliación de los autores:

Daniel Natusch; A08 Heydon-Laurence Building, University of Sydney, NSW 2006, Australia

Tomás Waller; Fundación Biodiversidad – Argentina, Suipacha 1311 – Piso 3, C1011AAC Ciudad Autónoma de Buenos Aires, Argentina

Patricio Micucci; Fundación Biodiversidad – Argentina, Suipacha 1311 – Piso 3, C1011AAC Ciudad Autónoma de Buenos Aires, Argentina

Victoria Lichtschein; Ministerio de Ambiente y Desarrollo Sustentable, San Martín 451, 1040 Ciudad Autónoma de Buenos Aires, Argentina

1.0 Introducción y antecedentes

1.1 Introducción

Cada año, millones de serpientes de numerosas especies son objeto de comercio internacional a fin de responder a la demanda de pieles, alimentos, animales de compañía, medicinas, y toda una serie de otras finalidades. Aproximadamente 150 especies están incluidas en los Apéndices de la Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestres (CITES) pues el comercio internacional puede convertirse, o se sabe que se ha convertido, en una amenaza para la supervivencia a largo plazo de dichas especies en el medio silvestre. En el caso de muchas especies de serpientes, la recolección en el medio silvestre y el comercio han tenido lugar durante siglos contribuyendo a menudo a los medios de subsistencia de las poblaciones rurales. El hecho de garantizar que las recolecciones de serpientes sean sostenibles y no provoquen reducciones que puedan llevar a la extinción contribuye al objetivo de conservación que consiste en mantener a las serpientes como parte integrante de ecosistemas en buen estado de funcionamiento. De igual manera, el mantenimiento de la capacidad por parte de las poblaciones de utilizar los recursos de serpientes locales y renovables, como medios de subsistencia, se ha convertido en un objetivo cada vez más reconocido de la gestión (CITES Res. Conf. 8.3 y 16.6).

El Artículo IV de la Convención CITES establece que el comercio internacional de serpientes incluidas en los Apéndices de la CITES, o sus partes y derivados tales como las pieles y la carne, estará sujeto a Dictámenes de Extracción No Perjudicial formulados por la Parte de exportación. A pesar de que las Partes entienden la importancia de los DENP y están comprometidas en cumplir con sus obligaciones en el marco de la CITES, en muchos casos carecen de la capacidad, las herramientas o el asesoramiento para formular los DENP de manera efectiva. Esta situación es válida a menudo en el caso de las serpientes, muchas de las cuales siguen siendo objeto de comercio sin que haya una información sobre los efectos que dicha utilización está teniendo en sus poblaciones.

El objetivo de este documento es guiar a las Autoridades Científicas CITES con relación a cómo formular un DENP para las serpientes incluidas en los Apéndices de la CITES. Estas Directrices sobre los DENP están divididas en dos partes:

i) La primera parte recoge las directrices básicas para la formulación de los DENP, las cuales ofrecen una visión general sobre (1) la mejor manera de determinar el carácter no perjudicial, (2) el contexto del manejo de las serpientes, y proporciona (3) una guía paso por paso sobre cómo evaluar si las extracciones y el comercio no tienen efectos perjudiciales. Las Directrices sobre los DENP se proponen ser simples, y contienen la información mínima imprescindible que las Autoridades Científicas necesitan a fin de formular un DENP para las serpientes; en esencia, se trata de "los elementos necesarios para formular un DENP".

ii) La segunda parte está compuesta por un Anexo en el que se presenta información adicional, se examinan cuestiones conceptuales, y se proporcionan informaciones más detalladas sobre cómo elaborar un DENP e implementar programas de supervisión y manejo. Se alienta a las Partes a consultar atentamente los Anexos cuando utilicen las directrices para los DENP.

Para obtener una explicación más detallada e informaciones adicionales sobre la génesis de esta guía, véase la Sección I del Anexo A.

1.2 ¿Cómo utilizar esta guía?

Las dos partes que componen estas Directrices sobre los DENP han sido concebidas de manera que se completen mutuamente. En el Anexo, los usuarios podrán encontrar información adicional detallada sobre los temas que sean de particular interés para ellos o que requieran aclaraciones adicionales. Para simplificar los movimientos entre la parte principal de las Directrices sobre los DENP y el Anexo, en cada sección de las Directrices se incluyen varios enlaces. A través de dichos enlaces el usuario puede acceder a la sección específica del Anexo en la que podrá encontrar información adicional sobre ese tema. Cada una de las secciones del Anexo también incluye enlaces hacia la sección correspondiente de la parte principal de las Directrices sobre los DENP, facilitando así el regreso a cada sección. Estos enlaces deberían simplificar la utilización electrónica de esta guía.

1.3 La CITES y las serpientes: las Directrices sobre los DENP y las dificultades para su aplicación

De las aproximadamente 3 600 especies de serpientes reconocidas en el mundo (http://www.reptile-database.org/db-info/SpeciesStat.html), en el momento de redactar el presente documento, 130 (un 3,7 %) están incluidas en el Apéndice II de la CITES, que permite que tenga lugar un comercio sostenible reglamentado de dichas especies. De estas, sólo un 25 % (33) son objeto regularmente de comercio internacional. Dos tercios de las especies incluidas en el Apéndice II de la CITES forman parte de las familias Boidae y Pythonidae (las boas y pitones). Éstas serpientes de gran tamaño y a menudo coloridas son objeto de comercio principalmente por sus pieles, su carne y como animales de compañía, y representan la mayor parte del comercio en cuanto a especies y volumen. Desde un punto de vista geográfico, más de la mitad de las especies de serpientes incluidas en los Apéndices de la CITES que son actualmente objeto de comercio (un 61%, 20) proceden de Asia Suroriental, región que también representa un 73 % del comercio mundial de serpientes y derivados en cuanto a volumen (Base de datos sobre el comercio CITES / PNUMA-CMCM, 2015). Muchas otras especies de serpientes (por ejemplo, las serpientes de agua Homalopsine y algunas serpientes rata de Asia Suroriental) también son objeto de comercio internacional en grandes cantidades, pero no están incluidas en los Apéndices de la CITES.

Tomando en cuenta que las transacciones comerciales se limitan en gran medida a las especies del Apéndice II, las partes deben cumplir con el Artículo IV de la CITES y conceder únicamente un permiso de exportación para las especies de serpientes incluidas en el Apéndice II cuando:

(1) La Autoridad Científica designada del Estado de exportación ha determinado que esa exportación *no será perjudicial para la supervivencia de la especie en la naturaleza*, y

(2) Una vez que las exportaciones están teniendo lugar, la Autoridad Científica ha realizado un seguimiento de los niveles reales de exportación para garantizar que la especie *se mantiene, a través de su hábitat, en un nivel consistente con su papel en los ecosistemas donde se halla y en un nivel suficientemente superior a aquel en el cual esa especie sería susceptible de inclusión en el Apéndice I*.

Cuando una Autoridad Científica tenga dudas con relación al carácter no perjudicial de las exportaciones de especímenes de especies incluidas en el Apéndice II, deberá comunicar a la Autoridad Administrativa correspondiente las medidas que deben tomarse, a fin de limitar la concesión de permisos de exportación para especímenes de dicha especie. Si se considera que las exportaciones no son perjudiciales, éstas podrán continuar sin que sea necesario intervenir. Este proceso se designa como Dictamen de Extracción no Perjudicial CITES (DENP). La evaluación del posible carácter perjudicial de la extracción de animales de la naturaleza para el comercio, y la formulación de un DENP, son elementos esenciales de la reglamentación para las especies incluidas en el Apéndice II de la CITES y, por consiguiente, de la Convención (Jenkins, 2009). Sin embargo, en la práctica, resulta difícil para muchas Partes formular DENP sólidos para todas las exportaciones.

Un DENP puede ser muy fácil y sencillo para algunas especies en determinados contextos, pero de gran complejidad y dificultad para otras especies en contextos diferentes. A pesar de que la CITES no prescribe la manera en que las Partes deben determinar el carácter "no perjudicial", habitualmente se les alienta a que examinen la información disponible sobre el estado, la distribución y las tendencias de la población, la recolección, el comercio, y otros factores biológicos y ecológicos de la especie que es objeto de comercio, según corresponda. También se alienta las Partes a que tomen en cuenta los Principios y directrices de Addis Abeba para la utilización sostenible de la diversidad biológica publicados por el Convenio sobre la Diversidad Biológica (2004), así como las Resoluciones pertinentes de la Conferencia de las Partes en la CITES.

A pesar de estas orientaciones, muchas Partes carecen de la capacidad y los recursos necesarios para realizar algo más que los DENP más simples (Nash, 1993; Apensberg-Traun, 2009; Jenkins, 2009). En muchos casos, las informaciones biológicas de que disponen las Autoridades Científicas reflejan únicamente el propio conocimiento del personal acerca de la especie o él de los operadores comerciales o la industria, lo cual no constituye necesariamente la mejor información disponible. Como resultado de estas dificultades que se acumulan, a menudo las Partes exportan especies incluidas en el Apéndice II sin realizar evaluaciones suficientes sobre los efectos del comercio internacional en las poblaciones silvestres y, por consiguiente, en muchos casos no están cumpliendo su obligación de garantizar que el comercio sea "no perjudicial" para dichas especies (Jenkins, 2009).

Este problema está exacerbado por el hecho de que, en el pasado, las Directrices sobre los DENP casi siempre han partido de la suposición de que se conoce o se debería conocer la tendencia de la población de la especie. En realidad, rara vez es así. Por ejemplo, las Directrices de la UICN para asistir a las Autoridades Científicas CITES en la formulación de los DENP identifican 26 criterios considerados pertinentes para la especie en cuestión. Los criterios para evaluar el carácter perjudicial se centran en los datos biológicos, la protección, los incentivos, la supervisión, el control, el manejo, y el estado de la especie y su comercio (Rosser and Haywood, 2002). Un conocimiento completo con relación a estos elementos puede ayudar a predecir la probabilidad de que haya un efecto perjudicial, pero proporciona poca indicación sobre la situación real de la especie en la naturaleza. Por ejemplo, una especie con características del ciclo biológico que hacen que sean reciliente frente a la utilización (a saber, un crecimiento rápido y una alta fecundidad), que sea común, que esté bien protegida, y que ocupe una amplia área de distribución, puede experimentar, a pesar de todo, niveles no sostenibles de recolección. Ello se debe a que a pesar de poseer múltiples características que hacen que la especie sea reciliente frente a la utilización, el nivel de recolección puede ser tan alto que no se puede frenar la disminución de su abundancia. Sin un conocimiento más completo sobre los cambios de la población que pueda ser utilizado en una evaluación para un DENP, puede haber niveles no sostenibles de recolección que no se detecten si no hay una buena supervisión y que no se modifiquen si no se dispone de un buen manejo.

1.4 Efecto no perjudicial y cría en cautividad

La cría en cautividad con fines comerciales de serpientes incluidas en el Apéndice II es frecuente en muchos Estados del área de distribución, así como en países fuera del área de distribución de la especie. Los especímenes cubiertos por la CITES que son objeto de comercio utilizando el código de origen C o D no requieren un DENP. Sin embargo, entre otras obligaciones, las Partes de exportación que utilizan el código de origen "C" para especímenes criados en cautividad deben cumplir a pesar de todo con lo dispuesto en el Artículo IV de la CITES y velar porque las exportaciones no sean perjudiciales para la supervivencia de las poblaciones silvestres (Resolución. Conf. 10.16).

En el caso de las especies criadas en cautividad respetando la legislación nacional, en relación con los planteles silvestres que entran en los establecimientos de cría en cautividad, "*el método utilizado para formular un dictamen de extracción no perjudicial para un espécimen que se sabe que no es de origen silvestre puede ser menos riguroso que el utilizado para un espécimen de origen silvestre*" (Resolución Conf. 16.7). Sin embargo, existen dificultades evidentes en situaciones en las que los sistemas de producción basados en la cría en cautividad están estrechamente vinculados con extracciones que están teniendo lugar en la naturaleza sin cumplir con la legislación nacional. Este tipo de situación puede presentarse cuando los especímenes silvestres recolectados ilegalmente son blanqueados a través de establecimientos de cría en cautividad, y cuando la recolección de especímenes silvestres como plantel parental no es sostenible. En estas situaciones, el Artículo IV (párr. 2b) establece que se emitirán permisos de exportación únicamente cuando "*una Autoridad Administrativa del Estado de exportación haya verificado que el espécimen no fue obtenido en contravención de la legislación vigente en dicho Estado sobre la protección de su fauna y flora*".

1.5 Efecto no perjudicial y comercio ilegal

Cuando está teniendo lugar un comercio ilegal en contravención de la legislación nacional, el comercio internacional de estos especímenes constituye una violación tanto del derecho internacional como de la CITES. Los efectos del comercio ilegal en las poblaciones silvestres son generalmente difíciles de detectar, pues dicho comercio es por naturaleza clandestino y no declarado. La situación es mucho más complicada cuando la utilización y el comercio ilegales están teniendo lugar conjuntamente con la utilización y el comercio legales. Estas situaciones ocurren cuando las serpientes son recolectadas ilegalmente en la naturaleza y declaradas fraudulentamente como criadas en cautividad, o cuando los especímenes que sobrepasan los cupos nacionales se sacan simplemente del país de contrabando. Cuando se desconocen los volúmenes de recolección ilegal, se pueden utilizar los métodos propuestos en este documento para inferir el nivel de sostenibilidad de dicha recolección. Sin embargo, incluso si se logra hacer esta estimación, la recolección sigue siendo ilegal y debe ser objeto de medidas de cumplimiento y observancia, aunque se considere "no perjudicial".

2.0 Definición del efecto "no perjudicial"

En muchos casos relacionados con serpientes, se utilizan indistintamente palabras tales como *insostenible*, *sobreutilización*, *sobreexplotación o perjudicial*. Por consiguiente, antes de comenzar un DENP para exportaciones de especímenes de serpientes es importante definir qué significa un *perjuicio*, y, por tanto, cuáles son los criterios para determinar cuándo una exportación particular es "no perjudicial".

A pesar de que la recolección resulta inevitablemente en una disminución de la abundancia de las poblaciones, ello no implica automáticamente que la recolección sea "perjudicial". Las variables que influyen en el crecimiento o en la recuperación de la población pueden seguir siendo superiores a las que causan su disminución (en este caso, la recolección). Si se puede mantener el nivel de abundancia a lo largo del tiempo a través del manejo, en ese caso la población está siendo recolectada de manera sostenible, y teóricamente podría continuar siendo recolectada para siempre. El problema principal con relación a la CITES tiene lugar cuando, por cualquier razón, no se puede controlar o manejar la disminución de la abundancia o el nivel de la recolección, y la capacidad de la población para recuperarse se ve comprometida incluso si cesa la recolección. En estos casos, las especies concernidas podrían terminar reuniendo las condiciones para la inclusión en el Apéndice I.

Así pues, en muchos casos, la manera más práctica de garantizar que la recolección sea *no perjudicial* consiste en garantizar que las poblaciones de una especie objeto de comercio sean utilizadas de manera sostenible ("*la utilización de componentes de la diversidad biológica de un modo y a un ritmo que no ocasione la disminución a largo plazo de la diversidad biológica, con lo cual se mantienen las posibilidades de ésta de satisfacer las necesidades y las aspiraciones de las generaciones actuales y futuras*") . Esto es especialmente válido para las especies del Apéndice II, que no están amenazadas de extinción debido al comercio. Por ejemplo, para las especies incluidas en el Apéndice II, el objetivo es mantenerlas en un nivel suficientemente superior a aquel en el cual esa especie sería susceptible de inclusión en el Apéndice I (Artículo IV, párr. 3). Sin embargo, puede resultar difícil determinar en qué momento una especie ha disminuido hasta un nivel en el que las intervenciones de manejo no pueden evitar disminuciones futuras ni controlar la recolección, haciendo así que esta última sea perjudicial. Por otra parte, si se demuestra que las poblaciones están siendo manejadas y utilizadas de manera sostenible se está dando cumplimiento en esencia a las obligaciones de manejo de la vida silvestre establecidas en el Artículo IV mediante un mecanismo flexible y cautelar que garantiza que no haya un efecto perjudicial (Webb et al. 2003).

Así pues, esta guía sobre los DENP se focaliza en determinar que el comercio no es perjudicial garantizando que sea sostenible. El comercio no perjudicial (sostenible) puede alcanzarse si es posible responder positivamente a dos preguntas básicas:

1) ¿Son sostenibles la recolección y el uso a lo largo del tiempo (existen indicaciones de una tendencia a la disminución, u otros efectos negativos en las poblaciones silvestres de la especie?); y

2) ¿Se están controlando los efectos de la recolección y el comercio dentro de límites prescritos (sostenibles)?

Se puede utilizar toda una variedad de diferentes indicios para responder a estas preguntas, entre ellos: cambios en la distribución; cambios en la densidad; cambios en la estructura de la población; áreas de recolección (proporción de la distribución total; modificación de las áreas); capturas por unidad de esfuerzo; cuestiones jurídicas; y otras amenazas (pérdida de hábitat, cambio climático, contaminación, etc.) (Taller CITES de Cancún sobre los DENP, 2008).

Al asegurar que la recolección y el comercio son sostenibles (no perjudiciales), las Autoridades Científicas CITES pueden también tener la seguridad de que la especie se mantiene en un nivel adaptado a su función en el ecosistema.

Para un examen más detallado de la teoría de la recolección y la interrelación entre *uso sostenible* y *efecto perjudicial*, véase la Sección II del Anexo A

3.0 El contexto del manejo de las serpientes

Las serpientes son particulares pues poseen toda una serie de características, tales como su naturaleza críptica y altamente sedentaria, que dificulta la realización de evaluaciones convencionales del estado de la población a partir de estudios de campo. El resultado es que en el caso de muchas especies de serpientes, simplemente no existe suficiente información para realizar evaluaciones bien fundamentadas sobre si el nivel de comercio es perjudicial o no. Para complicar aún más la situación, la metodología científica tradicional, basada en los estudios de campo, que se utiliza para el manejo de las serpientes a menudo no es capaz de proporcionar respuestas sobre el posible efecto perjudicial en la escala de tiempo que piden los responsables del manejo.

Si bien es posible establecer conclusiones con relación a la probabilidad de que el comercio de determinadas poblaciones de serpientes sea sostenible, y formular recomendaciones basándose en una serie de criterios indicativos (características del ciclo biológico, área de ocupación, etc.), la única manera de saber a ciencia cierta lo que sucederá cuando se manipula una población silvestre es a través de ensayos y experimentos, lo cual requiere que se establezca un sistema de supervisión adecuado para las especies sometidas a regímenes de recolección.

Por estas razones, y para que sean lo más útiles posibles a los responsables del manejo y de la toma de decisiones, los DENP para las serpientes deberían ser:

- Precisos: se debe garantizar la calidad de los datos que componen la información, utilizando la mejor información científica disponible;
- Siempre que se pueda, se ha de utilizar la información derivada de la gestión misma, particularmente a través de indicadores fácilmente mensurables (por ejemplo, las características biológicas de los especímenes recolectados, el rendimiento de la recolección, la relación entre esfuerzo y rendimiento, la proporción entre los sexos, la demografía de la recolección basándose en los animales vivos o el tamaño de las pieles, los análisis de las tendencias, etc.) en vez de recurrir a programas de investigación y supervisión totalmente independientes;
- Simples y rentables, desde el punto de vista de la cantidad y calidad de la información necesaria para examinar los indicadores más importantes.

Para un examen más detallado de los elementos que dificultan la formulación de los DENP para las serpientes, véase la Sección III del Anexo A.

4.0 Directrices para la formulación de los DENP para las serpientes

El DENP de la CITES es una evaluación de si **un nivel dado de recolección para el comercio internacional es *no perjudicial***.

El primer paso para formular un DENP para las exportaciones de serpientes es (1) identificar correctamente el/los espécimen(es) que será(n) objeto de comercio, (2) confirmar su origen (W, R, F, C, etc.), y (3) verificar que su adquisición sea legal. Si no se cumplen estos criterios la exportación no puede tener lugar. El propósito de estas directrices no es asistir a las Partes para determinar la taxonomía, el origen, o el carácter legal de las serpientes que son objeto de comercio. Cada uno de estos criterios deberá ser examinado y confirmado por la Autoridad Administrativa CITES de la Parte a partir de la contribución técnica de la Autoridad Científica CITES. Si fueran necesarias otras consultas a expertos que puedan contribuir en este proceso se deberán establecer contactos con museos, universidades, ONG pertinentes y otras redes de expertos tales como el Grupo de Especialistas en Boas y Pitones de la CSE-UICN (GEBP. La finalidad estas directrices es ayudar a las Partes en la CITES a determinar si la recolección y el comercio son no perjudiciales para las poblaciones silvestres de serpientes.

Esto puede lograrse siguiendo los pasos de la **Figura 1**. El grupo de trabajo sobre reptiles del Taller internacional de expertos sobre dictámenes de extracción no perjudicial (Taller CITES de Cancún sobre los DENP, 2008) propuso una metodología en dos niveles para los DENP: (a) evaluación del riesgo; y (b) supervisión y manejo. Tras haber considerado varias hipótesis de trabajo con relación a las serpientes, proponemos una metodología en cinco pasos que van del más simple al más complejo, en función de los efectos posibles del comercio en cada situación:

Paso 1: Realizar una *Evaluación Primaria* del riesgo de que la recolección para el comercio ponga, o pueda poner, a la especie en peligro de extinción.

Paso 2: Si a partir de la *Evaluación Primaria* no es posible establecer el carácter no perjudicial, entonces es necesaria una *Evaluación Secundaria*. En este paso se incorporan nuevos datos, si están disponibles, o los datos obtenidos de los procedimientos de supervisión y manejo.

Paso 3: Cuando son necesarios procedimientos de supervisión y manejo para establecer el carácter no perjudicial, pero estos todavía no han sido establecidos, se ha de describir cuáles son las intervenciones de supervisión y manejo previstas, y de qué manera los resultados van a ser interpretados para establecer el carácter no perjudicial.

Paso 4: Si una vez completados los Pasos 1 a 3 existe suficiente información para determinar que el comercio no es perjudicial entonces las exportaciones pueden comenzar o continuar de la manera habitual. Sin embargo, si existen razones suficientes para que una Parte considere que las extracciones pueden ser perjudiciales, podría ser adecuado formular un DENP negativo y restringir voluntariamente las exportaciones hasta que se cumpla el criterio del carácter no perjudicial.

Paso 5: Los DENP no son eventos únicos. Las situaciones pueden cambiar por toda una serie de razones, y se deben repetir y actualizar periódicamente los DENP para reflejar estos cambios.

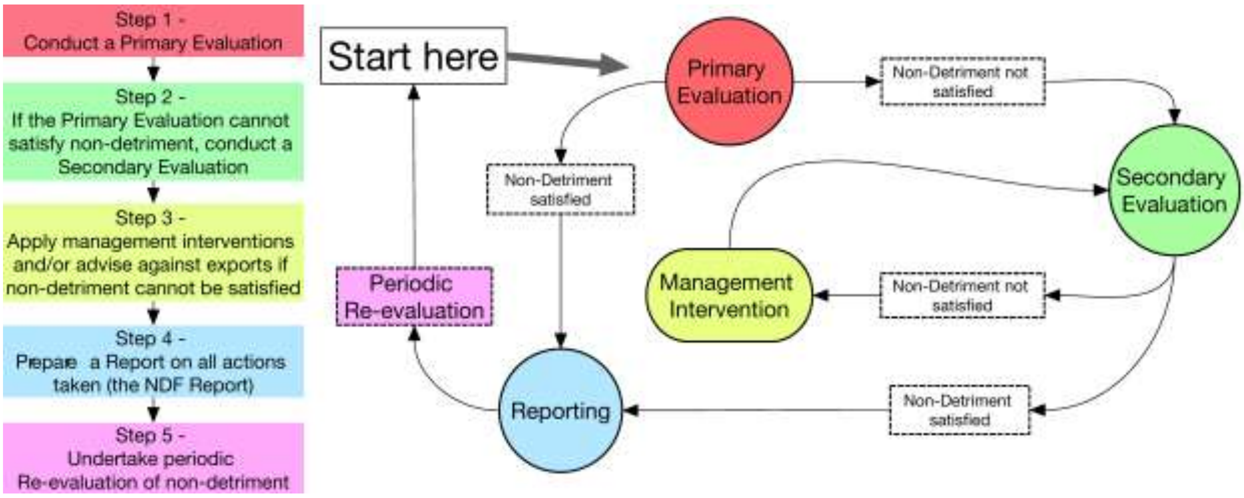


Fig. 1. Proceso paso por paso a seguir a fin de determinar el carácter no perjudicial de las exportaciones de serpientes incluidas en el Apéndice II de la CITES.

4.1 Fuentes de información para formular un DENP

Un elemento clave del Dictamen de Extracción no Perjudicial (DENP) es la información o incluso la inferencia del nivel de recolección de una especie, su área de ocupación, el posible tamaño de su población, la tasa de recolección y los parámetros de su ciclo biológico. Se deberá documentar la información disponible utilizada para fundamentar un DENP, con fuentes y referencias cuando corresponda. Estas Directrices están en consonancia con la Resolución Conf. 16.7 de la CITES, que recomienda que entre las fuentes de información que se pueden tener en cuenta cuando se realiza una Evaluación Primaria o Secundaria como parte de un DENP, se incluya, sin limitarse a ello:

- **i.** las publicaciones científicas relevantes sobre la biología, el ciclo vital, y la distribución de la especie;
- **ii.** los pormenores de cualquier evaluación de riesgo ecológico realizada;
- **iii.** los estudios científicos realizados en los lugares de recolección y en los sitios protegidos de la recolección u otros impactos
- **iv.** los detalles sobre los sistemas de supervisión y manejo aplicados a las especies en cuestión;
- **v.** los conocimientos y la experiencia práctica pertinentes de las comunidades locales e indígenas;
- **vi.** las consultas con los expertos locales, regionales e internacionales pertinentes; y
- **vii.** la información sobre el comercio nacional e internacional como la que existe, por ejemplo, en la base de datos sobre el comercio de la CITES mantenida por el (PNUMA-CMCM), las publicaciones sobre el comercio, los conocimientos locales sobre el comercio y las investigaciones sobre las ventas en los mercados o a través de Internet.

4.2 Paso 1: Evaluación Primaria

La finalidad de una *Evaluación Primaria* es determinar si se puede establecer fácilmente el carácter no perjudicial utilizando información básica. Para ello se debe dar una puntuación a cuatro criterios básicos:

- **i.** Nivel anual de la recolección
- **ii.** Área de ocupación, y
- **iii.** Características del ciclo biológico
- **iv.** Factores adicionales de riesgo

Se pueden aplicar puntuaciones determinando cuáles de estos tres criterios de interés son aplicables basándose en la matriz que figura en la **Tabla 1**, que se aplica a todas las especies de serpientes. La puntuación máxima para cada categoría es tres y la puntuación mínima es uno.

Tabla 1. Criterios para la puntuación de las cuatro variables de interés en la *Evaluación Primaria*.

	Número de puntos			**Puntuación**
Criterios	**1**	**2**	**3**	
Nivel anual de la recolección	Bajo (<2 000)	Mediano (2 000 - 20 000)	Alto (>20 000)	
Área de ocupación	Grande (>20 000km²)	Mediana (2 500 - 20 000km²)	Pequeña (<2 500km²)	
Ciclo biológico	Rápido	Medio	Lento	
Factores adicionales de riesgo	Se deberán tomar en cuenta otros factores que influyen en el riesgo que representa la recolección. De manera específica, si se dispone de indicios de la existencia de comercio ilegal y/o la especie ha sido clasificada como vulnerable, en peligro, o en peligro crítico en la Lista Roja de la UICN, se deberá asignar una **puntuación máxima de 1 punto.**			

Paso 1: Una vez que se han establecido los niveles de recolección de una especie, su área de ocupación, las características de su ciclo biológico y los factores adicionales de riesgo, se puede asignar una puntuación de la *Evaluación Primaria* para determinar si el comercio puede ser perjudicial.

Paso 2: Registre la puntuación de la *Evaluación Primaria* para cada uno de los criterios de la plantilla para la *Evaluación Primaria* que se proporciona (en el **Anexo B**), conjuntamente con una justificación de la puntuación específica asignada a cada criterio.

Paso 3: A partir de los criterios en la **Tabla** 1, determine si es necesario realizar una *Evaluación Secundaria* para establecer el carácter no perjudicial utilizando las orientaciones que figuran en el recuadro "Evaluación del Carácter No Perjudicial".

Evaluación del Carácter No Perjudicial

Una puntuación en la Evaluación Primaria inferior a cinco (5) = el comercio es no perjudicial (**indique la puntuación y la justificación en la plantilla para la Evaluación Primaria que figura en el Anexo B**). **Esto puede ser utilizado para el Paso 4 del Dictamen de Extracción no Perjudicial**).

Si la puntuación de la *Evaluación Primaria* es igual o superior a (5) entonces no se cumple la condición del carácter no perjudicial, y se precisa de información adicional a partir de otros indicios para evaluar si existe un efecto perjudicial o no.
Se deberá realizar una *Evaluación Secundaria*.

4.3 Guía para la realización de una *Evaluación Primaria*

La finalidad de una *Evaluación Primaria* es determinar si se puede determinar fácilmente el carácter no perjudicial utilizando información básica. No se trata de un Dictamen de Extracción no Perjudicial (DENP) en el que "se pasa o se falla". Tal vez las Autoridades Científicas no puedan formular un DENP positivo utilizando únicamente la *Evaluación Primaria*, pero eso no significa que automáticamente la recolección y el comercio sean considerados como perjudiciales Ello significa simplemente que es necesaria más información para determinar si los efectos son perjudiciales o no. La utilidad de la *Evaluación Primaria* es que muchas especies puede ser "eximidas" básicamente de evaluaciones complejas para el DENP, lo cual permite que las Partes dediquen su energía y recursos a las especies que requieren realmente una evaluación más sofisticada. Por ejemplo, el pitón de Albert (*Leiopython albertisii*) está presente en toda la isla de Nueva Guinea, en diversos hábitats (tanto naturales como degradados), y tiene una recolección natural de sólo 400 individuos en menos de un 5 % del área de distribución de la especie. Claramente, esta especie no ha sido extirpada de las áreas donde es recolectada, tiene un ciclo de vida que le permite recuperarse de la recolección, y una población silvestre total que probablemente abarca millones de individuos. No existe una probabilidad razonable de que la recolección pueda causar la extinción de la especie y por consiguiente, no es necesario un DENP complejo y detallado antes de que las exportaciones puedan tener lugar.

Uno de los elementos clave en la *Evaluación Primaria* consiste en determinar el posible porcentaje de la población que está siendo recolectado. Esto se puede evaluar de manera general si se examina el nivel de recolección conjuntamente con un valor sustitutivo para la proporción de la población que está siendo recolectada (en este caso, el área de ocupación de la especie). Además de esto, es útil examinar un valor sustitutivo para la capacidad de la especie para recuperarse de la recolección (en este caso, las características del ciclo biológico). Finalmente, si existieran otros factores que podrían estar afectando a las poblaciones silvestres (comercio ilegal, especies invasoras, contaminación) éstos también deben ser tomados en consideración. Estos criterios combinados pueden ser utilizados para determinar la probabilidad de que la recolección constituya un riesgo para la supervivencia de la especie.

La *Evaluación Primaria* sigue un enfoque cautelar, en la medida en que cualquier puntuación de tres (3) en cualquiera de las categorías que figura en la **Tabla 1** implica automáticamente la necesidad de una *Evaluación Secundaria*. Independientemente de la puntuación asignada, se debe indicar para cada criterio de interés la razón por la que se asignó dicha puntuación. Si una especie tiene una puntuación general inferior a cinco en la *Evaluación Primaria*, entonces es muy poco probable que esté amenazada por el comercio, y no es necesario realizar una *Evaluación Secundaria*. En el caso de muchas especies, se puede formular un DENP en esta fase. La realización de un DENP muy básico, utilizando únicamente una pequeña porción de información, es totalmente aceptable y ha sido aprobado por la Conferencia de las Partes en la CITES en la Resolución Conf. 16.7, que establece que:

"las necesidades de datos para determinar que el comercio no es perjudicial para la supervivencia de la especie deberían ser proporcionales a la vulnerabilidad de la especie de que se trate."

La Evaluación Primaria debería ser actualizada con regularidad para que se ajuste a los posibles cambios en los criterios (tales como las reducciones en el área de ocupación debido a la pérdida de hábitat). Las especies para las cuales no es necesaria una *Evaluación Secundaria* en el primer año tal vez requieran una el año siguiente. A continuación, se presentan explicaciones sobre cómo determinar los niveles de recolección de una especie, su área de ocupación y las características de su ciclo biológico, y también se proporcionan modelos en blanco y evaluaciones completas a título de ejemplo:

Nivel anual de la recolección

El nivel de recolección que experimenta la población de cualquier animal es la variable más importante que ha de tomarse en cuenta cuando se evalúe el riesgo de que haya un efecto perjudicial en una *Evaluación Primaria*. Si los niveles de recolección son muy bajos, podría no importar que la especie tenga una pequeña área de ocupación o un ciclo biológico muy lento. Por ejemplo, para la inmensa mayoría de las serpientes (con la posible excepción de algunas subpoblaciones insulares), una recolección de algunos centenares de individuos cada año no constituirá una amenaza para la supervivencia de la especie en la naturaleza. Sin embargo, en el momento de determinar los niveles de recolección, las Autoridades Científicas deberían también tratar de estimar los niveles de recolección ilegal (en el sentido de la Resolución Conf. 16.7 de la CITES). Esto puede lograrse utilizando un enfoque cualitativo: en primer lugar, se trata de determinar si existe un comercio ilegal y, en segundo lugar, se estima la probable magnitud del comercio ilegal en términos generales (por ejemplo, bajo, medio, alto).

Área de ocupación

El área de ocupación se define como el área al interior de la de la "extensión de ocurrencia" de una especie, excluyendo los casos de animales errantes (definición de la Lista Roja de la UICN). Esta medida refleja el hecho de que un taxón habitualmente no está presente de manera uniforme a todo lo largo de la extensión de ocurrencia, la cual puede incluir hábitats inadaptados o no ocupados. Este criterio es importante porque cuando una especie tiene una pequeña área de ocupación (por ejemplo, es endémica de una montaña o una isla) es más fácil acceder los individuos de toda la población y recolectarlos. Además, tomando en cuenta que a menudo la abundancia depende de la densidad, un área de ocupación más pequeña resultará en un tamaño absoluto de la población más pequeño. Por el contrario, las especies que viven en grandes áreas a menudo tienen tamaños de población mayores y la probabilidad de que todas las poblaciones dentro del área de distribución sean objeto de recolección (y se vean afectadas por sus efectos) es menor.

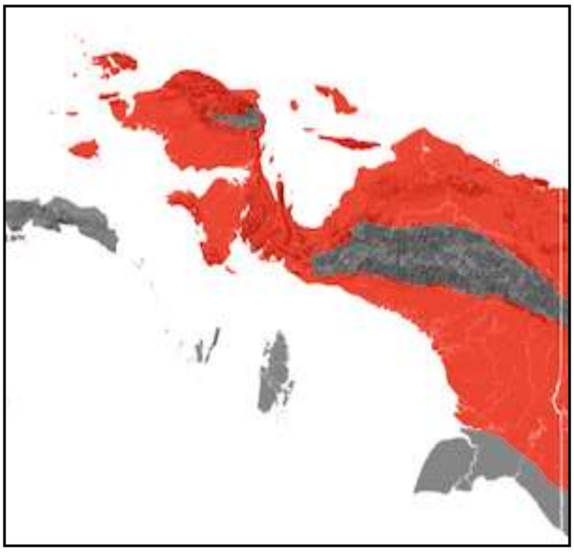
El área de ocupación de una especie es diferente a su área de distribución. En algunos casos, el área de ocupación puede ser prácticamente idéntica al área de distribución o a la extensión de ocurrencia, pero en otros casos no lo es. Por ejemplo, la boa constrictor (*Boa constrictor*) tienen una amplia área de distribución en América del Sur y Central, y también un área de ocupación igualmente amplia como resultado de su capacidad para desarrollarse en entornos modificados por los seres humanos. Por el contrario, la boa esmeralda (*Corallus caninus*) tiene una amplia área de distribución dentro de América del Sur, pero tiene un área de ocupación más pequeña debido a su dependencia de los hábitats en los bosques lluviosos o a su incapacidad para desarrollarse en entornos modificados por los seres humanos. En el recuadro que figura a continuación, se proporciona un ejemplo de cómo se puede estimar el área de ocupación. Para estimar el área de ocupación, es importante que los cálculos se basen en la información actual, por ejemplo, se deben tomar en cuenta los hábitats que han sido convertidos o transformados y que ahora son inadecuados para la especie. Las estimaciones del área de ocupación deben ser realizadas a nivel nacional y no a nivel de la subpoblación que es objeto de recolección.

Ejemplo de área de ocupación

En este ejemplo examinaremos el área de ocupación de *Leiopython albertisii* en Indonesia, una especie de pitón que vive en la isla de Nueva Guinea. Todos los años se recolectan pequeñas cantidades en Nueva Guinea Occidental (perteneciente a Indonesia) para abastecer el comercio de animales de compañía.

- *L. albertisii* está presente en Indonesia, que tiene una superficie de tierra de 1 904 569 km² (**recuadro A**).
- Sin embargo, se sabe que *L albertisii* está presente únicamente en las provincias de Papúa y Papúa Occidental en Indonesia. El área de estas provincias es de 416 129 km².
- Además, *L albertisii* está presente únicamente en los hábitats de bosques lluviosos, que no existen en las zonas montañosas o en la parte meridional de Papúa.
- Basándose en esta información, se estima que el área de ocupación de *L albertisii* en Indonesia es de **176,750 km²**: la extensión de los bosques lluviosos de llanura en Papúa y Papúa Occidental (**recuadro B**).

Recuadro A. El área de Indonesia.



Recuadro B. *L. albertisii* está presente en las áreas de bosques lluviosos de llanura de Papúa (en rojo), pero no en las zonas arboladas o en las zonas montañosas (en gris).

Características del ciclo biológico

El ciclo biológico se refiere a las características que posee una especie que afectan su supervivencia y su potencial reproductivo, tales como la edad de madurez, la frecuencia reproductiva y la fecundidad, así como la duración de la vida. De manera general, estas características desempeñan un papel significativo para determinar la resiliencia de una especie frente al uso. A pesar de que la recuperación frente a la recolección está influida por más factores y no sólo por el ciclo biológico de una especie (por ejemplo, su dependencia a la densidad), en general, una especie que tarda mucho para alcanzar la madurez, se reproduce de manera poco frecuente y sólo tiene un pequeño número de crías, necesitará más tiempo para recuperarse (**Fig. 2**). Por el contrario, una especie que crezca y madure rápidamente y que tenga muchas crías cada año probablemente se recuperará más rápidamente. Las Autoridades Científicas que realizan una *Evaluación Primaria* deberán tomar en cuenta todos los aspectos del ciclo biológico de una especie y tomar la mejor decisión posible (reconociendo que no existen criterios fijos o cuantitativos para "rápido", "medio" o "lento").

En la mayoría de los casos las características del ciclo biológico de una especie pueden ser determinadas consultando la literatura existente. Sin embargo, en algunos casos, no se dispone de información para llegar a una conclusión. En esos casos, las Autoridades Científicas pueden estimar dichas características basándose en estudios de especies afines, que puedan presentar características similares a las de la especie considerada. No obstante, las Autoridades Científicas deberían esforzarse por incrementar su conocimiento de las características biológicas de la especie realizando estudios de campo o estudiando las serpientes que son recolectadas para el comercio.

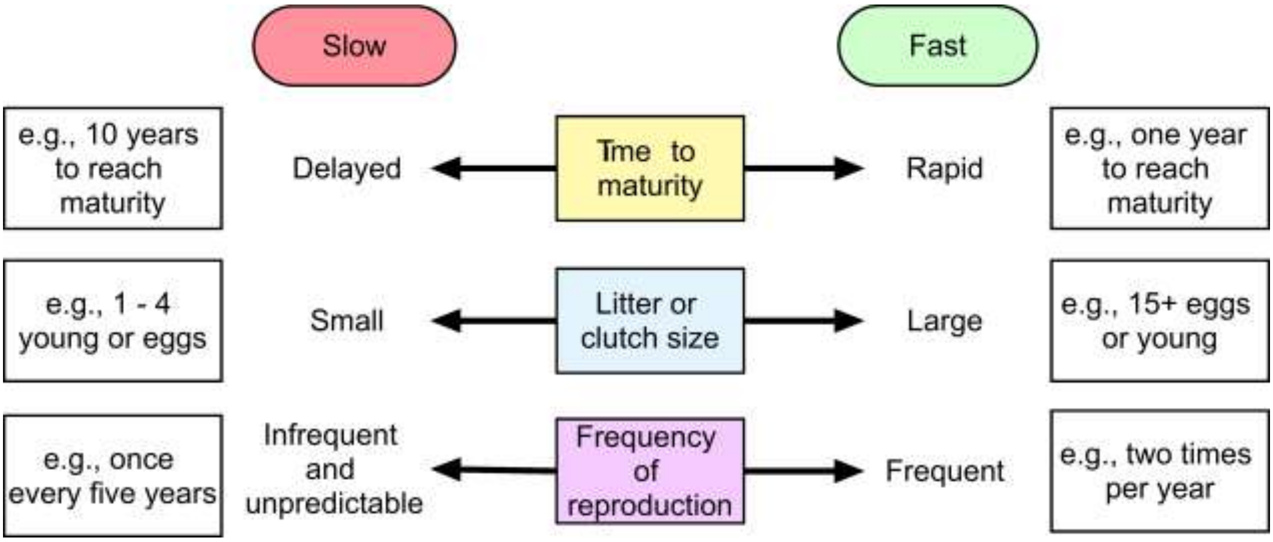


Fig. 2. Diagrama del gradiente de las características del ciclo biológico, recalcando las diferencias entre ciclos biológicos "rápidos" y "lentos" (modificado con autorización de Fitzgerald, 2017).

Factores adicionales de riesgo

Los DENP CITES deberían considerar todas las extracciones que se están realizando para el comercio internacional. Este criterio puede ser utilizado como parte de la *Evaluación Primaria* para tomar en cuenta los niveles sospechados o estimados de comercio ilegal. Si los niveles de comercio ilegal son conocidos, o pueden ser estimados aproximadamente, la Autoridad Científica deberá incluir los niveles de comercio ilegal en el criterio de **Nivel de recolección anual** de la *Evaluación Primaria*. Si se desconocen los volúmenes de comercio ilegal, pero se sospecha que son perjudiciales, se puede asignar una puntuación de "1". Si se sospecha que existe comercio ilegal, pero la probabilidad de que dicho comercio ilegal sea perjudicial para la supervivencia de la especie es baja, el criterio debería dejarse en blanco, o recibir una puntuación de "0".

Además, cualquier otro proceso que sea una amenaza para la especie puede agravar el riesgo que representa la recolección para el comercio. Por ejemplo, la probabilidad de que el comercio sea perjudicial podrá ser mayor en el caso de las especies de serpientes que están afectadas por predadores invasores que en él de las que no lo están. Por consiguiente, como medida cautelar, la Autoridad Científica debería verificar el estado de la especie Lista Roja de la UICN cuando realice una *Evaluación Primaria*. Si la especie está clasificada como Vulnerable, En peligro o En peligro crítico, se debe asignar una puntuación máxima de "**1**" a este criterio. La inclusión de este criterio es una manera útil de evaluar una amplia gama de riesgos adicionales, a la vez que la *Evaluación Primaria* sigue siendo simple y eficaz para los usuarios.

Realización de una *Evaluación Primaria* con datos limitados

La Evaluación Primaria ha sido concebida de manera que pueda realizarse utilizando una información mínima sobre la especie. Así pues, debería haber pocos casos en los que no se disponga de un conocimiento somero. Por ejemplo, los niveles de recolección o exportación deberían ser conocidos porque la Autoridad Administrativa CITES contactará a la Autoridad Científica para recibir información para las exportaciones de un número dado de especímenes. De igual manera, se debería disponer de cierto nivel de conocimiento sobre el área de ocupación de la especie, pues se dispone de una localidad tipo de la especie. Si no se dispone de ninguna otra información sobre la especie, o si se desconocen las características de su ciclo de vida o si no pueden ser inferidos a través del conocimiento de especies estrechamente relacionadas, se deberá aplicar un enfoque cautelar.

Nota con relación a los criterios utilizados

Los valores utilizados para los tres principales criterios de la *Evaluación Primaria* se basan en parte en los valores proporcionados en los criterios de la Lista Roja de la UICN. Éstos han sido probados y aplicados a todas las serpientes incluidas en el Apéndice II de la CITES que están siendo actualmente criadas o recolectadas en la naturaleza para el comercio. En el Anexo B figuran las puntuaciones en la *Evaluación Primaria* para todas las especies de serpientes incluidas en los Apéndices de la CITES. A pesar de que los criterios utilizados en la *Evaluación Primaria* son específicos y los responsables del manejo podrían no tener una información perfecta sobre la especie (por ejemplo, el área de ocupación podría ser superior a la estimación), las categorías son amplias. Por consiguiente, existe una gran probabilidad de que los responsables del manejo evalúen una especie basándose en la categoría correcta para cualquier criterio dado.

Para consultar ejemplos elaborados de *Evaluación Primaria* para serpientes incluidas en los Apéndices de la CITES véase el Anexo B.

4.4 Paso 2: *Evaluación Secundaria*

Una vez realizada una *Evaluación Primaria*, si no se puede establecer fácilmente que no existen efectos perjudiciales es necesario realizar una *Evaluación Secundaria*. Utilizando la información disponible, las Autoridades Científicas deben tratar de descartar los siguientes criterios:

Una disminución continua observada, estimada, inferida o sospechada de cualquiera de los elementos siguientes:

- **i.** abundancia de la población,
- **ii.** área nacional de ocupación,
- **iii.** número de localidades de subpoblaciones,
- **iv.** número de individuos maduros
- **v.** tamaño medio del cuerpo,
- **vi.** tamaño mínimo al alcanzar la madurez sexual
- **vii.** capturas por unidad de esfuerzo, y/o
- **viii.** Otros factores que indique un nivel de recolección no sostenible

Estos criterios han sido modificados con relación a los criterios de la Lista Roja de la UICN de especies amenazadas y los criterios utilizados por las Partes en la CITES para evaluar la necesidad de inclusión de una especie en el Apéndice I (Res. Conf. 9.24). Cada uno de estos criterios son indicios comunes utilizados por los responsables del manejo de la vida silvestre para evaluar la sostenibilidad de las extracciones. Si se cumple cualquiera de los criterios anteriores, el uso podría no ser sostenible, lo cual podría llevar a un comercio perjudicial y requerir intervenciones de manejo para evitar disminuciones futuras. Vaya al **Paso 3**.

Si se dispone de información suficiente para descartar cualquiera de los criterios anteriores, se puede formular y emitir un DENP en el **Paso 4**.

4.5 ¿De qué manera debería realizarse la *Evaluación Secundaria*?

Una Evaluación Secundaria puede ser simple o compleja, y los datos necesarios para garantizar que el comercio no sea perjudicial deberían ser proporcionales al nivel de riesgo. Por ejemplo, se puede determinar fácilmente el carácter no perjudicial en el caso de una especie para la cual el 80 % del área de distribución se sitúa dentro de áreas protegidas, de manera que sólo un 20 % de la población de la especie está disponible para la recolección. O bien, pueden ser suficientes simples datos de supervisión para determinar que no existen efectos perjudiciales. Por ejemplo, las Autoridades Científicas CITES puede disponer de datos que muestren que la recolección anual o los volúmenes de exportación y el número de permisos emitidos han permanecido constantes a lo largo del tiempo, y los estudios de campo periódicos han demostrado que la especie todavía puede ser avistada con relativa facilidad a todo lo largo de su área de distribución. Estos datos simples pueden ser suficientes para realizar una *Evaluación Secundaria* y determinar el carácter no perjudicial.

En otros casos, tal vez se necesite una supervisión más compleja para determinar que no hay efectos perjudiciales con suficiente seguridad. Sin embargo, en todos estos casos, las Autoridades Científicas deberían concentrar sus esfuerzos en garantizar que no estén teniendo lugar disminuciones en los criterios enumerados más arriba.

Para más información sobre las metodologías de supervisión que pueden proporcionar información para la *Evaluación Secundaria* véase la Sección IV del Anexo A.

Para consultar ejemplos elaborados de *Evaluaciones Secundarias* véase el Anexo C.

4.6 Paso 3: Intervenciones de manejo

Cuando son necesarios procedimientos de manejo para garantizar el carácter no perjudicial, pero estos todavía no han sido establecidos, las Partes deben describir cuáles son las intervenciones de supervisión y manejo previstas, y de qué manera los resultados van a ser interpretados para establecer el carácter no perjudicial en el **Paso 4**.

Los tipos de las intervenciones de manejo que deberán tener lugar, y el alcance de las mismas, dependerán de las especies, el riesgo que representan la recolección y el comercio, y el contexto específico del país Por ejemplo, en algunos casos tal vez sea necesario aplicar límites ligeramente inferiores para los especímenes que pueden ser objeto de recolección. En otros casos, las intervenciones de manejo pueden incluir reducciones significativas de los cupos de recolección o, en los casos en los que la supervisión ha puesto de manifiesto disminuciones más severas de las poblaciones, una suspensión de las exportaciones. Las intervenciones de manejo utilizadas habitualmente incluyen:

- Restricciones del tamaño
- Restricciones estacionales
- Restricciones del esfuerzo
- Cupos
- Suspensiones de las exportaciones

Se pueden consultar orientaciones adicionales sobre los tipos específicos de intervenciones de manejo y los métodos para su aplicación en la Sección V del Anexo A.

4.7 Paso 4: Presentación del informe

El informe del DENP deberá detallar los pasos seguidos para establecer el carácter no perjudicial. En el caso de muchas especies, puede tratarse simplemente de la realización de una *Evaluación Primaria*, pero en el caso de las especies que requieran una *Evaluación Secundaria* el informe puede incluir desde los análisis básicos de las tendencias de la recolección hasta los protocolos detallados de supervisión y manejo. **No es necesario utilizar un formato específico para la presentación de los resultados y las explicaciones de los protocolos de supervisión o los sistemas de manejo utilizados para realizar la *Evaluación Secundaria*.**

4.8 Toma de decisiones en las situaciones en que se dispone de pocos datos

Cuando no se dispone de datos o estos son insuficientes para descartar los criterios que forman parte de la *Evaluación Secundaria*, las Autoridades Científicas deberán esforzarse por mejorar los protocolos de supervisión (utilizando las orientaciones sobre los sistemas de supervisión que figuran en la **Sección IV del Anexo A**) o realizar intervenciones de manejo cautelares para garantizar que el comercio no sea perjudicial (utilizando las orientaciones que figuran en la **Sección V del Anexo A**).

5.0 Manejo de las poblaciones de serpientes

El manejo de la recolección de serpientes para el comercio puede ser simple o complejo. La complejidad del sistema dependerá en gran medida de los objetivos de los responsables del manejo y de los beneficios que se obtendrán del recurso. Por ejemplo, cuando existen pocas probabilidades de que la recolección sea no sostenible, el manejo de la recolección que resulta necesario puede ser reducido o nulo. Cuando se sospecha que puede haber un efecto perjudicial, reducir simplemente la recolección y las exportaciones puede ser un mejor uso de los recursos que el establecimiento de sofisticados sistemas de manejo de la recolección. Por otra parte, los sistemas de manejo de la recolección sofisticados pueden ser necesarios para mejorar la rentabilidad sostenible máxima del recurso a fin de obtener beneficios económicos superiores para mejorar la certeza de que la recolección a determinado nivel no es perjudicial para la especie. Independientemente del tipo de manejo puesto en práctica, lo ideal sería que éste incluya una supervisión permanente para detectar los cambios futuros de la población que es objeto de recolección y tomar las medidas correctivas correspondientes cuando sea necesario.

Estas Directrices sobre los DENP no prescriben de qué manera debe ser el sistema de manejo. Las Partes pueden implementar diferentes sistemas de manejo que contribuyan a la formulación de los DENP para las especies de serpientes incluidas en los Apéndices de la CITES y cada uno deberá ser evaluado en función de sus ventajas respectivas.

Las herramientas que pueden ser utilizadas para el manejo de la recolección de serpientes se presentan y analizan en la Sección V del Anexo A. Se podrán consultar ejemplos de sistemas de manejo e intervenciones específicas de manejo para las serpientes en el Anexo C.

5.1 Concepción de un sistema de manejo apropiado

La concepción de un sistema de manejo específico para el comercio de serpientes es a menudo compleja. Las incertidumbres presentes y el deseo de solo permitir el comercio cuando se alcance un conocimiento completo de las características biológicas y de los niveles de recolección de la especie pueden obstaculizar un manejo adecuado. En realidad, el conocimiento completo es a menudo inalcanzable y los sistemas de manejo deben basarse en un enfoque de gestión adaptable. La gestión adaptable ha sido ampliamente recomendada como herramienta para el manejo de las poblaciones y la toma de decisiones en los casos de extrema incertidumbre (por ejemplo, en la Resolución Conf. 16.7 de la CITES sobre los DENP). El principio básico es que las decisiones de manejo deben ser consideradas como experimentos deliberados a gran escala; por consiguiente, el sistema óptimo de manejo se consigue a través de un proceso constante de ensayo y error. El manejo adaptable es particularmente importante en el caso de las serpientes, cuyas poblaciones son inherentemente difíciles de estudiar con precisión en el terreno (como se analiza en la **Sección 3.0**). Esta dificultad se ve agravada frecuentemente por la falta de informaciones tales como las tasas de migración de la población, los patrones de movimientos de las serpientes y la supervivencia por edad específica. Sin embargo, a través de un proceso de ensayos, evaluaciones y correcciones constantes, es posible obtener soluciones de manejo que sean beneficiosas para las serpientes, las personas y el medio ambiente.

Así pues, un sistema adecuado de manejo debe incorporar tanto supervisión como manejo de manera que se puedan realizar intervenciones de manejo si la supervisión pone de manifiesto cambios en la población objeto de recolección que puedan ser perjudiciales. En la concepción de un sistema de manejo holístico para las serpientes se deben incluir tres pasos importantes:

1) Entender la historia natural y la dinámica del comercio de la especie concernida;

2) Decidir con relación a la implementación de un sistema de supervisión adecuado específico a cada caso (**orientaciones en la Sección IV del Anexo A**);

3) Adoptar e implementar intervenciones de manejo adecuadas para garantizar que la recolección se mantenga en niveles sostenibles (**orientaciones en la Sección V del Anexo A**).

5.2 Financiación específica

No se puede desarrollar, implementar o mantener un sistema de manejo sin ninguna financiación específica. Tomando en cuenta que un manejo adecuado permite mantener el buen estado de las poblaciones de serpientes, y los beneficios económicos que se derivan de ellas, redunda en interés de las Partes y de las personas que participan en la recolección y el comercio de serpientes asignar fondos para la supervisión y el manejo de las especies que son objeto de comercio. Así pues, cuando se conciba un sistema de manejo como parte de los DENP de la CITES, se deberá incluir un mecanismo de financiación específico. Poco importa si la financiación procede del presupuesto asignado por el Gobierno, a partir de gravámenes aplicados a la industria misma. Sin una estructura de financiación sólida, la continuidad de cualquier sistema de supervisión y manejo estará en riesgo, y ello podría impedir que las Partes elaboren DENP satisfactorios en el futuro. Se debe proceder con cautela con relación a la rentabilidad. Los planes de manejo o supervisión deberían ser concebidos de manera que se ajusten a los recursos económicos y se deberían implementar de manera proporcional a los posibles beneficios obtenidos a partir del uso del recurso. Algunos planes de manejo se vuelven tan rigurosos y sofisticados que dejan de ser viables económicamente desde el punto de vista de la rentabilidad.

Annex A

Additional Guidance on CITES NDFs for Snakes

Section I . Background to this guidance

This Non-detriment Findings (NDF) Guidance for snakes is the result of Decision 16.102 from the Sixteenth Meeting of the Conference of the Parties to CITES (Bangkok, Thailand, 03-14 March 2013). At CoP16, the Parties requested the CITES Secretariat to:

"*compile information and develop guidance that can assist Parties in the making of non-detriment findings, management systems for wild populations and the establishment of export quotas for Appendix-II snake species in trade, by undertaking relevant research, consulting with relevant experts, examining suitable examples and case-studies, and building on the results of the International Expert Workshop on CITES Non-Detriment Findings (Cancún, 2008) and recommendations on the making of non-detriment findings from the Conference of the Parties."* http://www.cites.org/eng/cop/16/doc/E-CoP16-57.pdf

The CITES Secretariat in turn commissioned the IUCN, through the IUCN-SSC Boa and Python Specialist Group (BPSG), to assist this task. This report is the result of this work and aims to provide CITES Scientific Authorities with guidance in monitoring, management and implementation of effective NDFs for snakes, so trade can continue to benefit people while ensuring wild populations are not negatively impacted.

This Guidance was refined in May 2017 at an Expert Workshop on the Making of CITES Non-detriment Findings for Appendix II listed snakes held in Kuala Lumpur, Malaysia.

Click here to return to the Introduction.

Section II . Definitions and concepts

This section provides further information and discussion about several aspects related to non-detriment, sustainability and harvest theory. This section is aimed at those seeking to understand the principles of harvest biology, and how this might be applied to developing the basic capacity to make NDFs. To begin, we provide a number of key points and discuss them in detail below:

1) In the majority of circumstances, ***animal populations can withstand some level of harvest.***

2) Harvesting can result in large declines in species abundance, yet harvest can still be ***sustainable*** and well above the level at which it is deemed ***detrimental***.

3) ***Commercial extinction*** can result in a species becoming commercially unsustainable to harvest, even if the harvest is biologically sustainable and extremely safe from ***biological extinction***.

4) Thus, the main issue concerning CITES is when neither declines in abundance nor harvest levels can be controlled or managed and are in free-fall.

Harvest theory

In its simplest form, sustainability is the ability to endure or keep something going (Erdelen, 1998; Webb, 2002). The text of the CITES Convention does not mention the word sustainability, but merely that trade should not detrimentally impact the species being traded.

Theoretically, a non-harvested population, at carrying capacity, can be expected to have an abundance that fluctuates from year to year (due to various environmental and other factors), but is stable over time. The factors increasing the population (reproduction, immigration) are balanced against the factors decreasing the population (emigration, mortality), so there is zero population growth (**Fig. 1**).

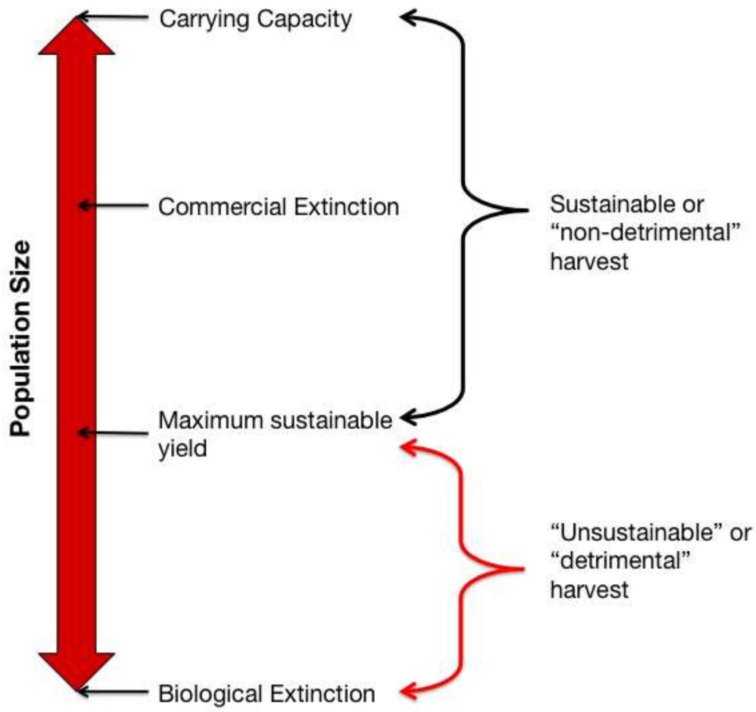


Fig. 1. Hypothetical visual representation of how several concepts of sustainable use and detriment interact, and their application to a population of snakes.

When populations are harvested, abundance declines, but population growth is stimulated. This is because the resources available to a population are density-dependent; the remaining individuals within the population have access to relatively greater resources, and the factors favouring population growth increase relative to those favouring population decline (Caughley and Sinclair, 1994).

In every population there is an optimum level of population reduction, to a new and reduced level of abundance, in which population growth is maximised. If this level of abundance is sustained over time, by management, the annual growth component can stay maximised and be harvested - theoretically forever. This is sustainable use producing the *maximum sustainable yield*. If the level of population reduction does not reach the optimum level but the new level of abundance is sustained, then this remains *sustainable use* but not generating *maximum sustainable yield*. (**Fig. 1**).

Often the most important variable for wildlife populations is not the absolute volume of a harvest itself, but instead the rate of harvest. However, knowing that the rate of harvest comprises a high proportion of the population may not make that harvest unsustainable. For example, in managed animal populations, the total annual harvest can exceed the size of the standing population supporting the harvest (**Table 1**). Domestic animals provide a valuable example of highly productive animal populations. **Table 1** shows that harvest rates vary considerably depending on the life histories of the species concerned. Of significance is that the population sizes of pigs and chickens are well below the annual harvest rate for those same species, owing to their low mortality, high fecundity and rapid growth rates (Webb et al. 2003).

Table 1. Population sizes and sustainable harvest rates for Australian agricultural animals (Source: Australian Bureau of Statistics, 2014)

Species	Population size	Harvest	Sustainable harvest rate
Cattle	26.4 million	9.7 million	36.70%
Sheep	75.5 million	33.4 million	44.20%
Pigs	2.0 million	4.7 million	235.10%
Chickens	84.0 million	572.1 million	681.10%

The main issue concerning CITES is when the rate of harvest exceeds the factors promoting population growth, and neither the resulting decline in abundance nor the harvest level can be controlled or managed. This is unsustainable use or overexploitation (**Fig. 1**), and may result when (from Caughley, 1992):

- the number of individuals harvested each year exceeds the maximum sustainable yield of the species; or
- the percentage harvested each year exceeds the intrinsic rate of increase of the species; or
- harvesting reduces the species to a level at which it is vulnerable to other influences upon its survival.

It is in these situations that the risks of extinction escalate and ongoing harvest for trade is considered "detrimental" to the survival of the species.

For a useful and more detailed discussion of these concepts and harvest theory for CITES listed species see the following document from the Cancun CITES Non-detriment findings Workshop.

Commercial vs biological extinction

CITES deals with the risk of biological extinction (a conservation problem). By contrast, commercial sustainability refers to decreasing productivity of a harvest, perhaps reaching commercial extinction – harvest of that species is no longer commercially viable (an economics problem; Magnusson, 2002).

As in the case of fisheries, snake populations can be harvested "unsustainably", leading to their commercial extinction, yet their wild population can still number in the millions (this typically occurs when the cost of locating and capturing individuals is greater than their sale price). Commercial extinction can therefore occur when a species' population is healthy and stable, and at no risk of biological extinction (**Fig. 1**). This can create dangers when interpreting trade data to make inferences about the status of wild populations. For example, volumes of trade in a snake species may suddenly decline, suggesting that biological sustainability may be compromised. While in some cases this may be true, it may be equally plausible that the decline is a result of other variables, for example, employment in other sectors that are more economically lucrative than the snake trade. People may then stop harvesting snakes in search of better income earning opportunities, resulting in fewer individuals entering trade. This can give the false impression that population declines have occurred, when in reality the trade volumes rise again once snake harvesting becomes more profitable – either through increased export prices or falls in prices of goods in other sectors. Commercial extinction is thus not a static force. It can come and go, with little correlation with what is happening with populations of wild snakes.

Click here to return to return to Defining "Non-detriment".

Section III – The management context for snakes

➢ Snakes are difficult to study

The population status of many species of animals can often be easily evaluated. Snakes do not offer such possibilities, largely due to their secretive, cryptic and sedentary nature, resulting in very low detection probability. Many snakes are difficult to capture in traps, cannot be detected by remote infrared cameras, nor identified by tracks. Snakes are thus notoriously difficult to census, which constrains our ability to monitor and evaluate their population trends – even when significant resources are dedicated to the task. The lack of a standardized methodology for monitoring remains a major limitation for the management of snake populations (Seigel and Mullin, 2009). In most countries there is a lack of experience in dealing with the innovative approach needed to manage snake harvesting. Parties are often confronted with strong demands, requesting profound academic knowledge on the population of the species being utilized. However, the expectation that Parties using snakes for domestic and export purposes should have perfect knowledge about the status of wild populations supporting those uses is unrealistic and scientifically out of reach in most contexts.

➢ Limited background information

As a result of the above-mentioned constraints, there is a lack of literature on snake demography for most traded species. This information gap prevents the use of modern analytical tools (such as Population Viability Analysis, etc.) that have been widely used for assessing harvests in other vertebrate taxa (Dorcas and Willson, 2009). In general, snakes exhibit great intraspecific variation in many of their demographic and biological parameters, both at spatial and temporal scales. This means that basic biological parameters obtained for a specific place or time usually will not be useful or applicable for making inferences in a different situation at a different time. Added to this, some snake species appear to become more productive in parts of their range where natural habitats are converted for agricultural purposes, whereas others may not. As Fitzgerald (2012) states: replicating estimates throughout the range of a commercially exploited species is simply not feasible.

➢ Resistance to snake research

Some CITES-listed snake species (e.g., cobras) are highly venomous, as are many traded snake species that are not listed on CITES. As a group, snakes are responsible annually for a higher number of human fatalities than all other wildlife species combined. There is thus an age-old conflict between humans and snakes, which lead to many snakes that are encountered opportunistically being killed as pests, regardless of legal status. This also limits public interest and participation in snake research and conservation, which is reflected in a paucity of information available for most species. From a management perspective, people collecting wild snakes, and investigators working to understand their population biology, often have to contend with real risks. Added to this is a preference for the study of taxa deemed to be more charismatic than snakes, or those that receive greater funding, despite high levels of trade in many species of snakes. The negative values generally attributed to snakes have resulted in limited studies being conducted and for this reason there is little biological information available for many species.

➢ Attributes that assist sustainable trade

Despite snakes being difficult to study because of the attributes discussed above, these same attributes also confer a level of sustainability to harvesting for trade. The sedentary and cryptic nature of snakes, that makes surveying their populations so difficult, also makes them difficult to find for collectors. This difficulty allows many individuals within populations to remain undetected, and allows them to thrive even within urban environments. These characteristics are partly responsible for the very high, yet seemingly sustainable, volumes of harvest experienced by many snakes around the world.

➢ Improving knowledge

To improve basic knowledge about snakes in trade, managers are urged to learn as much as possible about snakes by examining individuals collected for trade. Gathering data from hunters, slaughterhouses or holding facilities can provide important biological and ecological information on species, such as: harvest rates, habitat preferences, breeding seasons, body sizes, sexual dimorphism, sex ratios, food habits, sizes at maturity and first reproduction, as well as many other important attributes that could not easily be determined using traditional research survey approaches (e.g., Shine et. al., 1999; Waller et al., 2007; Natusch and Lyons, 2012). In many cases this is a far more simple and cost-effective means of data collection than undertaking targeted field studies and can be carried out simultaneously with harvest management. Parties are urged to consider using this method to begin improving knowledge about the basic biology of snakes entering trade.

Click here to return to Management context for snakes.

Section IV . Additional guidance on completing a *Secondary Evaluation*

What is a *Secondary Evaluation* trying to achieve?

The *Secondary Evaluation* as part of these NDF Guidelines aims to build up an understanding of how populations are changing over time and whether harvesting for trade may be negatively impacting those populations. For many Parties, sufficient information may already be available to establish non-detriment (from existing monitoring programs or use of basic information). For example, although a species may have qualified for a *Secondary Evaluation*, 80% of its population may occur in protected areas, making a secondary assessment straightforward. However, for those Parties for which such information is not available, it may not be possible to make a decision about non-detriment with reasonable confidence. In this instance, the implementation of monitoring systems may be required to elucidate trends that indicate whether population declines are occurring. This section provides guidance on how Parties can implement monitoring programs to adequately complete the *Secondary Evaluation* and establish non-detrimental harvest of snakes for trade.

Key principles for successful monitoring programs

Ongoing monitoring – to predict the future we must look to the past

Long-term monitoring is the best way to reveal detrimental trends in snake populations. This is because snake populations exhibit enormous variability and unpredictability in annual abundance in response to environmental stochasticity. Although short term, single year studies can yield important information on population features (e.g., number of snakes, their sizes and sexes), their limited duration provides only a temporal snapshot, and cannot be used to determine population trends that can reveal population status or health. Because of this, resolving whether an observed population trend is normal for a species or the result of potentially detrimental declines due to harvesting, in many cases, may be impossible without long-term monitoring. This may in turn complicate management strategies and result in scarce resources being used to solve problems unrelated to harvesting. Establishing baseline knowledge of what a dynamic natural population looks like can help us recognize when unnatural and potentially detrimental changes may have occurred and allow us to apply suitable management interventions to ensure trade is sustainable in the future.

Consistency

Consistency can be the most important part of any ongoing species-monitoring program. When monitoring is carried out, managers must ensure the same sites are visited at the same times of year. The same variables of interest must also be measured, and effort must be made to ensure the same techniques and investigators (if possible) are also used. These should all remain consistent in order to properly tease apart what are real (environmental or anthropogenic) effects on the population and what are observer of methodological biases. For example, visiting a wildlife trader and counting snakes at a different time of year than the year before may erroneously suggest that populations are decreasing if fewer individuals are counted. Similarly, measuring snakes from the snout to the tail tip, when in previous years snakes were measured from the snout to the anus, may falsely indicate that the population's mean body size is increasing when it may not be. Such biases will reduce the power and effectiveness of monitoring schemes and may result in managers overlooking harvest effects and failing to implement proper management protocols.

Case by case application

All snake species are unique, and the characteristics that define one species may not define another. In addition, the trade dynamics and market forces that act upon different snake supply chains vary among species, between countries, and over time. This inevitably results in no two non-detriments findings being the same, which requires evaluation of trade impacts to be determined on a case-by-case basis. When carrying out a *Secondary Evaluation* and implementing a monitoring program, Scientific Authorities must account for these differences and design systems that are most suited to the species and trade situation in question.

Harvest monitoring

Harvest monitoring is often the simplest yet most important means of monitoring the sustainability of a harvest of snakes. Many Parties already adequately monitor their harvest of Appendix II listed snakes and the CITES Secretariat also contributes to trade monitoring by maintaining the UNEP-WCMC CITES Trade Database.

Where is a harvest monitored?

Harvest monitoring can take place at any part of the trade chain. Some Parties may choose to monitor harvests at a single point in the chain such as the harvester, while others may choose to monitor at multiple points. Each situation involving different species will be unique and will depend on the type of trade being conducted (e.g., trade in skins or live snakes), the logistical feasibility of monitoring and the level of resolution that the Party wishes to monitor.

There are three main points at which a harvest can be monitored. These are:

- Hunters and collectors (the first people in the trade chain that are capturing the snakes)
- Traders and exporters (this can include middlemen, agents, pet holding facilities, slaughterhouses, stockpilers, tanneries and exporters)
- National and international trade databases (e.g., the UNEP-WCMC CITES Trade Database, which provides data on exports of every CITES Appendix II listed species made by the Parties, based on data provided in the Annual Reports submitted by Parties on their exports and imports).

Often these levels of monitoring overlap. For example, many pet collectors are also exporters. Regardless of which level within the trade chain focus is placed, by regularly collecting information from actors at one or more of these points, managers are conducting harvest monitoring. If in a particular year a harvest begins to decline, this can be recognized because of resulting changes in the data collected in that year compared to previous years.

What level of trade should be monitored and how?

Determining where in the trade chain to monitor depends largely on the type of information to be gathered and the type of trade that is taking place. For example, for trade in pet snakes, the most logical points to monitor may be at the exporter level (to understand how many individuals are collected and obtain large samples on the body sizes and sexes of harvested snakes). On the other hand, for trade in snake skins it may be more logical to monitor at the slaughterhouse level than the tannery or exporter level because this can yield information on numbers traded, sizes, sexes and reproductive condition of snakes, before their skins are removed and this valuable information is lost. For those countries where there are no slaughterhouses because snakes are skinned by the hunters in the field, monitoring a sample of hunters would be preferable so that important demographic information can be gathered from snakes as they are killed. For larger samples and for making management decisions, analyzing information from skins at the first point of stockpiling may be the most useful option. Determining at what point to monitor may also be linked to the type and geographic scale of management system that is in place (**see Section V**). **Table 3** summarizes information on the types of data that can be gathered and the limitations of monitoring harvests at different points of the trade chain.

Table 3. The types of data that can be gathered at different levels within the trade chain and the data limitations of each (modified from Fitzgerald, in McDiarmid et al. 2012).

Level of trade	Data to be gathered	Limitations
Hunters and collectors	• Numbers of individuals captured per unit effort. • Demography of the harvested individuals (sex, size and perhaps reproductive condition of snakes). • Information on hunting patterns. • Understanding of collection methods. • Collection date and geographic origin.	• Logistical difficulty in surveying many hunters regularly. • Small sample sizes. • Information often only anecdotal in nature. • Logistical difficulty to sample large harvesting areas.
Traders and exporters	• Large samples of snake body sizes (or skin sizes), sexes and reproductive condition that are representative over large areas. • Trends in individuals purchased per year and in different seasons. • Can often provide information on levels of illegal trade.	• Precise origins difficult to determine unless trade is traced. • Little information on hunter effort. • Lack of biologically meaningful information (sex, body size, reproductive condition) when dealing with skins only.
National and International trade databases	• National and global trends in import and export volumes and trade routes can be understood and compared.	• Often no information on domestic trade. • Need to be interpreted with caution due to many external forces (e.g., market forces) that influence trade.

What information is important and how is it interpreted?

Harvest monitoring aims to understand changes over time, and does so by examining trends in the medium term (3-5 years) to the long term (>5 years). When a database of knowledge about a harvested population has been consistently and rigorously gathered, ongoing monitoring can reveal changes to that population, which may be a direct result of harvesting pressure (e.g., see Lyons and Natusch, 2011, for an example of demographic changes over two years). Thus any wildlife monitoring program, regardless of which point in the trade is being monitored, is interested in *change*.

Specific types of change relevant to monitoring are discussed in detail as follows:

Changes in numbers of snakes harvested

Increases or decreases in harvest levels can be useful indicators that something in the wild population is changing. Data on the numbers of snakes harvested can be collected at the hunter level, middlemen, trader, slaughterhouse or exporter level, and at the export level. If sample sizes at the lower levels of the trade chain (e.g., hunter, slaughterhouse) are appropriate for analysis, then we should expect to see a correlation between the number of snakes collected by hunters and the number of snakes sold by exporters.

Unfortunately, however, data on the number of snakes collected (equivalent to "yield" in fisheries) does not provide a conclusive answer to the sustainability of trade. Other factors unrelated to the health of snake populations can result in changes in harvest levels, so overall trends need to be interpreted with accompanying data from other monitoring procedures and associated factors (see discussion below for examples).

Changes in hunting effort

The most common scenario for snake harvest systems is that many opportunistic hunters contribute few animals to trade, while a few expert hunters contribute many animals. Because of this, focusing monitoring effort on those expert hunters can be extremely useful. Not only can expert hunters provide important qualitative information about harvesting sites and trends, but they also allow managers to determine the effort needed to a capture a given number of snakes. Hunter effort may also be gained indirectly but efficiently from actors in other areas of the trade chain. For example, many hunters only sell snakes, or their parts and derivatives, to specific traders, pet collectors or slaughterhouses. Requiring these operations to record each hunter and the volume of snakes or their parts collected by them over known periods will provide managers will valuable information. This is called the catch per unit of effort (CPUE) and is a quantitative means of understanding the relationship between hunter effort and harvest numbers. For example, if hunter effort increases (e.g., the numbers of hunters increase or the same hunters spend more time or effort hunting) but the number of snakes harvested remains the same, then this may suggest that the population is in decline. Similarly, if hunter effort increases and the numbers of snakes harvested declines then it is possible that the population is rapidly being overexploited. Conversely, if hunter effort is decreasing but the number of snakes harvested remains the same, it may be that the population is increasing. When combined with data from other sources about trends in trade (such as total number of snakes harvested and population demography) robust conclusions can be drawn about whether such changes in the wild population are being caused by harvesting pressure.

Changes in the harvest demographic

Several studies on snakes have shown that prolonged harvesting can affect a species' population structure, which may make it more vulnerable to overexploitation (Lyons and Natusch, 2011). For example, a decrease in the average body size of snakes collected may mean fewer females are reproducing before they are harvested or that large highly fecund females are being disproportionately harvested. Both scenarios may result in a reduction in population growth. Monitoring the sex of harvested individuals is also important. For example:

- some sexes can be easier to capture than others (perhaps male snakes hunt in shallow water whereas females hunt in deep water);
- one sex may be more sought after (males display bright colours desired by the pet trade whereas females do not);
- the capture could inadvertently favor one sex over another (e.g., sexual dimorphism in body size may result in pet collectors targeting small females, whereas the larger males are not as sought after);
- or minimum capture size policies applied to highly dimorphic snakes (like boas, pythons or cobras) may favor the hunting of one sex over another.

In most cases, the best place to monitor the harvest demographic is at the trader, middlemen, slaughterhouse or pet collector level. Visits to these facilities allow investigators to cost effectively gather large amounts of demographic data that are representative of the entire harvest. Body size and sex can be determined either in live or dead animals. When live or dead animals are not available, as is the case when snakes are skinned in the field, consistent measuring of skins at the trader, middlemen, or tannery level, year after year, also provides useful information on trends in population structure.

Importance of collecting associated information

It is important that Scientific Authorities and wildlife managers consider how factors independent of harvesting pressure, such as market demand, currency exchange rates, environmental factors and changes in local economies, can influence the number of snakes harvested, hunter effort and population demography. For example, it may be tempting to interpret changes in harvest numbers, demography or hunter effort as evidence of overexploitation when in reality that is not the case. It is therefore important to incorporate secondary information in any analysis of harvest monitoring data.

Examples of when factors independent of harvest affect snake population estimates may include:

- A new hunting technique may be implemented that reduces hunter effort while increasing numbers of snakes harvested.
- Consumers may switch demands for pets from large adults to small juveniles, resulting in a shift in the harvest size demographic.
- End users may begin to request snake skins above a certain length, resulting in a change in harvest demographic in the exporting country.
- Many snakes are commonly encountered only in the wet season. Monitoring the population or harvest in the dry season may suggest that declines have occurred, when that may not be the case.
- Increased employment opportunities in other industries, or a rise in social or unemployment subsidies, may result in fewer people capturing snakes. The consequence is that fewer snakes will be harvested, which could be erroneously attributed to population declines.
- Recruitment of a new generation of hunters without experience in detecting snakes may result in differences in capture vs. effort data erroneously suggesting the snake population is decreasing.
- Sudden changes in price structure (like a change in the pricing policy for different snake lengths) may introduce distortions over the size structure of the harvested snakes.
- Environmental changes (exceptional droughts or floods) in a given year may affect the ability of hunters to reach snakes or even produce temporary reductions in snake populations that may be erroneously interpreted as a population decline due to harvest.
- Changes in fashion may reduce or increase the demand from the fashion or manufacture industry.

Natusch et al., (2016) offers a useful example of harvesting monitoring data being used to assess sustainability in a heavily traded snake.

Examples

Examples of harvest monitoring programs for hypothetical populations of snakes are provided in **Tables 4, 5 and 6**.

Table 4. A hypothetical scenario and harvest monitoring system for the trade in snake skins.

Trade type	Scenario	Monitoring system	Hypothetical Result	Interpretation and course of action
Skin trade	A species of snake is harvested for skins in Country A to make traditional drums in Country B. The skins used for the drums need to be large, so no individuals smaller than one metre are collected. There are five slaughterhouses in the country that skin equal numbers of snakes each year.	• Fifteen professional hunters are visited once per year and their capture rates are recorded. • Two of the five snake slaughterhouses are visited once per year and data are gathered on the number of snakes killed, their body sizes and sexes. • Export volumes are recorded and published in the UNEP-WCMC CITES Trade Database.	Annual visits to the hunters show that the number of snakes being collected by each hunter is decreasing each year. Two hunters have stopped working and the others claim that the snake population is decreasing. Average body size of snakes brought to the slaughterhouses has decreased from 2.1 metres to 1.8 metres. The number of males and females collected has remained the same, but the total number of snakes brought to the slaughterhouse has been slowly decreasing, despite market prices for skins being high. Export volumes have been steadily decreasing despite market prices for skins being high.	All of the information gathered through the monitoring system suggests that the wild snake population is declining. Visits to hunters and slaughterhouses have revealed no other information that might explain these declines. The course of action is to implement a management intervention to ensure the sustainability of the harvest. A negative NDF and voluntary restrictions on exports may be warranted (**Step 3 of the NDF Guidelines**).

Table 5. A hypothetical scenario and harvest monitoring system for the trade in snakes for pets

Trade type	Scenario	Monitoring system	Hypothetical Result	Interpretation and course of action
Pet trade	A species of snake is highly sought after for the pet trade. Individuals of all sizes can be harvested and exported.	• Visits are made to five snake hunters once every two years to examine harvest rates and gather other information about the harvest. • Visits are made to six out of ten exporters to examine body sizes, sexes and the number of snakes harvested. • Exports are recorded on the CITES Trade Database.	Visits to hunters every two years reveals that each hunter collected approximately the same number of snakes each year, but anecdotal information provided by the hunters suggests that their competitors have gone out of business, despite snakes still being easy to find. Visits to exporters reveal that the number of snakes exported has declined each year, which is supported by trade volumes in the CITES Trade Database. Body sizes and sexes of the harvested snakes have remained the same each year. Secondary information suggests that this is because importing countries are now breeding many snakes themselves and are not relying on exports of wild specimens from other countries. In addition, two more exporters have started trading that species, further lowering the demand for snakes from the exporters being monitored.	Although the declines in exports reported by the exporters may suggest a decline in wild populations of this species, the secondary information on demand, the relative ease of collecting wild snakes and the consistency in the harvest demographic suggest that the decline is due to market forces rather than unsustainable harvesting. No changes to the management system are needed.

Table 6. A hypothetical scenario and harvest monitoring system for the trade in snakes for meat.

Trade type	Scenario	Monitoring system	Hypothetical Result	Interpretation and course of action
Meat trade	A species of snake is collected, killed and butchered for the meat trade. Harvesting takes place in two provinces in Country A and there are three processing facilities in each province. The snake species exhibits female biased sexual dimorphism (females grow much larger than males). Snakes of all sizes are harvested, but large individuals are more valuable because they yield more meat.	• Annual visits are made to four snake hunters in Province A and four snake hunters in Province B to examine harvest rates and gather other harvest information. • Visits are made to two processing facilities in each province and data are gathered on the number of snakes killed and their body sizes and sexes. • The relationship between the body sizes of whole snakes and the amount of meat they contain is known • Export volumes are recorded in the CITES Trade Database.	Visits to hunters in Province A reveal that the number of snakes collected and harvesting effort has remained stable. However, hunters in Province B are collecting the same number of snakes, but claim to travel twice as far to capture them and spend twice as long trying to find them compared to previous years. Visits to slaughterhouses in Province A reveal the number of snakes collected, their body sizes, and their sexes, have remained stable. In Province B, the number of snakes collected has remained stable, but the average size of snakes has decreased from 1.5 to 1.1 metres and, unlike previous years, the harvest has become heavily skewed towards males. The CITES trade database suggests that meat exports are slowly decreasing.	The data from hunters and processing facilities in Province A do not suggest harvesting has impacted wild populations in that Province because use appears to be sustained (no change). However, data from Province B suggests snakes are becoming harder for hunters to find, suggesting populations may be declining. This would not be detected at the processing facility because the hunters are working harder to supply the same number of snakes to the facility each year. However, the average body size of snakes collected has decreased, and is now focused toward males. This suggests that trade has disproportionately impacted large females and there are now very few females reaching reproductive size. This may have negative consequences for population recruitment. Finally, the slow decrease in snake meat export volumes may appear inconsistent because the same numbers of snakes are being harvested annually. However, this fits with a reduction in snake body sizes, because export volumes are recorded in tons of meat rather than individuals. The volumes of export have only been dropping slowly because Province A still has a healthy population. The course of action is to implement a management intervention to improve the sustainability. A negative NDF and voluntary restrictions on exports may be warranted.

Field Monitoring

This section provides guidance to Parties on how to conduct field monitoring for snakes and discusses some of the variables and biases that should be taken into consideration. The methods presented here are by no means exhaustive. Extensive literature exists on how population field monitoring can be undertaken for snakes. Two of the most up-to-date sources include:

Snakes: ecology and conservation (2009). Edited by Stephen J. Mullin and Richard A. Seigel. Cornell University Press, USA.

Reptile biodiversity: standard methods for inventory and monitoring. (2012). Edited by Roy McDiarmid et al. University of California Press, USA.

Deciding when a field study is worthwhile

As discussed in **Section 3.0**, snakes possess a number of traits that make field monitoring more difficult compared to other taxa. When determining whether it is worthwhile to conduct a population field study for a species of snake, the two most important variables are the species' distribution and detection probability. These are discussed below with examples of when a population field-monitoring program may be worthwhile. If a population field studied is not deemed to be worthwhile, then Parties should explore harvest-monitoring methodologies.

Distribution

Species of snakes with large distributions or with populations inhabiting variable landscapes may not be suitable for field studies aimed at making inferences useful for management because of different population dynamics among sites. For example, Reticulated Pythons (*Python reticulatus*) inhabit nearly every island in Indonesia, and are harvested from many of these. Known variability in the life-history traits of pythons from different islands means that extrapolating the results of field studies carried out in one area to make an inference about another, is problematic and possibly useless. The logistical difficulties involved in adequately surveying all harvested populations are insurmountable, meaning field studies for this species are not cost-effective or worthwhile. Species that are range restricted or harvested from only a few sites are better candidates for population field studies.

Detection probability

Many species of snakes are harvested in large numbers only because of the sheer number of people entering their habitats and opportunistically encountering them each day. However, these species may not be particularly easy to locate in a targeted way. Too much time may be required for investigators to gather enough data in the field to make robust conclusions about harvest effects. Species whose detection probability is high, or when large samples can be gathered quickly, are best suited for field studies. Examples include species that are easily captured in traps, can be easily located during surveys, or congregate together during certain periods of the year (e.g., pythons basking together in rocky gorges during winter months, or rattlesnake hibernacula). For example, Brooks et al. (2007) were able to assess abundance of Cambodian water snakes because the snakes are easy to capture in traps. In many cases, however, species that are easy for wildlife managers to capture are also easy for hunters to capture using similar methods.

Designing a population field study

Before implementing a monitoring system for a population of snakes, a decision should be made on the level of resolution that is required to understand changes in abundance. The researcher needs to decide whether they are attempting to determine the population size or density of snakes at a site (absolute abundance) or if it is merely sufficient to determine whether the population has changed since the last monitoring period (relative abundance). Because the purpose of monitoring is to investigate population change, these Guidelines suggest that in most cases an unbiased estimation of *relative abundance* is sufficient, particularly given logistical and financial limitations. Determining absolute abundance may be possible for species inhabiting small areas, and when logistical and financial impediments are not an issue.
What is the information of interest and how should it be interpreted?

In the same way that when conducting harvest monitoring we are looking for changes in the overall harvest and hunting patterns, population field studies are also looking for change over time (trends). In order to determine changes in abundance or population structure, a minimum of two years of monitoring is usually needed.

Thus, when conducting a field study, the information of interest is:

1) The number of animals captured in the sample (a proxy for overall population size), and

2) The size of the captured individuals in the sample (a proxy for overall population demographic which may signal if population is compromised)

A change in the number of individuals recorded in surveys, or changes in the body sizes of those individuals, may be a result of harvesting. As usual though, it is also essential to understand the biases that may be inherent in any field study. For example, field sampling may reveal that a population consists of predominantly large individuals. However, this may not reflect the true population demographic, but may be because trapping or survey methods are only suitable for large rather than small individuals. Ensuring consistency in survey methods, investigators and the timing of surveys from one sampling period to another is the best way to mitigate these types of biases. Environmental variations, like the impact of extraordinary droughts or floods, need to be considered in the interpretation of data, as climate phenomena have significant and wide-reaching effects on population numbers and structure that may obscure harvest effects.

Survey methods

A population monitoring field study aims to gather data from a representative sample of the total population. This can be achieved in a number of ways using both active and passive capture methods. The efficacy of different capture methods varies by snake species and can greatly alter results if inappropriate methods are used. For example, some species of snakes can be easily captured in traps, while others can only be captured by actively searching through areas of suitable habitat in the hope that individuals will be encountered.

Active survey methods

Active survey methods involve an observer or observers actively searching for snakes in areas (e.g., woodland or swamp) and at times (e.g., night or day) that the species of interest has a high probability of capture. Because of this, captures of snakes relies heavily on the competence of the observer, and is sensitive to observer bias. In order for a monitoring program to be successful, and to tease apart harvest effects from observer, behavioral or environmental effects, and survey methods must be standardized. This can be achieved by constraining the following variables:

Time **–** ensuring that snakes are searched for at the same time of day or night, and in the same season (for example, between 8-10 PM each night in August).

Effort **–** ensuring that the effort put into searching is kept constant (e.g., do not have one observer on some surveys and then two observers on others).

Space **–** ensuring that the same spatial area is surveyed on each occasion (e.g., defined transects or quadrats in the same area of forest or the same hibernacula each year).

Transects are a common active survey method for snakes. A transect is simply a line or path that passes through an area of interest from which systematic counts and measurements can be made. Transects can be curved instead of straight, and can follow natural or artificial paths. Examples include travelling along a section of river or lake and counting snakes in the trees on the bank (Plummer, 1997), or following a road to capture snakes crossing at night (McDiarmid et al., 2012). Another common surveying method is to visit areas where snakes are known to congregate at particular times of year. This may include snakes congregating to bask in the sun, congregating to mate or to hibernate. If the methods used to capture snakes are consistent then individuals captured in a defined area can be compared to those captured in previous monitoring occasions to make inferences about the status of the population and how it may have changed from one year to the next.

Passive survey methods

Passive survey methods involve trapping snakes. Although only certain species can be captured in traps, using traps is often preferable to active searching because they are insensitive to many biases and maximize repeatability. Nevertheless, quantifying the biases inherent in trapping studies is important. For example, some traps may sample only a portion of the population demographic traits if traps exclude a certain size of individual. This may lead to investigators overlooking harvest-related changes in body size because the size where change is occurring is not sampled by the capture method. Brooks et al. (2007) used gill nets to determine population density of water snakes in Tonle Sap in Cambodia. The gill net method captured small snakes, while hunters using reed traps and baited hooks capture a different size cohort within the population.

Combining population field studies with harvest monitoring

A pragmatic way to conduct population field monitoring is to combine it with harvest monitoring. When monitoring harvest at the hunter level, investigators can accompany hunters collecting snakes each year to understand how capture rates are changing. For example, investigators could travel for one week with hunters trapping aquatic snakes. The number and sizes of snakes captured within traps can be recorded accurately and efficiently. Repeating this schedule with the same hunters, using the same traps at the same time and place each year would quickly build a useful dataset to assess the status of the species of interest. The hunter's harvest effectively doubles as the field survey and is a pragmatic way of minimizing financial and logistical issues associated with conducting long-term population field studies.

Examples

Examples of field monitoring programs for hypothetical populations of snakes are provided in **Tables 7, 8 and 9**.

Table 7. A hypothetical scenario and population field monitoring system for the trade in snake skins.

Trade type	Scenario	Monitoring system	Hypothetical Result	Interpretation and course of action
Skin trade	An aquatic species of snake is harvested from three separate rivers for the skin trade. The hunters usually capture the snakes with fishing net snakes in which many of the snakes drown.	Each year, basket traps are set for one week in each of the three rivers to capture snakes. The number of snakes captured is recorded along with their body sizes and sexes. Halfway through the monitoring program a new type of basket trap is used to capture snakes. Basket traps are used because they do not kill the snakes when they are captured.	When monitoring first began the mean number of snakes captured in each trap was 10. The snakes had a mean body size of 80cm. After the new traps started to be used 15 snakes were captured per traps on average, but body sizes remained the same.	Despite the number of snakes captured over the course of the monitoring system increasing, this is unlikely to be related to a population increase. Instead, the increase is most likely due to a new, and more efficient, trap design being employed halfway through the monitoring period. No changes to the management system required.

Table 8. A hypothetical scenario and population field monitoring system for the trade in snakes for pets.

Trade type	Scenario	Monitoring system	Result	Interpretation and course of action
Pet trade	A species of snake endemic to a small island is harvested for the pet trade. Although arboreal, the species hunts on the ground and at night is easy to detect by walking through the forest with a torch. The species is easiest to observe during the wet season.	Each year, three 1 km long transect surveys are carried out for two weeks at two separate sites in rainforest habitat. All surveys are carried out in the month of January during the wet season. All snakes located are captured and their body size and sex is recorded.	When monitoring first began, an average of three snakes per hour of searching was captured at both sites. The mean body size of captured snakes was two metres long. After five years of harvest, the number of snakes captured has fallen to only one snake per hour at both sites and average body size of captured snakes is now only 1.5 metres long.	Assuming that survey methods have remained the same, all of the information gathered through monitoring suggests that the population may be affected by harvesting. The course of action is to implement a management intervention to improve the sustainability of trade. A negative NDF and voluntary restrictions on exports may be warranted.

Table 9. A hypothetical scenario and population field monitoring system for the trade in snake meat.

Trade type	Scenario	Monitoring system	Hypothetical Result	Interpretation and course of action
Meat trade	A species of large python is found over a wide area spanning several countries. Because of their large size, they are highly prized as bushmeat in Country A and populations have been severely depleted. In response, Country B has begun legally exporting meat to Country A, and some level of illegal trade is also known to occur. The species is known to congregate along rocky gorges to mate during spring.	Each year in spring, investigators survey two 1km long gorges in Country B and capture all pythons that have congregated there to breed. The snakes are measured, sexed, and released.	Over the course of the monitoring period the number of pythons located decreased from a mean of 36 individuals per survey (both gorges combined) to 20 individuals per survey. However, the average body size of pythons captured has increased slightly from 4.1 metres to 4.2 metres.	The steady decline in the number of snakes located in each gorge may be indicative of a harvesting affect. Although the data on body sizes does not reflect a change in population demographic, this may be because only individuals above a certain body size enter the gorge to breed so smaller animals are not represented in the sample. This bias may explain the decline in numbers of large individuals but not the absence of a demographic change. The course of action is to continue monitoring the population. If further declines are observed, then a management intervention should be implemented to improve sustainability.

Section V . Managing snake populations

Harvest management tools

If population changes are observed when monitoring (using either harvest or population field monitoring described in **Section IV**), and those changes are suspected to be a result of harvesting, a number of tools are available to assist management intervention. Wildlife management takes into consideration the complex interplay between social, biological and economic forces acting on wildlife populations. The management guidelines in this document touch upon each of these factors, where applicable. This is because harvest and trade is as much about managing people as it is about managing wildlife. If local people are not happy with a proposed management intervention, then there is a strong possibility that it will fail. So whenever we discuss different monitoring systems we focus on a set of variables, both natural and anthropogenic, to allow the application of the best management systems possible.

Quotas

Quotas are a fixed number, limiting the amount or share of the commodity of interest – in this case the harvest of snakes. Many Parties to CITES choose to implement quotas to assist in the management and regulation of harvests to ensure non-detriment. The setting of an export quota, advised by a Parties' Scientific Authority, effectively meets the requirement of CITES to make an NDF for species included in Appendix II (Res. Conf. 14.7). Indeed, this same Resolution states that when export quotas are established, they should be set as a result of a non-detriment finding by a Scientific Authority, and further establishes that a Non-Detriment Finding should be made before an export quota is established for the first time or revised, and reviewed annually. Unfortunately this is not always the case. In many instances, this assumption can have limitations because it reveals nothing about the science underpinning the quota. On the other hand, in many cases quotas are used as an administrative tool and do not reflect any sort of sustainable offtake, particularly for species whose populations may not be easily quantified. For example, applying a sustainable harvest quota may be relatively straightforward if the annual harvest of a species is only 20 individuals - such a harvest is unlikely to pose a threat because it would likely represent only a small proportion of the total population. However, if the quota is set for the harvest of 300,000 individuals, significant knowledge of the population is required to ensure that the quota does not exceed the maximum sustainable yield and put the species at risk.

Harvest or export quotas may only be effective if industry abide by them. Exceeding quotas coupled with high levels of illegal trade may do little to regulate harvests (Jenkins, 2009). In several countries, poor people collect snakes to directly improve their livelihoods and are often not aware that a quota exists. Others choose to ignore quotas to increase their income through harvesting. Often the capacity or incentives to exceed harvest quotas are substantial. In these situations, a quota can result in a number of issues that circumvent a wildlife manager's ability to ensure sustainable offtake and can create compliance issues for regulatory authorities. For example, if management relies only on a quota system, an incentive can be created to launder the excess through other sources in order to "meet" the "quota" during bad years, and when years are favourable, the excess may be smuggled or laundered through other countries. Furthermore, a fixed quota that is above the numbers easily produced during a bad year may foster an increase in hunting effort and prices to reach the "quota", rendering the harvest unsustainable. In such situations a quota has failed in its goal to regulate harvesting and the associated compliance issues can compound the difficulties of ensuring non-detrimental trade.

In addition to the potential for circumvention of quotas and illegal trade, quotas present difficulties for managers that are monitoring a harvest. For example, **Figure 2** depicts a scenario where a Party's quota is exceeded every year and the excess is exported illegally via neighbouring countries. Every year, the quota remains the same, as do the number of individuals annually exported via legal channels. The constant legal harvest may give managers the impression that sustainability has been achieved, when in reality the overall harvest has been rapidly decreasing and may be suggestive of unsustainable harvest. The application of a quota, in a trade situation where governance is poor and illegal trade is common, may result in mis-interpretation of harvest data. Even in situations where population declines can be observed, quotas often do little to ensure sustainable trade when used in isolation because they are indiscriminate to the types of individuals harvested and the timing when the harvest occurs. For example, even in situations where quotas are strictly adhered to, the quota alone cannot prevent the harvest of large reproductive individuals during the breeding season. Thus, harvest sustainability may be compromised even if the quota is not exceeded.

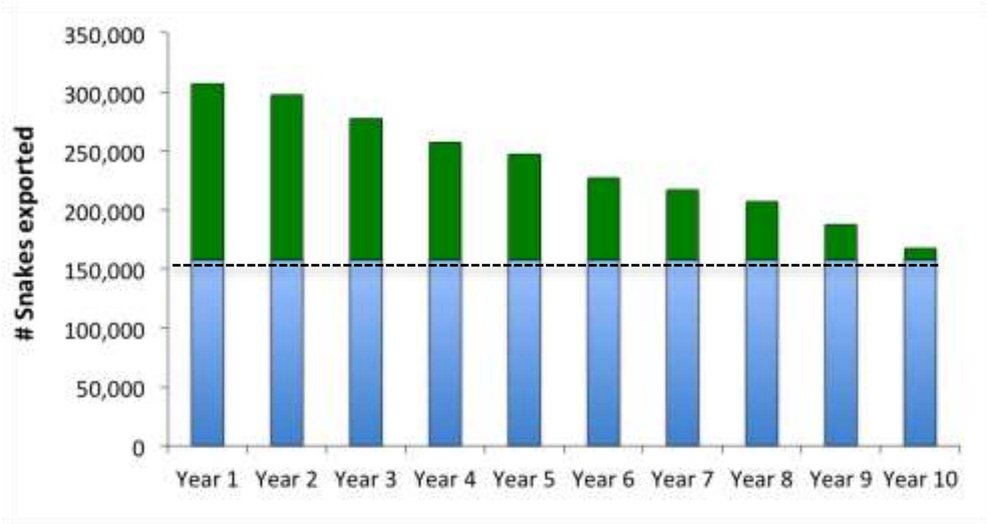


Fig. 2. A scenario where the effect of harvesting is hidden by a quota. The legal exports (blue columns) remain constant, giving the impression that sustainability has been achieved, when in reality the overall harvest has been declining as indicated by the decrease in illegal trade (green columns).

Size restrictions

Restricting the size of individuals that can be captured is a tool commonly used in fisheries management and aims to protect important life stages with the goal of maintaining high population recruitment. Typically, restrictions are placed on the minimum and/or maximum size of animals to protect immature and large, highly fecund, individuals, respectively. The underlying theory is that removal of individuals between such size limits is biologically safe, and likely to have the least impact on the viability of the population.

In principle, size restrictions act as a quota that takes into account natural population dynamics. From a biological point of view, and with constant hunting effort, we expect the harvest to represent some fraction of the existing population (Caughley and Sinclair, 1994; surplus yield models). This is because there are only a finite number of individuals within each size cohort that can be harvested at a given time. When the population increases because of favourable environmental conditions, the harvest increases - and vice versa.

Theoretically, a system in which size restrictions are being enforced can result in the harvest of the same number of individuals as a system in which quotas are being enforced. However, size restrictions have two advantages over quotas:

1) **Improved regulatory capacity.** Because the size of harvested specimens can be easily measured, size restrictions can be adequately enforced. It is very difficult to prevent quotas being exceeded because enforcement authorities cannot differentiate one individual from another.

2) **Ensuring sustainability through regulation**. Because harvest size restrictions can be set to protect specific life stages, managers can simply manipulate harvest sizes to better protect a specific demographic of the population. Similarly, if population declines are observed then harvestable sizes can be restricted to limit the total off take. This cannot be achieved with a quota.

We suggest that in a wide variety of cases involving harvest and trade in wild snakes, size restrictions are the most straightforward and meaningful way of managing populations to ensure harvest sustainability.

Effort restrictions

Restrictions on effort is a useful tool for regulating wild snake harvests. Typically, restrictions are imposed on the number of hunters that are legally registered to harvest snakes, or the total number of individual animals that hunters are allowed to harvest (the bag limit). The principle behind this type of management is that each hunter can only collect a finite number of individuals over a specified time period. Limiting the number of hunters restricts the harvest to the cumulative total of individuals that each hunter can theoretically capture.

Scenarios of how harvest can be managed using effort restrictions are provided below using four different situations in four countries:

Country A – Places no restriction on the number of hunters permitted to capture snakes. The number of snakes that can be theoretically captured is limited only by the size of the snake population.

Country B – Places no restriction on the number of hunters allowed to capture snakes, but allows each hunter a bag limit of only 10 snakes. The number of snakes that can be theoretically captured is limited by the number of hunters participating in the harvest or by the size of the snake population.

Country C – Places no restriction on the number of snakes that each hunter can catch, but restricts the number of hunters allowed to participate in the harvest. The number of snakes that can be harvested is limited by the number of snakes each hunter can harvest or by the size of the snake population.

Country D – Restricts the number of hunters that can participate in harvesting to 20 individuals and sets a bag limit of 10 snakes per week. The maximum number of snakes that can be legally harvested is 10,400 individuals per year.

Only in Country D is the total number of snakes collected effectively restricted. Effort restrictions act as a type of quota by setting an upper limit on the number of individuals that can be harvested. Thus, effort management can suffer from the same disadvantages as quotas when illegal trade and non-compliance issues are present in the trade situation. In situations where governance and regulation is poor, compliance can often be monitored at the higher levels within a trade chain. For example, the 20 registered hunters in Country D (above) may all sell their snakes to a single slaughterhouse. If that slaughterhouse only buys from those hunters, yet attempts to on-sell 20,000 snakes at the end of the year, there is a strong possibility that additional, unregistered hunters are participating in the harvest, or that the registered hunters are exceeding their bag limits. In many situations involving snakes, effort restrictions may not be pragmatic. Small numbers of snakes are commonly harvested by a large number of people, who opportunistically collect snakes to boost their income. These collectors are often not registered with authorities, and the logistical task of doing so may not be practicable.

Season restrictions

In many countries, wildlife managers restrict hunting to specific times of the year. Such restrictions are often biologically meaningful and coincide with times when animals are at their most vulnerable. For snakes, season restrictions might most logically be imposed when species are denning together during the winter (to avoid over-exploitation by harvesting at times when collection is easy) or when they are laying eggs or giving birth (to allow female snakes a reproductive opportunity). From a management point of view, such restrictions work because only a finite number of individuals can be captured within a prescribed season. The total number of individuals harvested will thus be lower than if collection occurs throughout the year - because it allows a greater number of individuals (that escaped detection) an opportunity to contribute to population recruitment.

Similar to the other management tools that restrict total numbers of animals captured (quotas and effort restrictions), snakes may continue to be captured during the off-season and stockpiled or laundered through legal channels. Thus season restrictions must be implemented only when strict controls are in place to minimize non-compliance (e.g., regular patrols during the no harvest season). This method may also not favor local people relying on the resource for income. The loss of income at certain times of the year may jeopardize local livelihoods and create further incentives to circumvent harvest regulations.

Quotas vs. size restrictions

The figures presented provide examples of the different effects that quotas and size restrictions have on the demographic of a harvest.

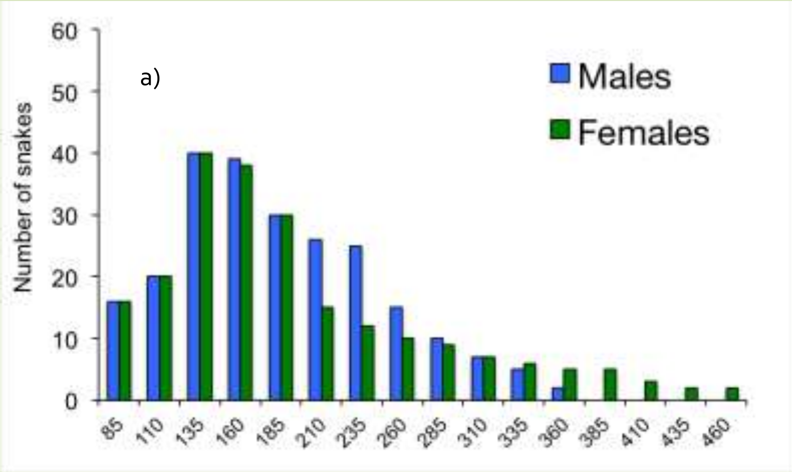


Fig. a). A hypothetical snake population showing the total number of males (blue) and females (green) within each size class. It can be seen that females grow larger than males.

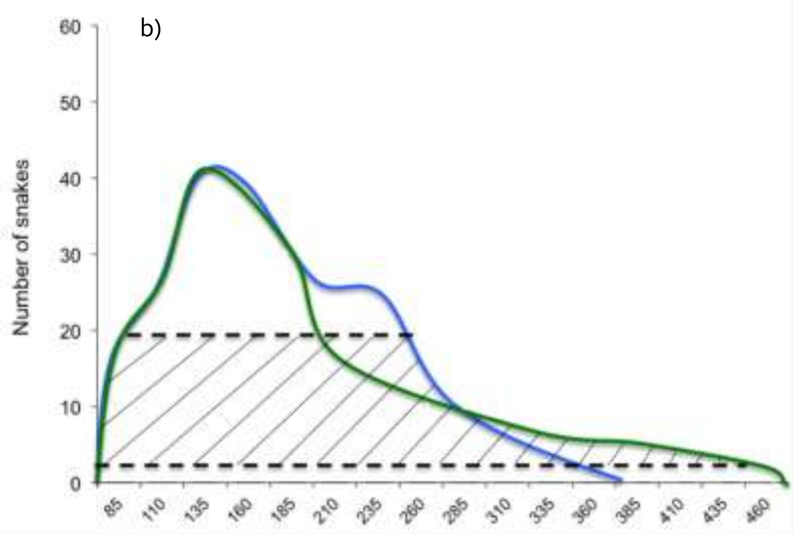


Fig. b). The same snake population with a set quota. The hatched area depicts the total number of snakes that can be legally harvested. Note that the quota restricts the number of individuals that can be harvested, but it does not discriminate the types (e.g., sizes or sexes) of individuals that can be harvested.

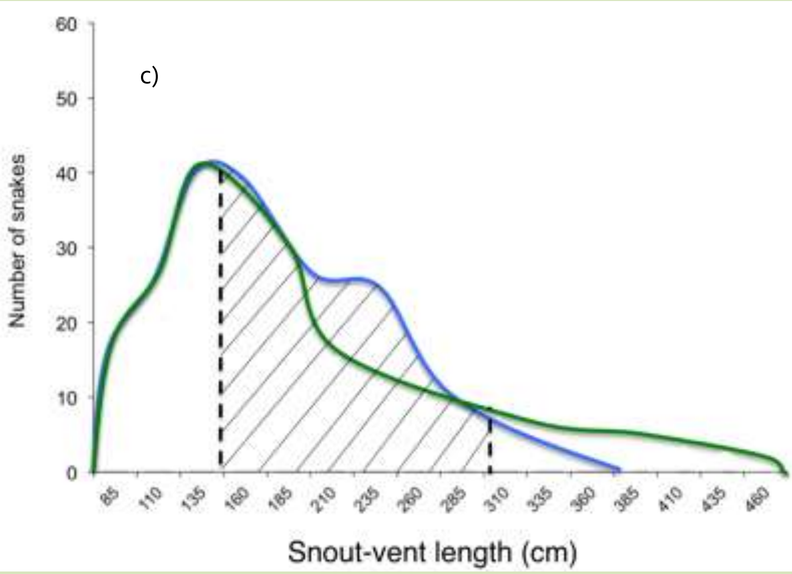


Fig. c). The same snake population with a size restriction only allowing the harvest of individuals between 150 and 300 cm in length. The hatched area depicts the total number of snakes that can be legally harvested. Using this method, small immature individuals and large females can be protected from the harvest without compromising the harvest yield.

Combining management tools

Many wildlife management systems do not rely on a single harvest management tool, but combine more than one method. For example, a system that restricts the number of people allowed to harvest within a set season, and only allows them to harvest a set number of animals within a given size range, uses all of the tools described above. The greater the number of management tools used, the greater control managers will have over the harvest. However, the financial and logistical costs also increase as management becomes more prescriptive. Each situation will be different and a balance between the amount of control and logistic feasibility needs to be struck. A summary of the pros and cons of each management tool is provided in **Table 10**.

Table 10. Pros and cons of the different management tools that can be used to regulate harvests of snakes.

Method	Pros	Cons
Quotas	• Can be a useful administrative tool for allocating harvests among provinces or states within a country. • Can be a useful administrative tool for handling minimum and very conservative export levels such that a management system is not required.	• Do not account for natural fluctuations in population size. • Cannot be easily monitored or enforced. • Can result in ongoing collection and stockpiling of specimens or smuggling. • Does not discriminate against sensitive age groups (e.g., immature individuals).
Size restrictions	• Can be biologically meaningful by protecting the most vulnerable or productive life stages. • Can be easily regulated and monitored. • Effectively acts a quota because only a finite number of individuals are available for harvest within a given size cohort. • Automatically accounts for the natural fluctuations of dynamic populations.	• Individuals outside the allowed size ranges can be harvested and illegally exported by captive breeding facilities or other countries where size restrictions are not in place. • Regulators do not have direct control over the yield of the population (as with quotas).
Effort restrictions	• Can naturally limit the number of individuals collected.	• Can be easily circumvented. • May negatively impact some hunters, especially when much of trade is opportunistic. • Can result in stockpiling or smuggling. • Difficult to enforce in many situations.
Season restrictions	• Can be biologically meaningful by preventing harvest at important period in a snake's life cycle. • Effectively work as a quota because only a finite number of individuals can be harvested in the specified period. • Reduces the time and resources invested to a hunting season.	• May result in stockpiling of specimens and smuggling. • Difficult to enforce in many situations. • May negatively affect local people who must find alternative work during periods when harvest is not allowed.

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Annex B

Primary Evaluation template and examples for CITES NDFs for snakes

CITES Non-detriment finding

Primary Evaluation Template

Text in italics is explanatory and should be deleted in completed documents. Please refer to the NDF Guidelines document for further explanation on how to complete this evaluation.

Species name	
Range state name	
Report compiled by	
Date compiled	

Section One: Summary

Please provide a short overview (1-2 paragraphs) of the trade in this species in the country of interest.

Section Two: Primary Evaluation score

Please score each attribute listed within the table below and sum these to provide a total.

	Number of points			Score
Criteria	**1**	**2**	**3**	
Annual harvest level	Low (<2,000)	Medium (2,000 - 20,000)	High (>20,000)	
Area of occupancy	Large (>20,000km²)	Medium (2,500 – 20,000km²)	Small (<2,500km²)	
Life history	Fast	Medium	Slow	
Additional risk factors	Other factors influencing the risk of harvesting should be taken into account. Specifically, if there is evidence of illegal trade and/or the status of the species is listed as vulnerable, endangered, or critically endangered on the IUCN Red List, give a **maximum score of 1 point**			

Section Three: Justification – Annual harvest level

Please provide an explanation with appropriate references to justify the score given.

Section Four: Justification – Area of occupancy

Please provide an explanation with appropriate references to justify the score given.
Section Five: Justification – Life history
Please provide an explanation with appropriate references to justify the score given.
Section Six: Justification - Additional risk factors
Please provide an explanation with appropriate references to justify the score given.
Section Seven: Conclusion, course of action and determination on exports
Please provide an overall conclusion on the perceived threat of trade to the species and details on whether further course of action will be taken to complete an NDF for the species.   .
Section Eight: Literature cited

Please provide references to all the reports and literature cited in this evaluation.

CITES Non-detriment finding

Primary Evaluation Template

Text in italics is explanatory and should be deleted in completed documents. Please refer to the NDF Guidelines document for further explanation on how to complete this evaluation.

Species name	Boa Constrictor (*Boa constrictor constrictor*)
Range state name	Suriname
Report compiled by	Suriname CITES Scientific Authority (**example only**)
Date compiled	2011 to 2012 (**example only**)

Section One: Summary

Please provide a short overview (1-2 paragraphs) of the trade in this species in the country of interest.

Boa constrictor is harvested from the wild in Suriname and is exported for the pet trade. They are harvested from throughout the country and approximately 200 – 300 specimens are exported annually. An export quota of 1010 individuals per annum is currently in place.

Section Two: Primary Evaluation score

Please score each attribute listed within the table below and sum these to provide a total.

	Number of points			Score
Criteria	1	2	3	
Annual harvest level	Low (<2,000)	Medium (2,000 - 20,000)	High (>20,000)	**1**
Area of occupancy	Large (>20,000 km^2)	Medium (2,500 – 20,000 km^2)	Small (<2,500 km^2)	**1**
Life history	Fast	Medium	Slow	**2**
Additional risk factors	Other factors influencing the risk of harvesting should be taken into account. Specifically, if there is evidence of illegal trade and/or the status of the species is listed as vulnerable, endangered, or critically endangered on the IUCN Red List, give a **maximum score of 1 point**			**0**

Section Three: Justification – Annual harvest level

Please provide an explanation with appropriate references to justify the score given.

A harvest quota of 1,010 individuals is allocated for harvest in all of Suriname annually. There is no evidence of illegal trade and only 1/3 of this quota is realised each year (exports between 200 – 300 individuals per year). This justifies the harvest level score of **1** (low).

Section Four: Justification – Area of occupancy

Please provide an explanation with appropriate references to justify the score given.

Boa constrictor occurs throughout Suriname. It is a generalist species that thrives in modified and anthropogenic habitats (including cities) (Henderson et al. 1995). For this reason we deem the area of occupancy within Suriname to be the total land area of the country: 163,821 km^2. This extent is considerably larger than 20,000 km^2 and thus justifies an area of occupancy score of **1**.

Section Five: Justification – Life history

Please provide an explanation with appropriate references to justify the score given.

Boa constrictor is a livebearer with a high reproductive output, producing an average of 27 young in a litter and up to 65 young in large females (Bertona and Chiaraviglio, 2003; Pizzatto and Marques, 2007). They are fast growing, but probably only produce litter bi-annually (Bertona and Chiaraviglio, 2003; Pizzatto and Marques, 2007). For this reason we follow a precautionary approach and give a life history score of **2** (medium).

Section Six: Justification - Additional risk factors

Please provide an explanation with appropriate references to justify the score given.

There is no evidence of illegal trade in *Boa constrictor* from Suriname. For this reason we assign a score of **0**.

Section Seven: Conclusion, course of action and determination on exports

Please provide an overall conclusion on the perceived threat of trade to the species and details on whether further course of action will be taken to complete an NDF for the species.

The sum of scores for the attributes listed above is **4**. All scores four and below do not require that a secondary evaluation be completed. Based on the information presented above, we can be confident that harvesting for trade does not affect the viability of *Boa constrictor* populations in Suriname.

This primary evaluation is a sufficient NDF for *Boa constrictor* in Suriname. Exports are deemed to be non-detrimental. Trade is allowed to continue and no further course of action will be taken to monitor or manage harvests.

Section Eight: Literature cited

Please provide references to all the reports and literature cited in this evaluation.

Bertona, M., and Chiaraviglio, M. (2003) Reproductive biology, mating aggregations, and sexual dimorphism of the Argentine Boa Constrictor (Boa constrictor occidentalis). Journal of Herpetology. 37, 510-516.

Henderson, R., Waller, T., Micucci, P., Puorto, G., and Bourgeois, R. (1995). Ecological correlates and patterns in the distribution of neotropical Boines (Seprentes: Boidae): A preliminary assessment. *Herpetological Natural History*, **3**, 15-27.

Pizzatto, L., Marques, O.A.V. (2007): Reproductive ecology of Boine snakes with emphasis on Brazilian species and a comparison to Pythons. South Am. J. Herp. 2: 107-122

Primary Evaluation Template

Text in italics is explanatory and should be deleted in completed documents. Please refer to the NDF Guidelines document for further explanation on how to complete this evaluation.

Species name	White-lipped python (*Leiopython albertisii*)
Range state name	Indonesia
Report compiled by	Indonesian CITES Scientific Authority (**example only**)
Date compiled	2011 to 2012 (**example only**)

Section One: Summary

Please provide a short overview (1-2 paragraphs) of the trade in this species in the country of interest.

Leiopython albertisii is harvested from the wild in Indonesia and is exported for the pet trade. All specimens are harvested from the wild in the provinces of Papua and West Papua. An annual harvest quota of 400 individuals is allocated. There is evidence that some wild specimens may be illegally exported as captive bred. Nevertheless, total annual exports are only 800 specimens.

Section Two: Primary Evaluation score

Please score each attribute listed within the table below and sum these to provide a total.

	Number of points			Score
Criteria	1	2	3	
Annual harvest level	Low (<2,000)	Medium (2,000 - 20,000)	High (>20,000)	**1**
Area of occupancy	Large (>20,000km^2)	Medium (2,500 – 20,000km^2)	Small (<2,500km^2)	**1**
Life history	Fast	Medium	Slow	**2**
Additional risk factors	Other factors influencing the risk of harvesting should be taken into account. Specifically, if there is evidence of illegal trade and/or the status of the species is listed as vulnerable, endangered, or critically endangered on the IUCN Red List, give a **maximum score of 1 point**			**0**

Section Three: Justification – Annual harvest level

Please provide an explanation with appropriate references to justify the score given.

A harvest quota of 400 individuals is allocated for harvest in the provinces of Papua and West Papua annually. There is some evidence that this quota may be exceeded and individuals are exported as captive-bred. Even if this is occurring, annual exports are approximately 800 individuals, which justify the harvest level score of **1** (low).

Section Four: Justification – Area of occupancy

Please provide an explanation with appropriate references to justify the score given.

L. albertisii occurs in the Indonesian provinces of Papua and West Papua (Natusch and Lyons 2012). It primarily inhabits primary rainforest and secondary regrowth habitats below 800 m above see level (O'Shea 1996). The extent of primary and secondary rainforest in Papua is 176,750 km^2 (Johns et al. 2006). This extent is considerably larger than 20,000 km^2 and thus justified an area of occupancy score of **1**.

Section Five: Justification – Life history

Please provide an explanation with appropriate references to justify the score given.

L. albertisii has a high reproductive output, producing 15 to 20 eggs in a clutch (Natusch and Lyons 2012; Parker 1982). Studies of closely related species inhabiting tropical areas suggest that growth rates are likely to be high. However, like closely related species, *L. albertisii* probably only reproduces every second year (Madsen and Shine, 2000). For this reason we follow a precautionary approach and give a life history score of **2** (medium).

Section Six: Justification - Additional risk factors

Please provide an explanation with appropriate references to justify the score given.

There is evidence of small volumes of illegal trade, where wild-caught snakes may be being mis-declared and exported as captive-bred (Natusch and Lyons, 2012). Even so, total exports of *Leoipython albertisii* from Indonesia (from all sources) is only approximately 800 individuals annually. Even if all of these individuals are taken from the wild, this level of harvest is deemed to have no impact on the species and as such is given a score of **0**

Section Seven: Conclusion, course of action and determination on exports

Please provide an overall conclusion on the perceived threat of trade to the species and details on whether further course of action will be taken to complete an NDF for the species.

The sum of scores for the attributes listed above is **4**. All scores of four and below do not require that a Secondary Evaluation be completed. Based on the information presented above, we can be confident that harvesting for trade does not currently affect the viability of *L. albertisii* populations.

This primary evaluation is a sufficient NDF for *L. albertisii*. Current exports are deemed to be non-detrimental. Trade is allowed to continue and no further course of action will be taken to monitor or manage harvests.

Section Eight: Literature cited

Please provide references to all the reports and literature cited in this evaluation.

Johns, J., Shea, G., and Puradyatmika, P. (2006). Lowland vegetation in Papua. In Marshall, A.J., and Beehler, B.M. (eds.). 2006. The Ecology of Papua. Singapore: Periplus Editions.

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Annex C

Secondary Evaluation examples for CITES NDFs for snakes

CITES Non-detriment finding

Primary Evaluation Template

Text in italics is explanatory and should be deleted in completed documents. Please refer to the NDF Guidelines document for further explanation on how to complete this evaluation.

Species name	Caicos Islands Dwarf Boa – *Tropidophis greenwayi*
Range state name	Great Britain (British Overseas Territory – **example only**)
Report compiled by	The CITES Scientific Authority (**example only**)
Date compiled	2017 (**example only**)

Section One: Summary

Please provide a short overview (1-2 paragraphs) of the trade in this species in the country of interest.

The Caicos island boa is a small species of boa endemic to the Turks and Caicos Islands. Two species are recognised – *T. greenwayi greenwayi* from Big Abergis Island and *T. greenwayi lanthanus* from the rest of the Turks and Caicos. The species is traded occasionally for pets, and each year a legal harvest of 100 specimens is allowed from throughout the species range*.

*This is a hypothetical scenario using a real species. *T. greenwayi* has been chosen for illustrative purposes only, but there is currently no known trade in this species from the Turks and Caicos Islands.

Section Two: Primary Evaluation score

Please score each attribute listed within the table below and sum these to provide a total.

	Number of points			Score
Criteria	1	2	3	
Annual harvest level	Low (<2,000)	Medium (2,000 - 20,000)	High (>20,000)	**1**
Area of occupancy	Large (>20,000km²)	Medium (2,500 – 20,000km²)	Small (<2,500km²)	**3**
Life history	Fast	Medium	Slow	**3**
Additional risk factors	Other factors influencing the risk of harvesting should be taken into account. Specifically, if there is evidence of illegal trade and/or the status of the species is listed as vulnerable, endangered, or critically endangered on the IUCN Red List, give a **maximum score of 1 point**			**1**

Section Three: Justification – Annual harvest level

Please provide an explanation with appropriate references to justify the score given.

The quota and annual harvest level for *T. greenwayi* is small (100 individuals). There is no evidence of substantial illegal trade. This justifies the harvest level score of 1 (low).

Section Four: Justification – Area of occupancy

Please provide an explanation with appropriate references to justify the score given. *T. greenwayi* is endemic to the Turks and Caicos Islands, meaning it is found nowhere else in the world (Edgar, 2009; Henderson and Powell, 2009). The islands have a combined total area of 612 km^2 (Reynolds, 2011; Reynolds and Gerber, 2012). *T. greenwayi* is known only from the larger islands in archipelago (Reynolds et al. 2010), hence the area of occupancy is considerably smaller than 2,000 km2 and thus justifies a score of 3 (small).
Section Five: Justification – Life history
Please provide an explanation with appropriate references to justify the score given. *T. greenwayi* has been poorly studied, and there is little is known about it life history. However, captive specimens are known to breed annually, and reach sexual maturity at small sizes (Iverson, 1986). These attributes may suggest a fast life history, however, the species only has between 1- 3 offspring in a litter, which is a small number (Henderson and Powell, 2009). Due to the lack of detailed information about this species, and the small litter sizes, a precautionary score of 3 (slow) has been given for life history.
Section Six: Justification - Additional risk factors
Please provide an explanation with appropriate references to justify the score given. There is no evidence of illegal harvesting taking place, and *T. greenwayi* has not been assessed by the IUCN. However, much of the Turks and Caicos Islands has experienced significant development and associated habitat loss for the tourism industry (Reynolds, 2011; Reynolds and Gerber, 2012). In addition, several introduced species have become established on the islands. The small size of *T. greenwayi* suggests it may be severely impacted by introduced pests (Reynolds and Niemiller, 2010). For these reasons, an additional risk factor score of 1 has been given.
Section Seven: Conclusion, course of action and determination on exports
Please provide an overall conclusion on the perceived threat of trade to the species and details on whether further course of action will be taken to complete an NDF for the species. . *T. greenwayi* scored an 8 in the primary evaluation, suggesting the species is highly susceptible to threatening processes. A more detailed Secondary Evaluation is required to ensure current harvest and trade levels are non-detrimental.
Section Eight: Literature cited

Please provide references to all the reports and literature cited in this evaluation.

Edgar, P. 2009. *The Amphibians and Reptiles of the UK Overseas Territories, Crown Dependencies and Sovereign Base Areas: Species Inventory and Overview of Conservation and Research Priorities*. Herpetological Conservation Trust, Dorset.

Iverson, J.B. 1986. Notes on the natural history of the Caicos Islands Dwarf Boa *Tropidophis greenwayi*. *Caribbean Journal of Science* 22:191–198.

Henderson, R. W., and R. Powell. 2009. Natural History of West Indian Reptiles and Amphibians. University Press of Florida, Gainesville.

Reynolds, R. G., G. P. Gerber, and J. Burgess. 2010. *Tropidophis greenwayi greenwayi* (Big Ambergris Dwarf Boa). Geographic distribution. *Herpetological Review* 41:520.

Reynolds, R. G., and M. L. Niemiller. 2010. Island invaders: Introduced reptiles and amphibians of the Turks and Caicos Islands. *Reptiles & Amphibians* 17:117–121.

Reynolds, R. G. 2011. Status, conservation, and introduction of amphibians and reptiles in the Turks and Caicos Islands, British West Indies. Pp. 377–406 in A. Hailey, B. S. Wilson, & J. A. Horrocks, eds. Conservation of Caribbean Island Herpetofaunas. Volume 2: Regional Accounts of the West Indies. Brill, Leiden, The Netherlands.

Reynolds, R.G., and Gerber, G.P. 2012. Ecology and conservation of the endemic Turks Island Boa (*Epicrates c. chrysogaster*: Serpentes: Boidae) on Big Ambergris Cay. *J. Herpetol*. 46, 578–586.

Schwartz A. 1963. "A new subspecies of *Tropidophis greenwayi* from the Caicos Bank". *Breviora* 194:1-6.

Example *Secondary Evaluation -* Caicos Islands Dwarf Boa *Tropidophis greenwayi**

*This is a hypothetical scenario using a real species. *T. greenwayi* has been chosen for illustrative purposes only, but there is currently no known trade in this species from the Turks and Caicos Islands.

Trade monitoring data

Over the past 10 years, a single trader has been permitted to collect and export specimens of *T. greenwayi*. The annual harvest quota has been set at 100 individuals per year, with harvest occurring on all islands. The number of boas exported each year has remained stable, and all individuals are exported to the United States for the pet trade. The exporter is located on the most developed island in the Turks and Caicos group – Providenciales.

Interviews with the exporter have revealed that collection from the wild occurs whenever US animal traders place an order for the species. The exporter claims that collection of specimens could occur relatively rapidly in the past, but lately it taking more time to fulfil an order. The exporter claims that this is because habitat loss has meant collectors need to travel to other islands within the archipelago to find snakes. The exporter claims that the species is still common on less populated islands.

Population monitoring in the field

T. greenwayi has always been a difficult species to locate during field surveys in the wild. This is due mainly to their small size, semi-fossorial habits (they live in leaf litter) and nocturnal activity patterns (Iverson, 1986). Most specimens captured for trade are done so opportunistically after heavy rains. Nevertheless, the species is one of the more common snakes encountered during cover-board surveys that have been conducted on several islands. Other related species of insular boid snakes are very common on some islands where suitable habitat persists (Reynolds and Gerber, 2012). The main prey species of *T. greenwayi* (Anoles and geckos) are common on the islands. In summary, it is unknown whether the apparent rarity of *T. greenwayi* is due to naturally low densities, poor detectability, or declines from former levels of abundance (or all three)?

Current management protocol

Current management protocols are limited to the annual harvest and export quota of 100 individuals. No other management protocols are in place.

Non-detriment finding conclusion

At present, *T. greenwayi* remains very poorly known. This lack of information, coupled with anecdotal information about declines on some islands, increasing development and habitat loss, and the threat of invasive species, does not allow the CITES Scientific Authority to make a positive NDF for an annual harvest and export of 100 specimens of this species from the Turks and Caicos Islands.

Proposed management interventions and research to ensure non-detriment

In order to grant a positive non-detriment finding for this species, the CITES Scientific Authority advises the CITES Management Authority to take a precautionary approach and implement the following management interventions:

i. Reduce the harvest of *T. greenwayi* from 100 specimens per year to 30 specimens per year,

ii. Only allow the harvest and export of specimens smaller than 22 cm SVL, which coincides with sexual maturity in females and thus protects reproductive individuals. Harvesting of juveniles is relatively biologically safe as those specimens have a higher probability of succumbing to natural mortality.

iii. Inspection of exports of the species should be undertaken to ensure adherence by the exporter to the legal size limit,

iv. Only allowing harvesting to take place on the relatively large islands of North, Middle and East Caicos islands,

v. Ensure harvesting does not take place on Big Ambergris Cay, where the sub-species *T. greenwayi greenwayi* is found,

vi. With the aid of herpetology students, undertake bi-annual cover-board surveys on North and Middle Caicos Islands (where harvest is allowed to take place), as well as two unharvested islands, to assess the relative abundance of *T. greenwayi* in harvested and unharvested landscapes.

Implementation of these management interventions will result in a positive NDF for this species. The NDF should be repeated and harvests reassessed in two years time, once results from the cover-board surveys become available.

Literature cited

Edgar, P. 2009. *The Amphibians and Reptiles of the UK Overseas Territories, Crown Dependencies and Sovereign Base Areas: Species Inventory and Overview of Conservation and Research Priorities*. Herpetological Conservation Trust, Dorset.

Iverson, J.B. 1986. Notes on the natural history of the Caicos Islands Dwarf Boa *Tropidophis greenwayi*. *Caribbean Journal of Science* 22:191–198.

Henderson, R. W., and R. Powell. 2009. Natural History of West Indian Reptiles and Amphibians.
University Press of Florida, Gainesville.

Reynolds, R. G., G. P. Gerber, and J. Burgess. 2010. *Tropidophis greenwayi greenwayi* (Big Ambergris Dwarf Boa). Geographic distribution. *Herpetological Review* 41:520.

Reynolds, R. G., and M. L. Niemiller. 2010. Island invaders: Introduced reptiles and amphibians of the Turks and Caicos Islands. *Reptiles & Amphibians* 17:117–121.

Reynolds, R. G. 2011. Status, conservation, and introduction of amphibians and reptiles in the Turks and Caicos Islands, British West Indies. Pp. 377–406 in A. Hailey, B. S. Wilson, & J. A. Horrocks, eds. Conservation of Caribbean Island Herpetofaunas. Volume 2: Regional Accounts of the West Indies. Brill, Leiden, The Netherlands.

Reynolds, R.G., and Gerber, G.P. 2012. Ecology and conservation of the endemic Turks Island Boa (*Epicrates c. chrysogaster*: Serpentes: Boidae) on Big Ambergris Cay. *J. Herpetol*. 46, 578–586.

Schwartz A. 1963. "A new subspecies of *Tropidophis greenwayi* from the Caicos Bank". *Breviora* 194:1-6.

CITES Non-detriment finding
Primary Evaluation Template

Text in italics is explanatory and should be deleted in completed documents. Please refer to the NDF Guidelines document for further explanation on how to complete this evaluation.

Species name	Yellow Anaconda (*Eunectes notaeus*)
Range state name	Argentina
Report compiled by	Fundación Biodiversidad Argentina (**example only**)
Date compiled	2015 (**example only**)

Section One: Summary

Please provide a short overview (1-2 paragraphs) of the trade in this species in the country of interest.

Eunectes notaeus is harvested from the wild in Argentina for its skin. Approximately 3,500 specimens are harvested and exported annually, largely from the province of Formosa in northern Argentina. No harvest quota is established, and local people are allowed to harvest as many snakes as they want between specific sizes and in a defined hunting season.

Section Two: Primary Evaluation score

Please score each attribute listed within the table below and sum these to provide a total.

	Number of points			Score
Criteria	1	2	3	
Annual harvest level	Low (<2,000)	Medium (2,000 - 20,000)	High (>20,000)	**2**
Area of occupancy	Large (>20,000km²)	Medium (2,500 – 20,000km²)	Small (<2,500km²)	**2**
Life history	Fast	Medium	Slow	**2**
Additional risk factors	Other factors influencing the risk of harvesting should be taken into account. Specifically, if there is evidence of illegal trade and/or the status of the species is listed as vulnerable, endangered, or critically endangered on the IUCN Red List, give a **maximum score of 1 point**			**0**

Section Three: Justification – Annual harvest level

Please provide an explanation with appropriate references to justify the score given.

There is no fixed limit on the number of individual snakes that can be harvested annually from Argentina. As a result, annual harvests and exports fluctuate. Nevertheless, the average annual offtake is approximately 3,500 snakes (up to a maximum of 6,000 snakes per year). There is no evidence that illegal harvest or trade is taking place. Based on this information, we provide a harvest score of **2** (medium).

Section Four: Justification – Area of occupancy

Please provide an explanation with appropriate references to justify the score given.

Within Argentina *E. notaeus* occurs only in aquatic inland ecosystems, specifically swamps, seasonally flooded marshes, or riverine habitats, associated with the Paraguay River and the middle sector of the Paraná River (Strüssmann and Sazima, 1993; Henderson et al., 1995; Dirksen, 2002) The yellow anaconda's extent of occurrence in Argentina encompasses about 120,000 km^2 (Micucci et al., 2006). Assuming a conservative 1:3 wetland/dry land ratio throughout this wetland-dominated area, we estimate that the total area of occupancy within Argentina is not less than 40,000 km^2. Nevertheless, because most of the yellow anacondas captured for trade originate from the La Estrella Marsh, which covers an area of 3,500 km^2, we conservatively assign an Area of Occupancy score of **2** (medium).

Section Five: Justification – Life history

Please provide an explanation with appropriate references to justify the score given.

E. notaeus has a high reproductive output, producing a mean of 24 offspring per litter. Growth is rapid, with females reaching sexual maturity after two to three years. However, data from dissections of individuals captured for trade shows that frequency of reproduction varies among populations and between years, with female snakes reproducing only every two to three years (Waller et al. 2007). Based on this information we assign a life history score of **2** (medium).

Section Six: Justification - Additional risk factors

Please provide an explanation with appropriate references to justify the score given.

There is no evidence of a current illegal trade in wild specimens of *E. notaeus.* The species has not been assessed by the IUCN, however, we know of no other major threatening processes for this species. We allocate a score of **0**.

Section Seven: Conclusion, course of action and determination on exports

Please provide an overall conclusion on the perceived threat of trade to the species and details on whether further course of action will be taken to complete an NDF for the species.

The sum of scores for the attributes listed above is **6**. All scores of five or higher should result in a Secondary Evaluation being completed for the species. Although *E. notaeus* possess a number of attributes that make them resilient to harvesting, because up to 6,000 individuals are harvested annually from a relatively small area of Formosa, we require more information to confidently satisfy non-detriment.

This Primary Evaluation is not a sufficient NDF for *E notaeus* in Argentina. For this reason we have completed a Secondary Evaluation for this species (see below).

Section Eight: Literature cited

Please provide references to all the reports and literature cited in this evaluation.

Dirksen, L. 2002. *Anakondas. Monographische revision der Gattung Eunectes Wagler, 1830 (Serpentes, Boidae).* Natur und Tier-Verlag, Münster.

Henderson, R.W, T. Waller, P. A. Micucci, G. Puorto, & R.W. Burgeois. 1995. Ecological correlates and patterns in the distribution of Neotropical boines (Serpentes: *Boidae*): a preliminary assessment. *Herpetological Natural History* 3(1):15-27.

Micucci, P. A., T. Waller, & E. Alvarenga. 2006. Programa Curiyú. Para la Conservación y Aprovechamiento Sustentable de la Boa Curiyú (*Eunectes notaeus*) en Argentina. Etapa experimental piloto 2002-2004, Formosa. In: M. L. Bolkovic and D. E. Ramadori (eds.) "Manejo de Fauna en Argentina: Proyectos de Uso Sustentable". Dirección de Fauna Silveste Secretaría de Ambiente y Desarrollo Sustentable, Buenos Aires, Argentina.

Strüssmann, C. & I. Sazima. 1993. The snake assemblage of the pantanal at Poconé, Western Brazil: faunal composition and ecological summary. Studies on Neotropical Fauna and Environment 28(3):157-168.

Waller, T., P. A. Micucci & E. Alvarenga. 2007. Conservation biology of the Yellow Anaconda (*Eunectes notaeus*) in Northeastern Argentina. Pp. 340-362 In R. W. Henderson and R. Powell (Eds.), Biology of the Boas and Pythons. Eagle Mountain Publishing, LC. Utah. 438pp.

CITES Non-detriment Finding Secondary Evaluation – The Yellow Anaconda Management Program

This document has been prepared by Fundación Biodiversidad Argentina* on behalf of the IUCN/SSC Boa and Python SG

*Fundación Biodiversidad Argentina, Suipacha 1311 – 3 Piso , C1011AAC CABA, Argentina – Email: biodiversidad@fibertel.com.ar

1. Introduction

The yellow anaconda (*Eunectes notaeus*) is one of four species of anacondas that occur in South America. This boa is the largest snake and one of the three existing species of boa found in Argentina.

Yellow anacondas have been historically considered a very valuable resource and have been largely exploited for their skins. In the past, harvests of anacondas were carried out in a very informal way, sometimes illegally, and not based on scientifically sound sustainable use guidelines or biological information. According to the CITES Trade Database, up to 320,000 skins were traded worldwide between 1982 and 2001, exported mainly from Argentina and Paraguay, before a complete ban entered into force in both countries.

In 2002, Fundación Biodiversidad devised a management system for the yellow anaconda in Argentina: the Yellow Anaconda Management Program (YAMP), aimed at promoting the conservation of this species based on its value as a renewable wildlife resource. To our knowledge, the Program is the only existing management plan designed to ensure the sustainable trade of skins of a snake species; since its inception, the Program has been able to produce a total of approximately 50,000 skins in a sustainable manner.

Because a Primary Evaluation could not easily determine non-detriment for exports of *E. notaeus* from Argentina, a Secondary Evaluation is suggested. This document is the result of that Secondary Evaluation, and summarizes the main components of the YAMP to provide an example of a management plan that is being implemented. It is intended to be read as an integral part of the NDF Guidelines for Snakes document prepared under Decision 16.102 of the Sixteenth Meeting of the Conference of the Parties to CITES.

2. Background of the yellow anaconda trade

a) International trade

Like many boa and python species, *Eunectes notaeus* is considered a valuable resource for its skin and the species is in high demand in the market for exotic leather goods (Jenkins and Broad, 1994). According to CITES import data, between years 1984 and 2013 (30 years), 296,748 whole yellow anaconda skins were traded worldwide (Fig. 1). This figure does not include a significant number of skins traded as skin pieces or reflected in the statistics by length or weight, nor does it comprise exports of thousands of skins manufactured into finished products such as belts, shoes or bags exported during the same period. Italy was the main importing country, followed by Germany and the USA (the three countries together accounting for 91% of the trade).

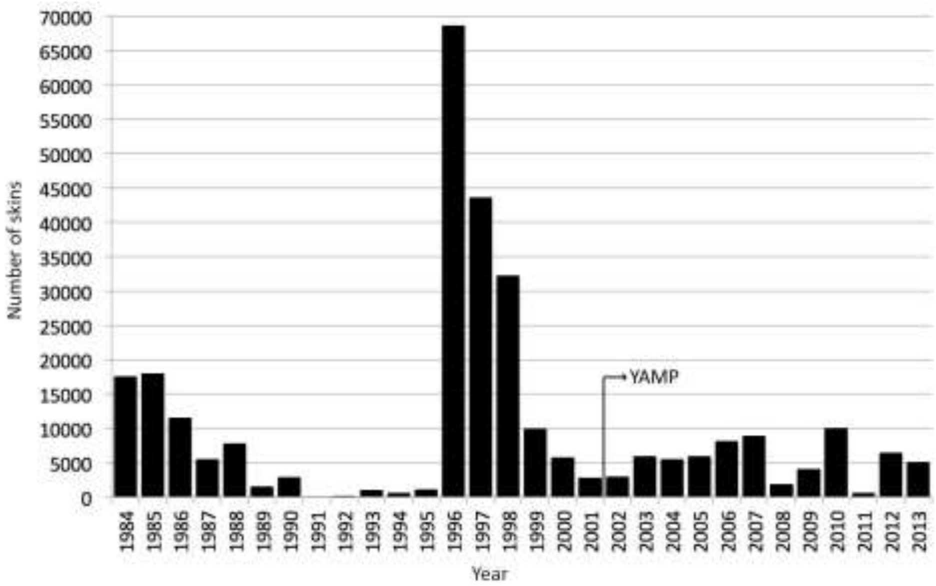

Figure 1. Minimum net trade for *Eunectes notaeus* whole skins between 1984 and 2013 (Source: CITES Trade Database). YAMP: Yellow Anaconda Management Program, started in 2002.

Most skins globally marketed during the last 30 years originated from Argentina, Paraguay and Bolivia. Argentina, however, accounted for 62% of the skins traded (CITES Trade Database). There are no export records from Brazil. Approximately 140,000 skins provided to the market by Argentina during the late 1990s originated from stockpiles accumulated as a result of a ban established in 1986. These skins were released for export between the years 1996 and 2000 (Micucci et al., 2006; T. Waller unpublished data). Thus, 78% percent of the trade recorded between 1984 and 2013 in fact took place before the year 2002; thereafter, the international trade in yellow anaconda skins diminished significantly due to control measures adopted by exporting countries (Micucci et al., 2006). Paraguay introduced a voluntary suspension on trade of all CITES Appendix II-listed species in 2003, while Argentina finished the export of stockpiles of yellow anaconda in 2000 and, subsequently, implemented the Yellow Anaconda Management Program (YAMP) in 2002 (Micucci et al., 2006).

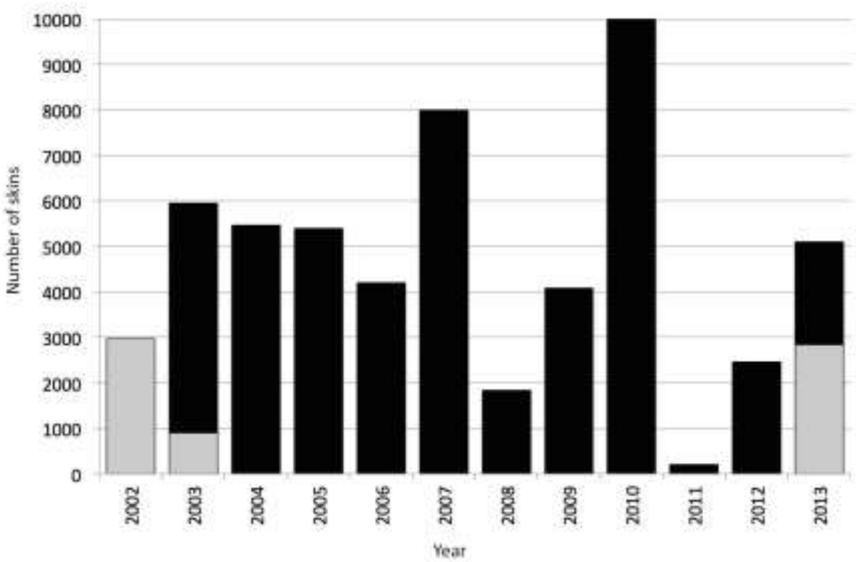

Figure 2. Gross exports of *Eunectes notaeus* skins from range countries between 2002 and 2013 (Source: CITES Trade Database). Black bars: Argentina; grey bars: Paraguay. *Note*: Usually YAMP skins are exported in the year following the harvest, with some exceptions. In years 2007 and 2010 skins were exported in the same year together with the skins from the previous year (2006 and 2009, respectively); this explains the peaks in 2007 and 2010 and the small number of skins exported in 2008 and 2011.

As is the case with almost all reptile species in trade (Dodd, 1993; Scott & Seigel, 1992), in the past exploitation of yellow anacondas was carried out very informally, often illegally, and not based on scientifically sound sustainable use guidelines or any biological criteria at all (Waller et al., 2007). However, from 2002 and to this day, the YAMP became the main source of yellow anaconda skins entering international trade (Fig. 2). Indeed, Argentina produced 88% of the 55,660 skins exported by range countries in recent years (2002-2013) (CITES Trade Database). The difference (12%) is due to Paraguay, yet these skins came from stockpiles obtained before 2003, when a voluntary suspension on CITES-Appendix II species was established. Most skins produced by Argentina (and Paraguay) between 2002 and 2013 were destined to tanneries in Italy (>90%; most of them imported through German ports), and the rest to the United States.

By contrast, trade in live specimens has been negligible, involving 477 specimens in 30 years, about half of them wild-sourced and exported by Paraguay before 2003. The USA has been the main importer of live anacondas. Due to their aggressive nature, anacondas in general are not particularly sought after as pets compared to other more docile constrictor snakes.

b) Domestic utilization and trade in range States

E. notaeus is occasionally collected for food or medicine by indigenous communities from northern Paraguay (Aquino-Shuster et al., 1991), Argentina (Gallardo, 1977) and presumably by some communities in Bolivia, but in general terms this is not a widespread practice (Waller, unpublished information).

Undoubtedly, obtaining skins to supply the local and international leather industry has been the main purpose for removing yellow anacondas from the wild. Nothing is known about the particulars of this trade in Bolivia. In fact, the last formal export from this country dates back to 1984, 32 years ago (2,950 skins; CITES Trade Database). In any case, Bolivia, Paraguay and possibly Brazil were directly or indirectly major suppliers of yellow anaconda skins to the international market, directly or indirectly, in particular between the 1960s the 1980s. Most of this trade took place surreptitiously across the borders, in such a way that it is difficult to establish the real origin of the skins traded internationally during those years; in fact, depending on differences in prices, regulations and law enforcement efforts, skins reaching the international market could have originated in any range country (Argentina, Bolivia or Paraguay) (Waller & Micucci, 1993).

Trade in snake skins began in Argentina possibly in the 1930s, with the establishment of the first tanneries specializing in reptiles, but peaked during the 1940s (Micucci et al., 2006). Annual exports from Argentina at that time were estimated to involve around 60,000 boa constrictor and yellow anaconda skins between 1940 and 1950, 30,000 skins in the mid-50s and 21,000 skins between 1975 and 1985 (Godoy, 1963; Gruss and Waller, 1988). These figures from official national records do not clearly distinguish exports from re-exports. In fact, in the early 1950s Argentina enacted new wildlife legislation banning the trade in this species. However, the local harvest and international trade continued uninterrupted, basically due to a sophisticated fraud mechanism involving the declaration of temporary imports and re-exports that ultimately facilitated the laundering of illegally harvested skins. This mechanism, that lasted 40 years, actually came to an end in the late 1990s, when hunting, inter-provincial movements, trade and imports of *E. notaeus* specimens and by-products were expressly prohibited in Argentina.

Furthermore, the export of a huge stockpile of approximately 140,000 skins, which had been accumulated by traders during the late 1980s, was authorized in 1996 with the requisite of tagging all the skins and a deadline to carry out the export. These stocks were exhausted by the year 2000, creating the conditions for the establishment of a management plan once the stocks had reached zero.

In 2001, and after a complete ban in trade was implemented, a field study was carried out to analyze the feasibility of establishing a harvest program for the species in northern Argentina. The study focused both on social and ecological aspects, collect information on the perception of local inhabitants about the utilization of anacondas and experimented with innovative management policies (Micucci et al., 2002). As a result of this research, in 2002 the national government commissioned a local NGO to design a management program for the species. After a three years experimental period (2002 to 2004) the Yellow Anaconda Management Program was definitely established in Argentina.

3. Legal framework

a) International

E. notaeus is listed in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) since February 4th, 1977, when the whole family Boidae was listed. There are no CITES quotas established for this species in any of the range countries. The yellow anaconda is included in Annex B of Council Regulation (EC) No 338/1997 of the European Union, which has since then been periodically updated (e.g. Commission Regulation (EU) No 1320/2014). It is not included in the Endangered Species Act of the United States; however, it has been recently listed as an "injurious species" under the Lacey Act, so that the introduction of live specimens of *E. notaeus* into the USA is prohibited since 2012. The yellow anaconda is the only commercial large snake species whose skins can be traded in California (this US State banned the trade in python skins in the 1970s).

b) National

Argentina: Argentina is a Party to CITES since 1981 (Ley 22344/1980). Argentina is a federal country. Provinces retain the right to administer their natural resources within their territories but the federal government has competence in exports, imports and inter-provincial movements. Further details on the legal status of the species in Argentina are provided in Section 6.d. *Bolivia*: The hunting and export of *E. notaeus* individuals (or their parts and derivatives) are currently banned. Bolivia is a Party to CITES since 1979. *Brazil*: Brazil has been a Party to CITES since 1975. Hunting and export of *E. notaeus* individuals (or parts and derivatives) are prohibited. *Paraguay*: Paraguay has been a Party to CITES since 1977. Export and hunting of wild *E. notaeus* specimens (or parts and derivatives) are currently prohibited. This country established a voluntary moratorium (suspension) on exports of all CITES species, including yellow anacondas, in 2003. It has recently lifted this voluntary suspension of trade only as relates to export of stockpiles of reptile skins collected between 2001 and 2003. The stockpiles included 5,300 yellow anaconda crust tanned skins that were exceptionally allowed for export.

4. Understanding the species

A thorough understanding of the species' biology is essential to devise and implement a management system. Until recently, biologically meaningful data to use as a basis for management of the yellow anaconda (*Eunectes notaeus)* were scarce, and mainly originated from general surveys, observation, or the study of a few specimens kept in zoos or museum collections. Petzold (1982), Waller and Micucci (1993), Dirksen (2002), and Reed and Rodda (2009) comprehensively compiled and summarized most of the published information on the species. More recently, Waller et al. (2007) presented basic population and biological data for *E. notaeus* in northern Argentina as a result of the ongoing field monitoring of the species under the YAMP.

a) Nomenclature

Four species of anaconda are currently recognized within the genus *Eunectes* Wagler (1830), including the largest snake in the world, the green anaconda (*Eunectes murinus*; www.reptile-database.reptarium.cz/). Anacondas are aquatic snakes that occur in South America. They are members of the family Boidae, which includes species from the Americas, Europe, Africa, Asia and many islands (O'Shea, 2011). *E. notaeus* was first described by Cope (1862) and represents the southernmost species of anaconda, distributed in Bolivia, Brazil, Paraguay and is the only species of anaconda that exists in Argentina (Giraudo and Scrocchi, 2002; Henderson et al., 1995). The taxonomy of this species remains largely unchanged and includes only one synonymy (*Epicrates wieningeri* Steindachner, 1903; Waller, 2000). *E. notaeus* is locally known as "*curiyú*" in Argentina and Paraguay, "*sicurí amarilla*" in Bolivia, and "*sucurí amarela*" or "*sucuridjú*" in Brazil (Waller et al., 1995; Dirksen, 2002). Trade names include "yellow anaconda", "southern anaconda", "*anaconda amarilla*" and "*curiyú*".

b) Coloration and identification

The background coloration of *E. notaeus* ranges from yellow to olive-brown yellow. The dorsum is covered with black 8-shaped blotches, which are separated from each other by lighter coloured scales. The sides exhibit smaller blotches and black spots. The ventral side is yellow with small black flecks. The head normally has five black stripes, three on the dorsal side and two post-ocular (Petzold, 1982; Waller et al., 1995; Dirksen, 2002; Reed and Rodda, 2009; O'Shea, 2011; Fig. 3).

E. notaeus is easily distinguished from other boids by their coloration and/or scale size and shape. However, it is more difficult to differentiate *E. notaeus* from two other closely related species, *E. deschauenseei* and *E. beniensis*, and demands closer scrutiny of coloration and pattern. Nevertheless, no trade has been recently reported for anaconda species other than *E. notaeus* and *E. murinus*. Unbleached *E. notaeus* skins and their by-products exhibit a very recognizable pattern (Fig. 3). More information for identification can be found in the CITES Identification Manual.

Figure 3. Left: *Eunectes notaeus* in the wild. Right: a bag made with three skins in parallel, exhibiting the natural pattern of *E. notaeus*.

c) Distribution and habitat

The known range of *E. notaeus* encompasses approximately 15 degrees in latitude throughout the Paraguay River and lower Paraná River basins, from Bolivia and Central Brazil in the north (ca. 15°S), to northeastern Argentina in the south (ca. 30°S; Henderson et al., 1995; Fig. 4). Periodical floods often carry individuals downstream to higher latitudes, some even reaching Uruguay, but there is no evidence of a reproductive population in this country (Waller and Micucci, 1993).

Figure 4. Left: The Approximate Extent of Occurrence (EoO) of *Eunectes notaeus* in South America (shaded area). The dark dots represent known records of occurrence. Right: *E. notaeus* is found in a variety of aquatic habitats, such as swamps, seasonally flooded marshes, lagoons and riverine habitats.

Throughout its range, *E. notaeus* occurs in aquatic inland ecosystems of the *Pantanal* and Wet *Chaco* eco-regions, specifically swamps, seasonally flooded marshes and riverine habitats, which are associated with the Paraguay River and middle sector of the Paraná River (Strüssmann and Sazima, 1993; Henderson et al., 1995; Dirksen, 2002). The majority of this region is a poorly drained plain without major geographic features. Seasonally flooded savannahs with palm trees, grasslands, and riparian forests are important landscape components (Strüssmann and Sazima, 1993; Waller et al., 2007; McCartney-Melstad et al., 2012; Kershaw et al., 2013; Fig. 4).

The Extent of Occurrence (EoO) of *E. notaeus* encompasses approximately 400,000 km^2 (Micucci et al., 2006). The Area of Occupancy (AoO) is difficult to define, however, assuming a conservative 1:3 wetland/dry land ratio throughout this wetland dominated area, we estimate that the total AoO for this species is not less than 130,000 km^2. EoO in Argentina was estimated in 120,000 km2 (Micucci et al., 2006), while AoO assuming a conservative 1:3 wetland/dry land ratio can be estimated in 40,000 km^2.

Sympatry with *E. murinus* occurs at the border between the *Pantanal* and the *Cerrado* regions, as well as in some of the large rivers that crosses the *Pantanal*, in Brazil and Bolivia (C. Strüssmann, pers.comm.).

d) Size, population structure and dimorphism

E. notaeus is a heavy-bodied medium sized boa that can grow to four metres in total length (Petzold, 1982; Strüssmann and Sazima, 1993; Dirksen, 2002). There are a few individuals recorded above this size, however most of these are based on the skin measurement that can stretch 25-30% more than the original length (Dirksen, 2002; Micucci and Waller, 2007). Most *E. notaeus* captured during field sampling in Paraguay and northern Argentina were on average half that size (Dirksen, 2002; Waller et al., 2007; Fig. 5).

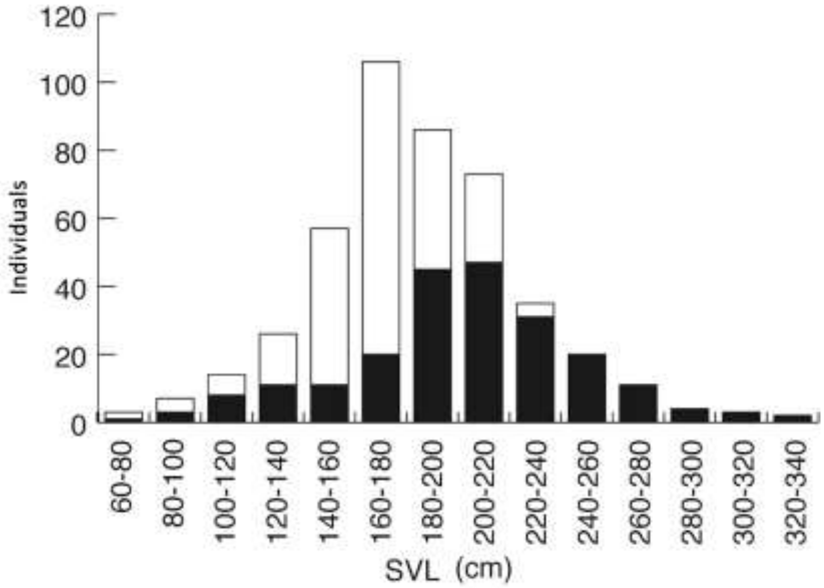

Figure 5. Snout-vent length (SVL) of *E. notaeus* males (black column) and females (white column) from a population in northern Argentina (N=449; Waller et al., 2007).

Sex ratio in clutches from wild populations in northern Argentina is 1:1 (Waller et al., 2007). *E. notaeus* are highly sexually dimorphic; males exhibit proportionately longer tails and larger spurs than females (Petzold, 1982; Dirksen, 2002; Waller et al., 2007). Sex can be determined by observing tail length and spur size, even in skins (Micucci et al., 2006; Fig. 6). Females can grow longer than males; the largest male and female found by Waller et al. (2007) after studying 1,555 individuals during field work in northern Argentina measured 2.6 m and 3.4 m SVL, respectively, and weighed 10.5 kg and 29 kg, respectively. The average SVL and weight for males was 1.7 m and 3.5 kg and 2 m and 6.3 kg for females.

As a result of these sexual differences in size, and the fact that the industry always seeks for medium to large skins (above 2 m), trade in *E. notaeus* indirectly relies on the harvesting of females (Micucci and Waller, 2007).

Figure 6. Male *E. notaeus* exhibit large spurs (left and arrow in right), which can be used to determine sex on dry skins (right).

e) Reproductive maturity

Age and size at maturation is a variable trait that depends on the availability of resources that directly impact on growth rates during early life stages. For this reason it is not feasible to determine an exact age at first reproduction for *E. notaeus*. Average size at physiological sexual maturity appears to be a relatively fixed trait and was established by the authors to be between 1.28 and 1.43 m SVL for males and 1.45 and 1.85 m SVL for females, approximately at the age of 2 or 3 years in northern Argentina (Waller et al., 2007); however, this does not mean that a female will actually reproduce at that size. First reproduction for females in northern Argentina may occur between 1.5 m SVL and 2.9 m SVL; some females in this population appear to avoid reproductive opportunities until reaching a size that permits them to maximize fecundity. This means their SVL at first reproduction is the result of their individual life history trajectories (Waller et al., 2007). Individual life trajectories vary greatly and render generalizations with regard to this trait meaningless.

f) Reproductive timing

Populations in Argentina show great seasonality and synchronicity in reproduction (Waller et al., 2007); males and females exhibit late summer to winter gonad recrudescence (February to October). *E. notaeus* are viviparous and secondary oviductal follicles were found from early October (Waller et al., 2007). Based on semi-captive experiments with wild specimens, mating in occurs in early spring (September to October) with parturition after 160-180 days of gestation, in the autumn of the following year (March to April; Waller et al., 2007). Hatchlings are large (41 to 59 cm SVL and 61 to 135 g), very aggressive and fast growing (Waller et al., 2007). There may be variations in the reproduction timing between populations of *E. notaeus*, as is to be expected in a wide-ranging species (Reed and Rodda, 2009), however, a similar pattern to the one depicted for Argentina has also been observed for the Brazilian Pantanal (Christine Strüssmann, pers.comm.). Furthermore, unpublished datasets from different Argentinian provinces and the south of Paraguay suggest that this cycle is generalized (T. Waller unpub. data). This dataset also shows that *E. notaeus* does not breed during the winter (May to August), which is traditionally the season preferred by hunters for harvesting *E. notaeus* in Argentina (Micucci et al., 2006).

g) Reproductive output

Reproductive output is the result of reproductive frequency and fecundity, both of which are strongly influenced by environmental conditions. Although the majority of *E. notaeus* males studied in Argentina by Waller et al. (2007) presented a constant annual reproductive frequency (99%, N=326), females reproduced every two years on average (54%, N=515), depending on fat reserves. However, this proportion can differ among years and between regions. For example, 200 females were surveyed in 2002 from two sites in Argentina; 51% of females exhibited secondary ovarian follicles (ready to reproduce in the next season) in one site compared to 29% in another site. The proportion of reproductively able females in northern Argentina changed from 44% in 2002 (N=200) to 60% in 2003 (N=283). The literature indicates that *E. notaeus* produces 5-37 hatchlings per clutch, but sources do not always distinguish between wild and captive datasets (Dirksen, 2002; Reed and Rodda, 2009). In Argentina, mean clutch size in 11 wild females that reproduced in "semi-captive" conditions was 19.5 with a range of 7-42. Based on a large sample of 246 wild specimens from northern Argentina, oviductal scars suggests an average clutch size of 24 with a range of 7-65 (Waller et al., 2007). Female SVL was significantly correlated either with clutch size (r^2=0.62, P<0.01), number of oviductal scars (r^2=0.67, P<0.001) or number of secondary follicles (r^2=0.44, p<0.001) (Waller et al., 2007; Fig. 7). Reproductive output also depends upon the body condition of females; populations of *E. notaeus* that exhibited heavier individuals were more prolific compared to those composed of lighter snakes. A good body condition offers other advantages with regard to population dynamics (i.e. a higher somatic growth rate, early maturity), which results in a higher population growth rate in some sites (or periods) compared to others.

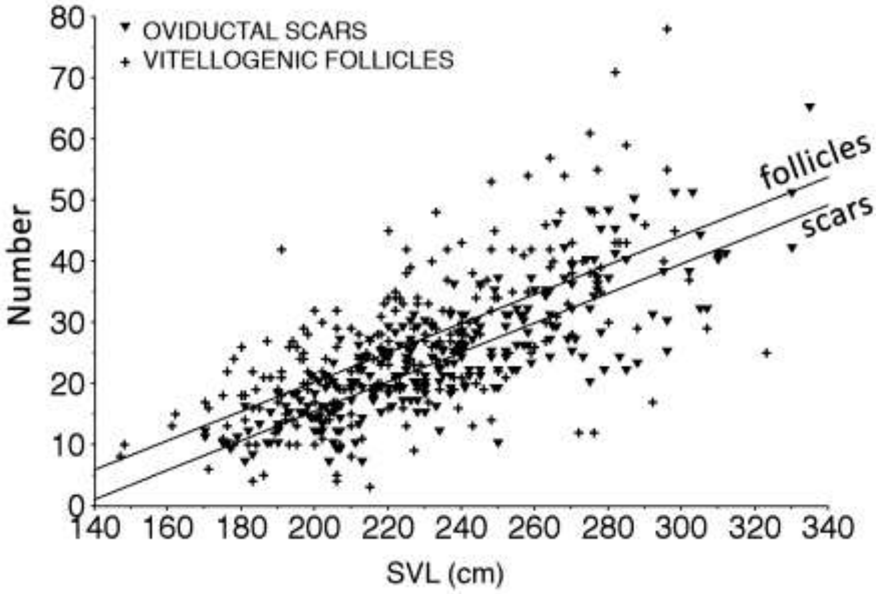

Figure 7. Relationship between female size (SVL) and number of oviductal scars and vitellogenic follicles (from Waller et al., 2007).

h) Growth

There is no conclusive data available on *E. notaeus* growth rates. This species shows rapid growth rates in captivity, with individuals increasing 40-60 cm each year depending on sex, until reaching sexual maturity, at which time growth rates diminish to 20-30 cm per year; females grew on average 20% faster than males (Petzold, 1982; Waller and Micucci, 1993; Norman, 1994; Dirksen, 2002). Growth appears to be relatively fast in wild populations from northern Argentina, with males and females capable of doubling their size in the first year of age and reaching sexual maturity in the second or third year of age (Waller et al., 2007). Consequently, this trait is expected to exhibit great spatial and temporal variations.

i) Longevity and survivorship in the wild

There is no data available on longevity or survivorship of wild *E. notaeus*. Captive individuals can live for more than 20 years (Snider and Bowler, 1992), but longevity is expected to be significantly less in the wild. Hatchlings are exposed to a variety of predators, however, the relatively large neonatal size, fast growth rates, and fierce temperament of this species, suggest that hatchlings and juveniles may be able to elude predation by outgrowing vulnerable offspring sizes in a few months (Waller et al., 2007). Extreme variability in wetland water levels is another potential cause of mortality. In northern Argentina, *E. notaeus* exhibited significant cyclical peaks and troughs in body condition (and reproductive frequency) in direct response to water levels (Waller, unpublished data). *E. notaeus* populations are also effected by extreme droughts and fire, local people killing snakes from fear and being killed crossing the road. Collection for the skin or live pet trade is currently negligible in most of the *E. notaeus* range.

j) Spatial ecology

E. notaeus appears to be active all year-round in most of its range. In summer, they are preferably nocturnal and become almost undetectable underwater when dispersed across seasonally-flooded savannahs. Often they are detected only when crossing roads or when they ambush prey on the shores of lagoons and creeks. Depending on the water level, they spend the majority of the time in densely vegetated water or resting on dry land near ponds during the dry season (Waller, pers.obs.). In northern Argentina, *E. notaeus* is often found concealed inside hollowed palm tree trunks or at the base of dense shrubs during droughts. In northern Paraguay, they seek shelter from the extreme summer heat in small caves in the vegetated mud banks of creeks and rivers (L. Aquino, pers. comm.). In Argentina, *E. notaeus* becomes more sedentary and detectable during the winter months (June to August), and can often be found basking to facilitate gonadogenesis and digestion (Waller et al., 2007); hunters take advantage of this (Micucci and Waller, 2007; Waller et al., 2007). Unpublished information from radio telemetric studies shows that *E. notaeus* in the southern tip of its range in Argentina may actually stay inactive for a few days or weeks during winter, staying underwater or under dense vegetation mats particularly during extreme cold weather.

Females utilize defined home ranges; adults (~2 m) utilized a range of ~15 ha compared to larger individuals that utilize ~50 ha. During the summer, adult *E. notaeus* travel long distances (~2 km) while smaller individuals move more often. Gravid females do not move for several months during gestation. A radio-tracked gravid female remained in the same position during the final 3 months of the gestation period (Waller, unpub. data). As with other large dimorphic snakes, smaller male *E. notaeus* are less territorial and better at dispersing compared to larger, heavy females. McCartney-Melstad et al. (2012) found that rivers and their associated floodplains are important in the dispersal of *E. notaeus*. Gene flow between *E. notaeus* populations was positively correlated with distance along the rivers connecting them, rather than with the straight-line distance between populations. The low dispersal ability of females due to their size and weight and the subtle natural barriers to dispersal represented by a complex river and wetland configuration possibly explain the significant differences in population structure among populations studied in northern Argentina (McCartney-Melstad et al., 2012; Kershaw et al., 2013).

k) Diet

E. notaeus is an aquatic trophic generalist that employs ambush predation and active search for capturing its prey (Dirksen, 2002; Henderson et al., 1995). Like most boas and pythons, *E. notaeus* kills its prey by constriction. Fish scavenging has also been reported (Strüssmann, 1997). Although considered aquatic in their behavior, *E. notaeus* have also been observed to ambush prey from trees < 2.5 m (Strüssmann and Sazima, 1991), in small bushes when basking, or on the shore of ponds and creeks (Waller, unpub. data). Their diet consists of fish (not identified), snakes (*Hydrodynastes gigas*, *E. notaeus*), caimans, small turtles, aquatic birds (cormorants, storks) and their eggs, and mammals (small rodents, capybaras; Strüssmann and Sazima, 1991; Strüssmann, 1997; Dirksen, 2002; Waller et al., 2001, 2007). There is an ontogenetic shift in prey size dependent on the size of the snake; in northern Argentina, juvenile *E. notaeus* prey on eggs and small rodents, while larger individuals prey on water cobras, large birds (egrets and cormorants), and mammals (capybaras; Waller et al., 2007). Predation usually occurs during the dry period, when wetlands have reduced and the concentration of prey is high surrounding remaining water bodies (Strüssmann, 1997; Waller et al., 2007). In northern Argentina predation also occurs during the flooding season, when water rats (*Holochilus chacarius*) and other small rodents are concentrated in the top of the emergent bushes.

l) Population abundance

Although absolute population sizes are unknown, available data suggests that *E. notaeus* are common and abundant. This is one of the commonest snake species in the Brazilian Pantanal (Strüssmann, 1997) and represents 15.1 per cent of all snake specimens captured in a collection of snakes from that region; it was second in capture frequency only to the false water cobra (*Hydrodynastes gigas*; Strüssmann and Sazima, 1993). During the filling of the reservoir of Yacyretá dam, in the Paraná River at the border between Argentina and Paraguay, approximately 1,500 *E. notaeus* were rescued from the flooded islands (Waller et al., 2001). The sustained harvest of *E. notaeus* each year by hunters for the skin trade from a single wetland, during more than a decade under the YAMP, confirms that this species is capable of reaching high population densities in suitable habitat. Logistical and methodological constraints impede rigorous density estimates, however, Micucci and Waller (2007), based on intensive sampling during daily hunting sessions in northern Argentina, broadly suggested a density of 30-60 *E. notaeus* per km^2. These preliminary estimates of an average of 0.5 *E. notaeus* per ha, extrapolated to an AoO of over 12 million ha, suggests a population size of several million snakes for the entire range.

m) Population trends, conservation threats and status

There is no evidence on negative trends for any *E. notaeus* population. Habitat availability is very high and remains fairly stable in most of their range (Waller et al., 2007). Conversion of wetlands to cultivated land probably represents the greatest threat for the species at the local level. Land drainage and systematization for rice cultivation and livestock rearing affects some marginal habitats in northern Argentina; these processes may be less significant through the species' habitat in Bolivia, Paraguay and Brazil due to landscape complexities limiting these initiatives. It should be noted however that the species also benefits from some man-made habitats, like artificial ponds and roadside channels (Waller et al., 2007), as well as vegetated dams or water reservoirs and rice fields (Waller, pers. obs.). People often kill snakes out of fear and road kill are other threats at the local level. International trade of *E. notaeus* skins peaked in the late 1990s, but stopped almost completely throughout the whole range of the species approximately 20 years ago (Micucci et al., 2006). There is little or no demand for *E. notaeus* skins locally and the unique source of skins for the international trade is the YAMP; that occurs in a negligible proportion of the total range of the species in Argentina. Furthermore, trade is now regulated, the trade system organized and populations are being continuously monitored under YAMP. In this sense, trade on skins, legal and illegal, is not a major threat to the species anymore. With these considerations, it is reasonable to assume that the overall population of the yellow anaconda is stable. *E. notaeus* is currently being assessed by the IUCN Red List, but available information on population status and trends suggests that this species should be classified as non-threatened. *E. notaeus* is listed as CITES Appendix II.

5. Understanding the traditional harvest of anacondas in Argentina

E. notaeus have always been captured serendipitously or actively searched for in rivers, marshes and lagoons during favorable weather conditions. No traps or sophisticated methodologies have been used to harvest anacondas. *E. notaeus* were collected by hand and killed immediately by hitting the head with a blunt implement, such as a pole or stick. They were skinned in situ or at the hunter's home, and the carcass was discarded. Wet skins were sun dried then sold or exchanged locally for merchandise (Micucci et al., 2006).

E. notaeus were harvested mostly during the cooler winter months (June to August), when they emerge to thermoregulate (Micucci et al., 2006). Trade figures from one skin trader in the late 1980s confirmed the harvest season peaked in the coldest months of July and August (Fig. 8). Harvests extended through winter until detectability declined abruptly due to an increase in temperature from the onset of spring.

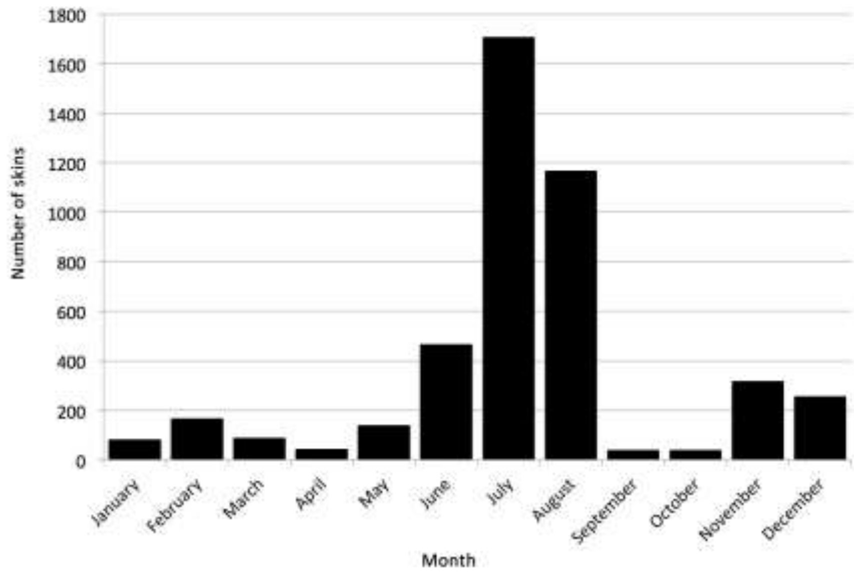

Figure 8. Number of *E. notaeus* skins received every month by a trader during the year 1988 (T. Waller, unpub. data).

According to local traders, the traditional harvest included skins over 15 cm in width; this corresponds to a total length of ~150 cm for dry skins and ~135 cm SVL for live snakes (Micucci et al., 2006). In 1995, approximately 500 skins were seized and measured in Paraguay and clearly included skins from immature individuals (Fig. 9). *E. notaeus* older than 1.5 years were vulnerable to unregulated hunting and market-driven demands (Micucci and Waller, 2007; Waller et al., 2007).

Skins > 20 cm wide (equating to ~200 cm for total length of dry skin and ~175 cm SVL for live snakes) commanded higher prices and were locally known as "full price"; smaller skins < 20 cm wide and poor quality skins were half the price. Fig. 9 clearly shows that the half price skins did not discourage hunting and these skins represented approximately 60% of the traditional harvest in those years.

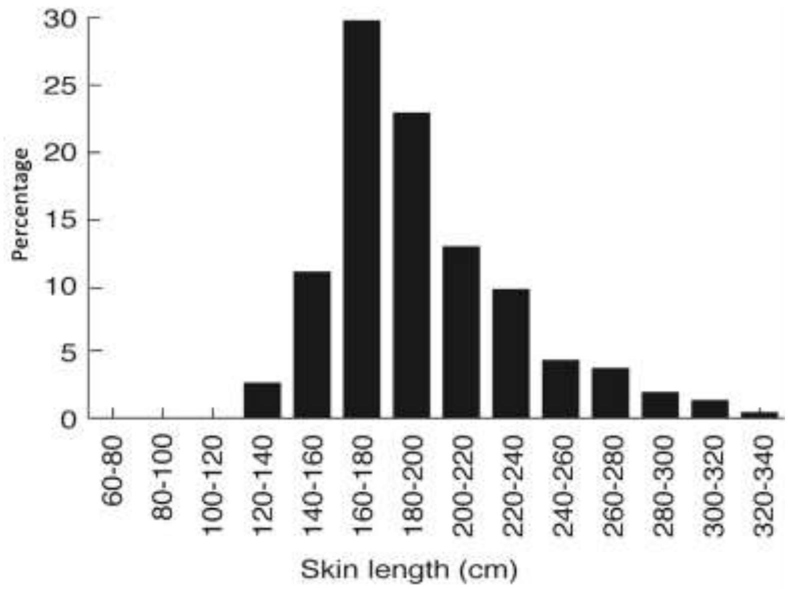

Figure 9. Proportion of skins for each size class in a lot of 526 commercial skins seized and measured in Paraguay in 1995 (Micucci and Waller, 2007).

Hunters were disregarded under this informal harvest system and revenue was mainly distributed among storekeepers, middlemen, transporters and exporters. Trade was not traced and the origin of skins was ignored. Skins and by-products were traded locally and circumvented local controls or were transported to neighbouring countries. Despite this, wild populations of *E. notaeus* have not presented any evidence of deterioration after years of unrestricted hunting (Micucci et al., 2006).

6. The Yellow Anaconda Management Program (YAMP)

a) Aims

The YAMP was devised in 2001 and sought to reconcile the traditional utilization of *E. notaeus* with its long-term conservation, in addition to promoting biological research and appreciation of the species and its habitat by local inhabitants. The YAMP also aims to maximize local income through sustainable harvest (Micucci et al., 2006).

b) Conceptual framework

The YAMP framework was developed on two basic concepts: the precautionary approach and adaptive management.

Some of the basic premises of the YAMP include the following:

- Implement operative measures. The development of a successful management plan requires concrete measures for all stakeholders involved, with clear and achievable yet fundamentally flexible obligations, which may vary with time and circumstances.

- Convene key stakeholders, such as hunters, to participate in the process. This allows managers to make realistic and just decisions and raise awareness for those in direct contact with the resource they are seeking to manage. A management plan that aims at valuing natural resources must be designed from the "bottom up"; from indigenous and rural communities to the end users, taking into account the cultural and historical relationships that may exist between the local inhabitants and the resource.

- Use the best available information. This implies that decisions are based on available scientific and technical information, including traditional knowledge of indigenous and local communities.

- Apply the principles of adaptive management. The adaptive management approach provides the ideal conceptual framework to deal with cryptic species, such as *E. notaeus*, when population monitoring by standard methods is not feasible and there are several uncertainties. Adaptive management is defined by the National Research Council (2005) as:

"…a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders."

The basic assumptions of adaptive management are the following:

- Supervise, based on appropriate indicators, the impacts of management decisions and actions;
- Promote research in order to reduce uncertainty;
- Warrant periodic assessment of results;
- Capitalize lessons learnt, and review and adjust, as needed, actions taken or decisions made;
- Establish an efficient and effective control system.

This method has been successfully used for other species that due to their biological features and CITES status could not be managed using traditional methods, such as fixed quotas or direct surveys. Adaptive management of *E. notaeus* has established a protocol to obtain data that guarantees the traceability and control of skins. Due to the difficulties associated with monitoring cryptic snake populations, adaptive management has become a fundamental, cost effective and reliable tool.

c) Location

The Province of Formosa in the north of Argentina was selected for implementing the harvest program due to the abundance of suitable habitat, a favourable governmental disposition towards sustainable use and a long stranding hunting tradition.

Formosa encompasses and area of approximately 72,066 km^2 and is a flat plain where the most conspicuous landscape elements are large rivers, small creeks, forests and wetlands. The entire are is within the Chaco eco-region; the weather is subtropical to tropical with a mean annual temperature of 23°C and annual rains decreasing in an east to west gradient (1200 to 600 mm). Winter is mild but occasional freezes occur during July and August.

For the purpose of YAMP, we divided Formosa in two regions (Fig. 10): a) Eastern Formosa, a 35,000 km^2 area characterized by the presence of savannahs with palm trees and forest patches interspersed with wetlands on one side, and the Paraguay river basin on the other; and b) Western Formosa or La Estrella Marsh, a seasonal floodplain extending over a distance of 250 km and covering an area of nearly 3,500 km^2. This seasonal wetland, located in western Formosa, was originated by the progressive regression of the Pilcomayo riverbed. Large grasslands, savannahs with palm trees, and standing dead Chaco forest patches that during the flooding season are covered with climbing plants (locally called "*champales*"), combine to form this landscape matrix. La Estrella Marsh represents the entire available habitat for *E. notaeus* in the dry west of the province.

E. notaeus is abundant in Formosa and the Eastern region offers the largest proportion of habitat for the species, potentially harboring the largest population. However, the YAMP has been particularly successful in managing *E. notaeus* in La Estrella Marsh, where a poor rural and indigenous community coexists with a highly productive and suitable habitat for the species. The more developed east region exhibits a different land tenure regime and best working opportunities for people that affect the adoption of this kind of initiatives (Micucci et al., 2007).

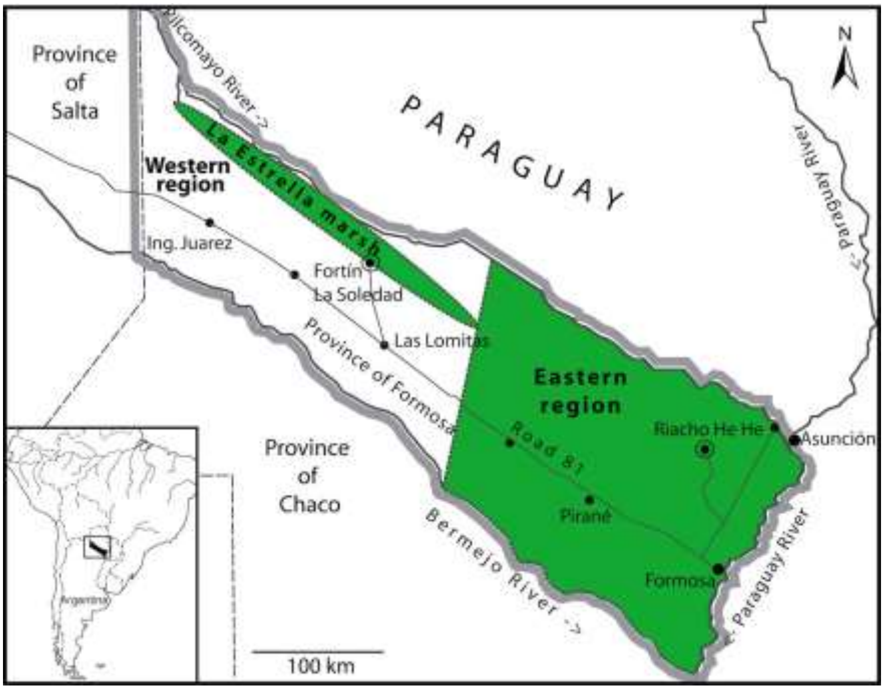

Figure 10. The Yellow Anaconda Management Program (YAMP) takes place in the Argentinian province of Formosa at the Chaco eco-region. *E. notaeus* naturally occurs in the eastern plains (shaded green) and the La Estrella Marsh, a 3,000 km² floodplain created by periodical flooding of the Pilcomayo River.

d) Institutional and legal framework

Argentina is a Federal country. Wildlife conservation and utilization is regulated at the national level by the *Ley de Conservación de la Fauna No. 22421/1981*. Importation of live *E. notaeus* and their parts and derivatives are expressly prohibited (*Resolución SAGP No. 53/1991*) to avoid local specimens laundering. Hunting, inter provincial movements, domestic trade, and exports of *E. notaeus* and their parts and derivatives have been also banned in the past to protect the species from unregulated harvest (*Resolución SAGP No. 24/1986*). With regard to YAMP, the national authority coordinates the program at the national level, providing the general framework, regulating inter-provincial movements and exports of dry skins, and controlling control compliance with CITES requirements. Since 2002, the production and exports of *E. notaeus* skins under the YAMP are excluded from the hunting and trade ban established for this species. Main provisions of the YAMP were established at the national level by *Resolución SADS* No. 1057/2002, *Resolución SADS* No. 115/2004, *Resolución SADS* No. 30/2005, *Resolución SADS* No. 204/2006, *Resolución SADS* No. 443/2009 and *Resolución SADS* No. 1173/09 (for more information see www.ambiente.gov.ar/?aplicacion=normativa&IdSeccion=3&agrupar=si). Every year the Province of Formosa establishes the procedures of the management program at the local level.

Fundación Biodiversidad (FB) was appointed under an agreement with the provincial government to lead and execute the technical aspects of the YAMP. Annual tasks and budget are detailed in operative plans submitted each year for approval by the provincial wildlife authorities. Exporters finance the YAMP under a mechanism originally established by the central government. Under federal regulations, project benefits (skins) are distributed among the exporters proportionally to the funds each one has contributed to the total fund. Depending on the results from different years, dedicated funding has been approximately US$ 6 to 12 per skin.

7. Harvest control and procedures under YAMP

a) Harvest control variables

Harvest season.- Harvest of *E. notaeus* is permitted in winter from June to August. This corresponds to when *E. notaeus* emerge from the water to bask and are easily detectable. During the remainder of the year, *E. notaeus* usually remain underwater, which reduces detectability. This brings numerous benefits: 1) the species is protected from hunting during the breeding season; 2) the harvest season is short in duration; 3) hunters are deterred from illegal harvesting outside of the harvesting period due to extreme temperature, which reduces control costs; and 4) hunters are able to capture dormant *E. notaeus* by hand and to visually appraise their size before killing them. Depending upon the YAMP research requirements, *E. notaeus* are usually killed in situ or transported live to the hunter's home for data collection before being killed.

Minimum size requirement.- The YAMP has a minimum size requirement of 230 cm measured from the neck to the anal scale; this size corresponds to a live specimen of approximately 200 cm SVL. Since female maturity occurs on average at 165 cm SVL (Waller et al., 2007), this precautionary provision is intended to allow female *E. notaeus* to have one reproductive opportunity before being harvested. According to interviews with traders and local dealers, the production of Formosa involved ~20,000 skins per year above 15 cm wide (Micucci *et al.* 2002, 2006). This width corresponds to a dry skin length of 150 cm from a live *E. notaeus* approximately 135 cm SVL (Micucci et al. 2002). This equates to approximately 90% of *E. notaeus* older than 1 to 1.5 years of age, which were vulnerable to being hunted under a market-driven regime (Fig. 11; Waller *et al.* 2007). With the current minimum size policy (230 cm skin or 200 cm SVL live) we are able to substantially reduce overall harvest levels, for juveniles and adults, compared to the historical volume of trade. Current production, without mediation of quotas, represents a management-derived reduction of harvest to a quarter of historical values for Formosa (5,000 vs. 20,000 skins), and a 40% reduction of female vulnerability to hunting (Micucci and Waller 2007).

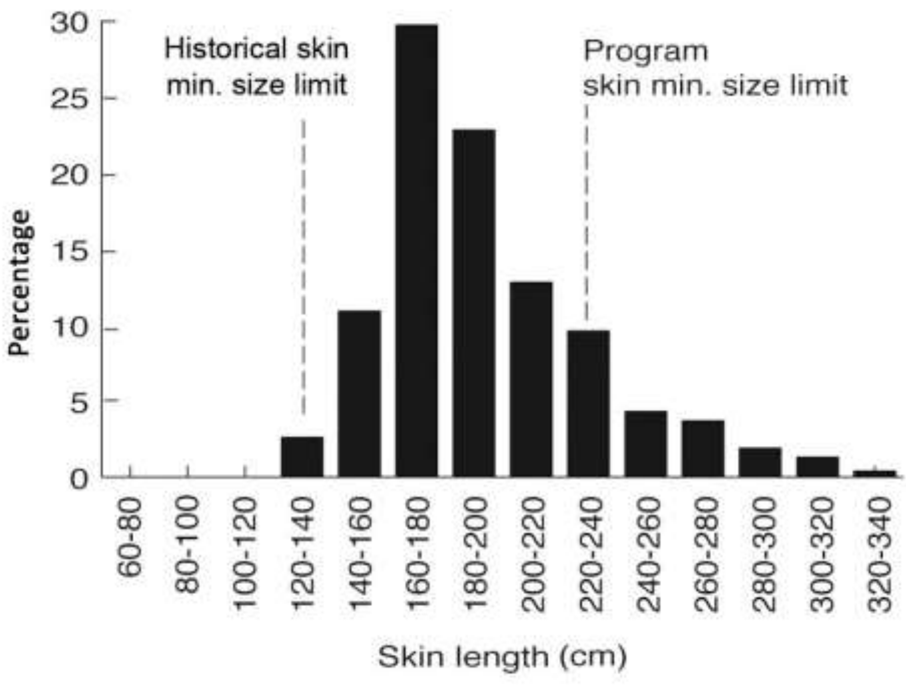

Figure 11. Skin length of 526 illegal dry skins seized in Paraguay (Micucci and Waller 2007). Current minimum size limits established by the YAMP are substantially more conservative than historical minimum sizes of skins in trade.

Skinning pattern.- Taking into consideration the anal spurs and other features of the skin, the YAMP skins can be recognized by altering the skinning technique and resulting pattern each year. For example, one year the skin must bear both spurs on one side and have the head skin attached or the following year one spur on each side without the head. Unique skinning patterns allow the YAMP to avoid illegal hunting and stockpiling outside of the harvest season (Fig. 12).

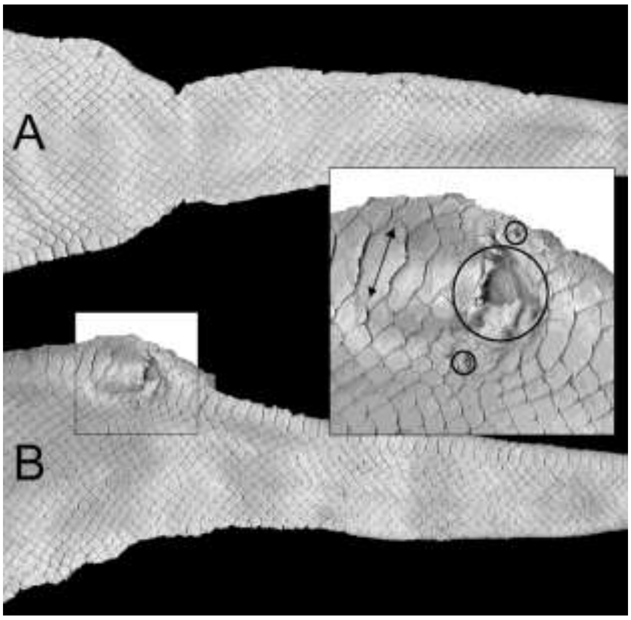

Figure 12. Tail region of *E. notaeus* crust tanned skins comparing two different skinning patterns: A) Traditional mid ventral cut exhibiting a symmetrical shape where mid ventral scales are divided to each side of the skin, B) Skinning pattern where all the cloaca region, including adjacent spurs (limb remnants), cloaca opening, and entire ventral scales, are left untouched at one side of the skin.

b) Harvest control procedures

The harvest of *E. notaeus* is strictly related to three fundamental economic stakeholders: *collectors*, *local skin buyers* (LSBs) and *exporters* (Fig. 13).

Hunters.- These are rural and indigenous community members (Pilagá, Toba) subsisting partially from livestock breeding but also from hunting and fishing. Approximately 200 to 300 families take part in hunting *E. notaeus* in Formosa, most of them (90%) from the surroundings of La Estrella Marsh.

Local skin buyers.- These are the people who buy the skins from the collector. They are usually a food supplier or market-man that trades basic supplies and skins (cows and goats) with the hunter and have the logistical means for transporting and stockpiling skins. Between 6 and 8 LSBs participate in a harvest season, with a mean number of 35 hunters per LSB.

Exporters.- These are the final acquirers of *E. notaeus* skins. They act jointly by designating a representative or purchase agent to acquire the skins from the LSBs under the YAMP supervision. They also pay for the YAMP implementation expenses.

Every year during April and May, before the start of the hunting season, a series of trips are organized to register and inform LSBs on the year's provisions and eventual modifications to the YAMP guidelines. These activities are aimed at regulating hunting effort; although the YAMP provides no limitations on the number of hunters (in reality there is a finite number), they have a close relationship with the LSBs due to economic and cultural reasons. LSBs have to pay hunters in cash for skins. According to the YAMP guidelines, the exchange of goods for skins is forbidden, unless by specific request of an indigenous community. To ensure compliance, at the end of each harvest season the YAMP carry out random polls to hunters, including specific requests on prices and payout modality.

During the last week of May, and immediately before the opening of the harvest season in June, the YAMP notify the LSBs on the *minimum skin size* limit and on the *skinning pattern* to be used in the forthcoming season. Most of the hunting requirements are implemented when the hunters bring their skins to the LSBs for sale, since the skins that do not comply with the YAMP standards are worthless for the LSBs.

Periodically the LSBs facilities are visited by the exporters' representative, a purchase agent, together with a provincial wildlife officer and a YAMP team member to buy skins. *E. notaeus* skins are examined for compliance with the year-specific skinning pattern and minimum size guidelines; skins that comply with the YAMP standards are individually tagged in situ for control and future tracking. Visits to LSBs facilities occur at an interval of two to three weeks on average. At the same time the LSBs should file an official form, called the '*effort form*'; a legal document that contains the number of skins, name of hunter, date and place of harvest. This document is needed to permit the legal transport of *E. notaeus* skins within the province. The content of the document are crosschecked with the result from periodical polls to hunters. In the case of irregularities, LSBs could be penalised with the cancellation of their license.

The purchase agent is the only person authorised to transport *E. notaeus* skins to the warehouse in Formosa city where they are inventoried. At the end of the harvesting season, and before leaving the province, skins are sexed (by their spurs and bone remnants), measured, and export tags that comply with federal regulations replace field tags. The export tag is required before transporting skins out of the province and to issue a CITES export permit. Wildlife inspectors of Formosa, and eventually from the central government, as well as a representative of the YAMP, supervise this procedure.

Once skins are tagged and all data gathered, the skins are 'released' for distribution among the exporters. In order to transport *E. notaeus* skins to tanneries or export ports, Formosa authorities must issue a Transport Guide to each exporter, that will be enclosed with the shipment to destination and, at the appropriate moment, will be required by CITES Management Authorities in order to issue the pertaining CITES export permit.

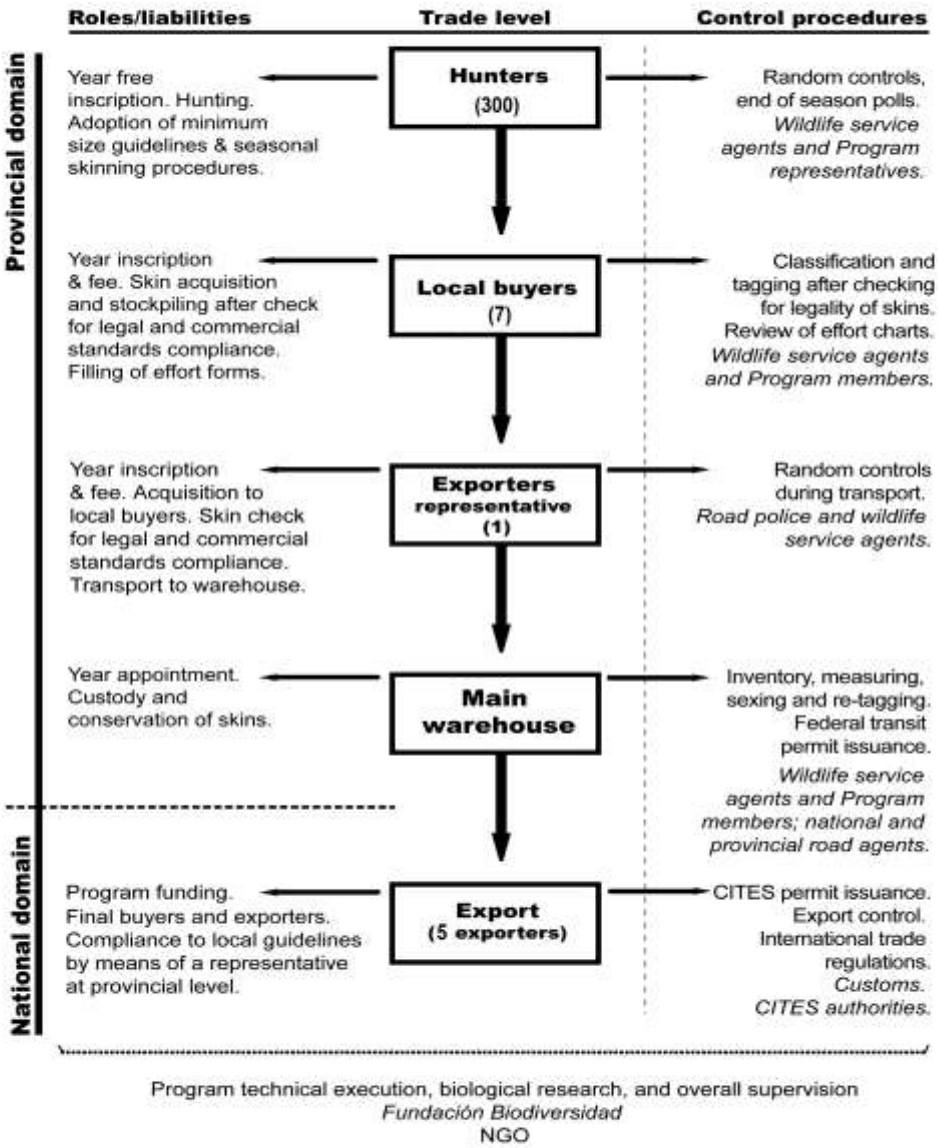

Figure 13. The YAMP operative scheme (modified from Micucci and Waller 2007).

8. Harvest monitoring under the YAMP

a) Monitoring effort instead of establishing a quota

A harvest can be controlled either by placing a quota on off-take or by controlling effort, which means setting a hunting season or limiting the number of people harvesting a population or the time they spend hunting, or both. *E. notaeus* are managed under 'sustained yield' harvest theory, so the YAMP makes no attempt to directly control the number of individuals harvested. Specifically, the YAMP apply the surplus-yield production model (Schaefer, 1954; Fox, 1970), which has been successfully used for many species, including terrestrial species, but was developed for use by fisheries management. Monitoring effort is usually a safer means of regulating a harvest than a quota (Caughley and Sinclair, 1994). Harvesting a constant number of individuals each year is hazardous, particularly when the population is effected by environmentally factors, such as drought, flooding and fire, or when surveying populations is a major constraint (Caughley and Sinclair, 1994); both situations are likely to occur with *E. notaeus* as they inhabit highly seasonal savannahs. There is a maximum rate at which a reduced population can recover (the rate of increase). The maximum harvest can be obtained and sustained when the population is reduced to a level stimulating the maximum recovery (Caughley and Sinclair, 1994; Webb, 2002). These monitoring techniques are combined with direct assessments of harvest attributes and are usually compared with actual population samples obtained by researchers directly in the field (field monitoring).

b) Monitoring harvest parameters

A management plan for the exploitation of a natural resource requires some indicator of the impact of such an activity on the wild population. As adaptive management is selected as the YAMP theoretical framework, the use of indicators that allows managers to adjust management actions is essential. For the YAMP, the following indicators were selected:

- Effort
- Yield
- CPUE as a function of Effort applied to obtain yield curves (surplus-yield models)
- Sex ratio
- Harvested skins average size and size distribution.

c) Yield, Effort and CPUE

Yield is defined as the total volume or number of a resource obtained in a given year. The total number is constructed by adding partial catches, i.e., the results obtained by each hunter in a given site. Yield is influenced mainly by the environmental conditions that predominate during the hunting season and by the composition, in terms of quantity and skill, of each hunter. In this sense, an analysis of yield alone, unrelated to other factors, does not provide sufficient information on the global functioning of the system, and monitoring of trends in the mid-term is strongly recommended. Fig. 14 shows the yield of skins from the YAMP between 2004 and 2014.

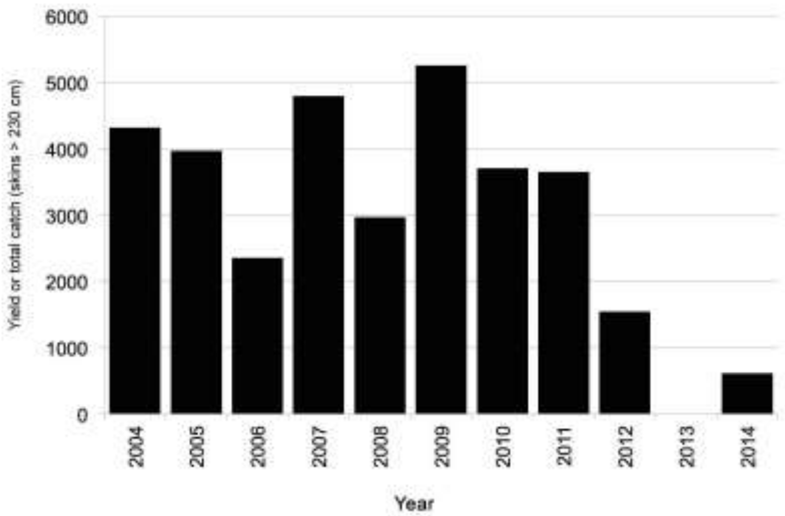

Figure 14. Yield of skins above 230 cm from the YAMP between 2004 and 2014. Harvest was not permitted during the year 2013 due to a serious drought affecting the main harvest area.

Since the rationale of sustained yield models implies that a harvest represents a specific proportion of the total population, a reduction of the crop would be expected, for instance, in the case of a population constraint by natural conditions (i.e. drought, fires), but this does not necessarily imply that over-harvesting has occurred in that year (Caughley and Sinclair, 1994). Temperatures play a significant role in *E. notaeus* harvested under the YAMP; they are more vulnerable to hunting, thereby increasing hunting success (Fig. 15).

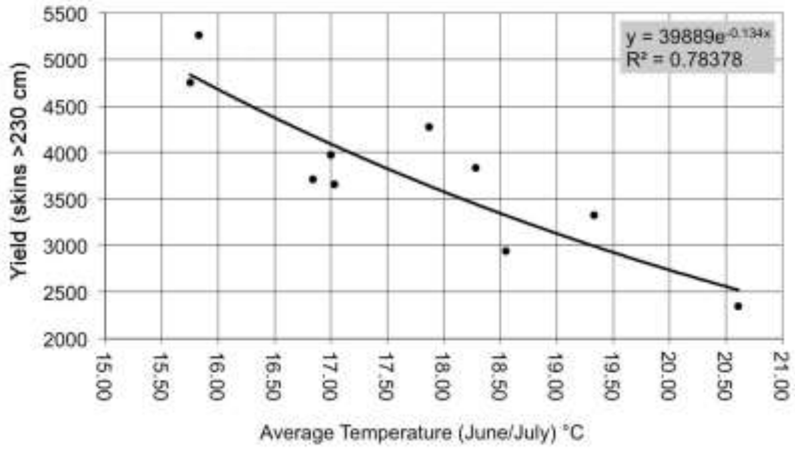

Figure 15. Annual yield of *E. notaeus* versus annual average winter temperatures for 2002 and 2011. High winter average temperatures reduce their vulnerability to hunting because they do not need to bask, reducing overall capture rate.

A decline in yield may not be indicative of the status of the harvested population if, for example, effort also decreases. As expected, yield and effort values are clearly related in the YAMP (Fig. 16). However, yield monitoring may provide useful information to analyze the system more thoroughly and make interventions, whenever feasible. For example, 2006 was a 'bad' year of captures in the YAMP because a low number of hunters participated in the activity, which means that the overall effort for that year diminished in relation to previous harvest seasons. This responds to an increase of traditional labor demand and to the massive distribution of unemployment benefits to hunters and their families by the government since 2003. For instance, if skin price is not continuously updated to compensate for inflation, the yield will continue dropping to new levels in which exporters' actual profits will be totally consistent with actual economic structure. If exporters do not increase skin price as a means of discouraging hunter desertion the system will tend to the commercial extinction. In an effort-mediated system a commercial collapse precedes a biological collapse. A similar situation was recorded in 2012 (low skin prices compared to unemployment benefits) that fostered an unprecedented reduction in effort aggravated by a progressive drought that peaked in 2013, when the harvest was suspended to avoid affecting the population stock. Yield in 2014 was the result of a short post-drought experimental harvest season (45 days instead of 90 days).

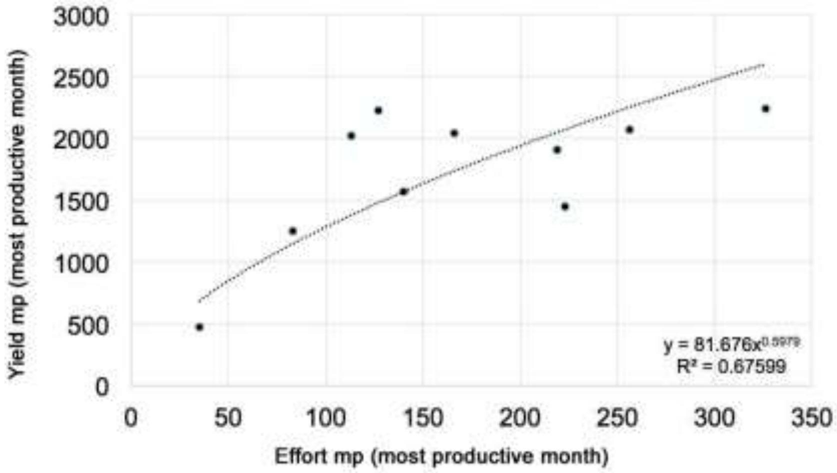

Figure 16. Relationship between yield and hunter effort during the most productive month of July from 2004 to 2014. Harvest was not permitted during the year 2013 due to a serious drought affecting the main harvest area.

Catch per capita is another indicator used, also known as the Capture per Unit of Effort (CPUE). Monitoring CPUE as a function of effort detects changes in abundance, particularly when active search for individuals is difficult or costly, as in the case of most snakes. Those species in which surveys are viable may be monitored using both techniques (CPUE or census), whereas in most snake species it is only possible to use the CPUE. Substantial differences between both techniques are the cost, scale or degree of resolution, and aim of monitoring. Since there is a commercial activity involved, the necessary data to assess CPUE are obtained at a low cost. The difficulty of this method is undoubtedly the impossibility of making comparisons between results obtained in the extraction area and the situation in a protected area.

The condition to obtain reliable monitoring based on catch per unit effort (CPUE) is an adequate selection of the effort unit (number of hunters, number of hunters per day of harvest, man hours, etc.) and monitoring of the ratio catch/effort units. In the early years of the YAMP, several effort units such as hours/men or days/men were used, leaving aside others such as men/boat (means of transportation) due to the great variation among hunters. As the YAMP progressed, the development of the harvest was found to follow a distribution in time with the shape of a curve (Fig. 17), with the month of July being the most intense period. In July, temperature favors detection of *E. notaeus*, i.e. vulnerability increases, and most of the hunters are active, i.e. maximum effort, and consequently the impact is also at its peak. Since the time unit is a single month, the time variable disappears and the effort unit is simplified to the number of hunters participating in the harvest. We calculate the CPUE for the most productive month (July) as the ratio between yield and the number of hunters for that month (Effort mp).

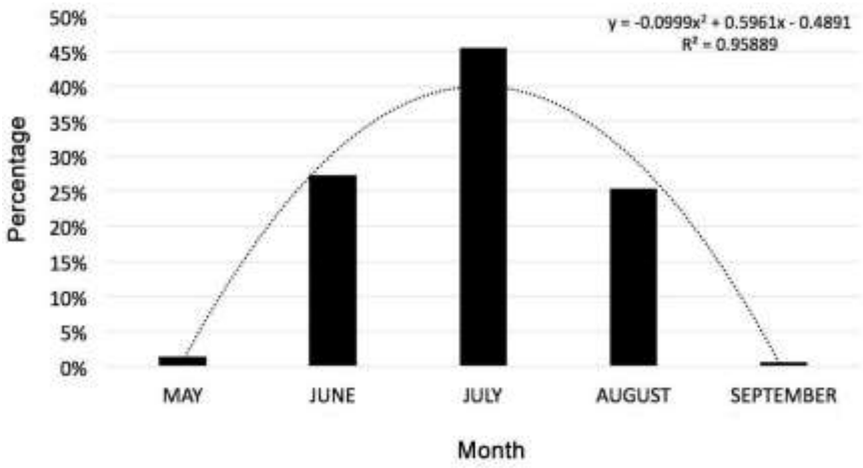

Figure 17. Proportion of the total capture obtained per month by hunters between 2004 to 2008, showing July as the most productive month.

As an indicator, the CPUE provides more information than yield as it is an isolated variable that allows "instantaneous" comparisons between years. However, an increase in the value of the CPUE may be explained by an increase in catch and by a decrease in effort applied (Fig. 18). After several years of monitoring, the YAMP uses the relationship between CPUE and Effort to construct the yield curves and to compare results obtained with the Fox (1970) and Schaefer (1954) model. The aim is to monitor the effort applied as a function of the MSY (Maximun Sustainable Yield) curve (Figs. 19 and 20).

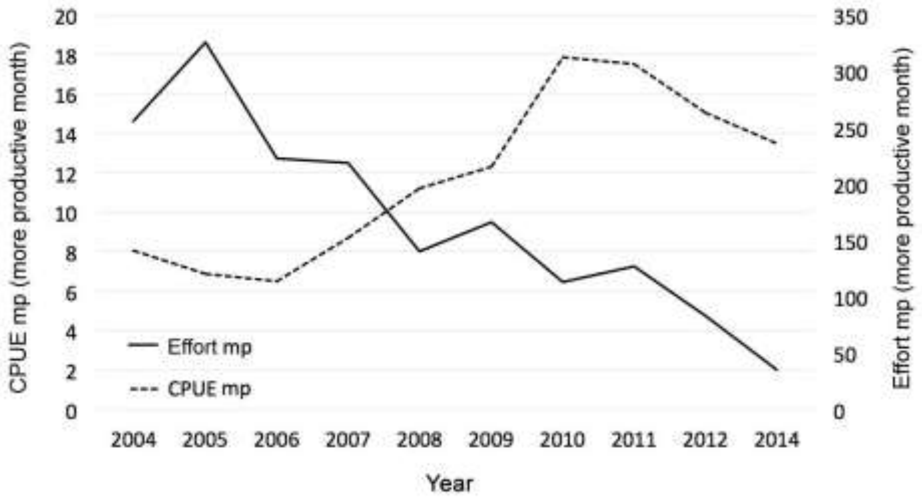

Figure 18. Evolution of CPUE and Effort in the YAMP between 2004 and 2014 showing the strong interaction between both variables. CPUE is the capture per hunter during the month of July and Effort is the number of active hunters during July. Harvest was not permitted during the year 2013 due to a serious drought affecting the main harvest area.

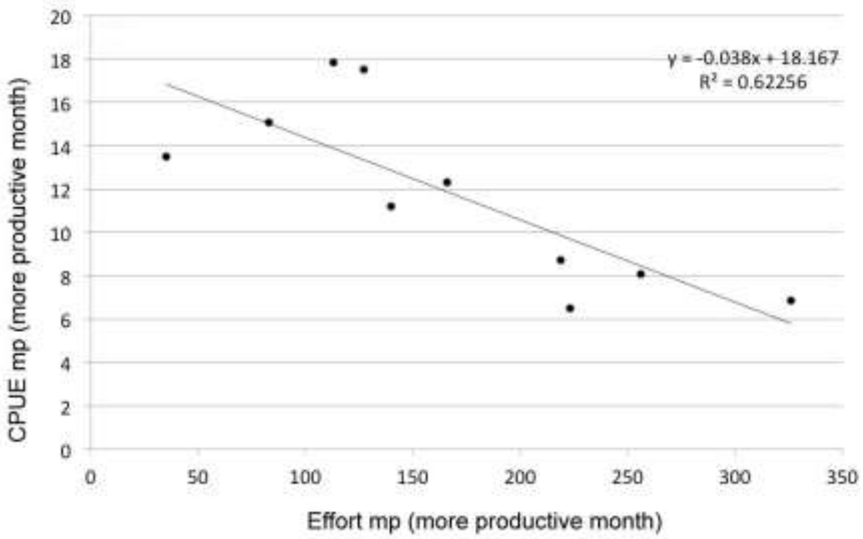

Figure 19. CPUE is inversely related to Effort, here for years 2004 to 2014. CPUE is the capture per hunter during the month of July and Effort is the number of active hunters during July. Harvest was not permitted during the year 2013 due to a serious drought affecting the main harvest area.

After twelve years of YAMP, a gradual decrease of catch Effort has been observed. This decrease can be attributed to several factors. The YAMP began in a highly unfavorable economic environment for the local inhabitants of the marshland; low demand for workforce, a very low income/expenses rate and an unstable currency value. This situation gradually improved and the State adopted a policy of economic assistance to rural inhabitants. On the other hand, labor demand increased as a consequence of land planning carried out by the provincial government, which permitted regularization of land tenure, intensive deforestation and cattle rearing. Many hunters who started at between the ages of 35 to 40 began to retire and younger people were not attracted by the prices offered for skins and access to education was improving as a result of provincial policies. In this context, the decline in effort (Fig. 21) has been the main cause of decrease in yields and the rise of CPUE, with this value always below the MSY predicted by the surplus-yield models (Fig. 20).

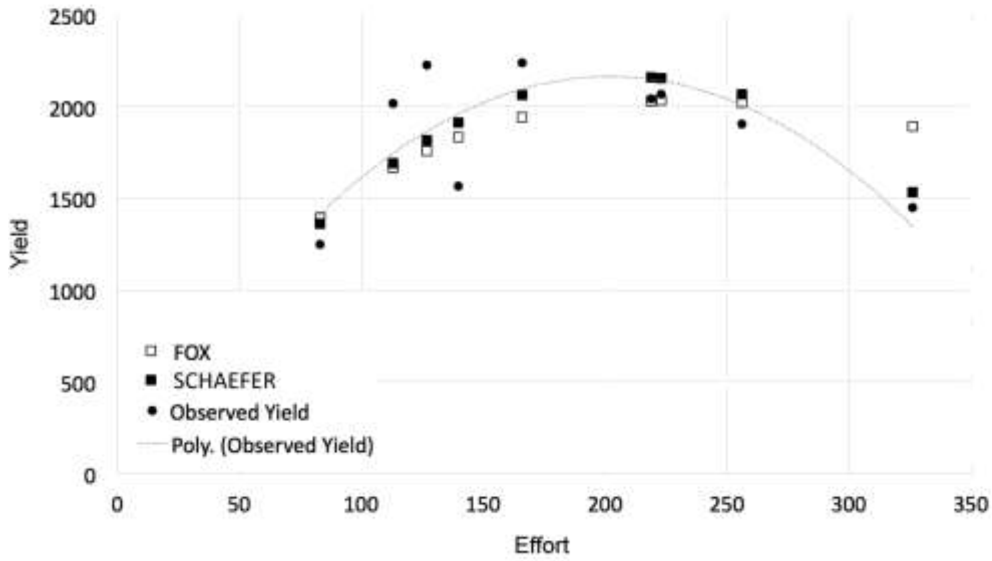

Figure 20. Maximum Sustained Yield curve for July for the years 2004 to 2014 based on Schaefer (1954) and Fox (1970) models. Black dots represent actual yield values; black squares represent Schaefer model prediction; white squares represent Fox model prediction; and dotted line represents the polynomial regression for actual yield values. Harvest was not permitted during the year 2013 due to a serious drought affecting the main harvest area.

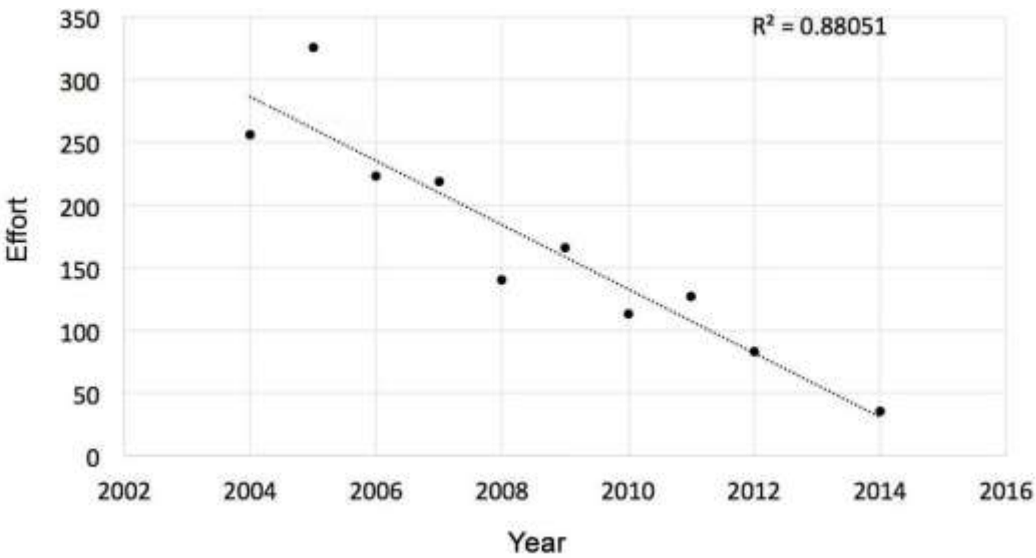

Figure 21. Effort (number of hunters) for the most productive month of July between 2004 and 2014. Harvest was not permitted during the year 2013 due to a serious drought affecting the main harvest area.

d) Size structure and average size of harvested skins

Size structure, although often fluctuating due to natural causes (Webb, 2002), permits observation of significant changes in the natural pattern, or at least in the pattern established as natural, prior to a significant activity of extraction. A random sample of all snakes from all sizes classes is compared to that obtained from the YAMP harvest of *E. notaeus*, to detect possible differences in the relative frequency distributions. However, in the case of skins, like in the YAMP, the best approach has been to compare the evolution of the harvested skins size structure in time (Fig. 22).

Size structure fluctuated between years but exhibits a decrease in the relative frequency of larger size classes after 2011 (Fig. 22). This decline coincides with a decline in CPUE after that year (Fig. 18). Applied effort and overall harvest also diminished in the last years for reasons already explained (Fig. 21), so observed trends in size structure appear to be related to a severe dry period that affected the region between 2010 and 2013 that led to the suspension of the harvest in the latter year. Droughts are expected to affect large individuals (mostly females) more, compared to the smaller juveniles and adults (mainly males). *E. notaeus* are well suited to traverse long distances and conceal themselves in dry areas when searching for prey or awaiting better environmental conditions.

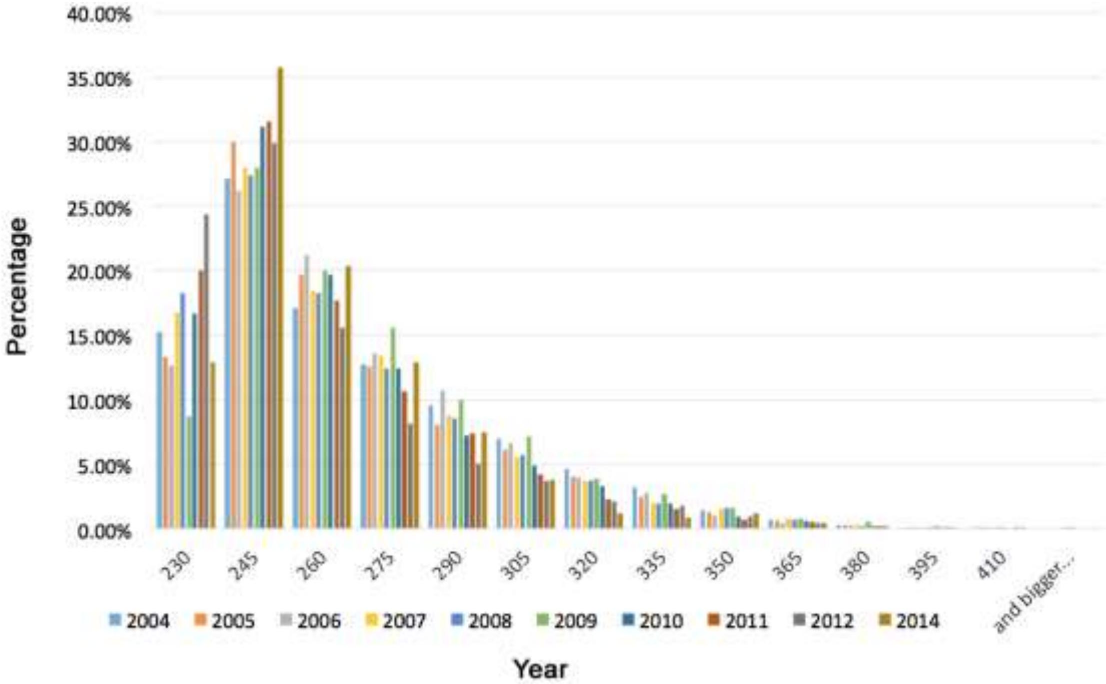

Figure 22. Size structure of harvested *E. notaeus* skins > 230 cm from 2004 to 2014. Relative frequency expressed as percentage of total sample for each year. Each 15 cm interval class is represented by the upper limit value. First interval exhibits the proportion of undersized skins (<230 cm) in the harvest. Harvest was not permitted during the year 2013 due to a serious drought affecting the main harvest area.

Monitoring average skin size or length, in addition to using other descriptive statistics, such as standard deviation, mode, median, etc., also provides useful information on the local effect of harvest on *E. notaeus* in the short term. However, the fact that larger individuals are normally the easiest to detect and the first to be collected should be taken into account. When the value of *E. notaeus* lies in the skin, measurements may allow the manager to forecast commercial viability of the activity in the future, when there is a minimum size that should be respected; the YAMP uses a minimum size so that all analyses are carried out on the skin population within the legal size range. Usually, however, there is a percentage of skins below the minimum size permitted, or "illegal" skins, but the proportion of such skins varies with enforcement effort and cannot be attributed to any cause of analytical value.

After twelve years of harvest data, the YAMP observed a decrease in the average value of *E. notaeus* skins by around 3%. The current value of the mean skin size (251 cm) indicates that most of the harvest affects mature individuals that may have already experienced a reproductive event (Waller et al., 2007). In this context, and assuming that there is a constant inter annual decline attributable to the harvest (which is very unlikely), commercial extinction for the *E. notaeus* population being studied in the YAMP could occur in 30 years (230 cm minimum skin size limit), whereas the breeding stock would not be affected for more than 50 years (200 cm skin, equivalent to a 170 cm live, or the age at maturity). This suggests that even in the worst-case scenario, commercial extinction would greatly anticipate (and prevent) biological extinction for this *E. notaeus* population.

e) Sex ratio

Sex ratio is known from the literature and is generally an excellent indicator when the species exhibits sexual dimorphism. A low impact extraction is not expected to alter the sex ratio. In the case of *E. notaeus*, differentiating skins by sex is an easy practice requiring little training; just observing the presence of spurs (Micucci et al., 2003, 2005). The size limit established in the YAMP permits the hunting of *E. notaeus* > 200 cm SVL; since females attain larger sizes than males, the harvest was expected to include more females than males, in a fairly constant and predictable proportion, according to the serendipitous nature of the hunting and sex and size structure of *E. notaeus* populations. Since both sexes are equally available (Waller et al., 2007), males and females were expected to be relatively equal in their vulnerability to capture with actual harvest sex ratio resulting from the minimum size limit established (~75% females). In the YAMP, sex ratios of harvested *E. notaeus* have been relatively constant, with slight fluctuations attributable to environmental factors (e.g., the dry period that started in 2010 that apparently diminished the survival of large individuals, mainly females).

Conclusion

The harvest and trade of Yellow Anaconda (*E. notaeus*) in Argentina has been transformed from historical misuse to a robust and sustainable management system. The YAMP has succeeded in designing and establishing specific management policies for a traditionally exploited snake species from the beginning, organizing the hunters, traders, and the government on a same path and with a same long term objective. The tools applied to control and monitor the harvest have been adequate and cost-effective, providing evidence that the harvest has not been detrimental to the survival of the wild population. Our knowledge of the species has increased exponentially, and legal trade is sustained through a balance simple yet robust regulation together with incentives for local people to trade legally.

The YAMP satisfies the Secondary Evaluation as part of the NDF Guidelines for CITES listed snakes. Importantly, the system is managed adaptively. Even if our monitoring system identifies population declines due to harvesting, we do not automatically move to make a negative non-detriment finding and cease trade. Instead, the framework is in place for us to make simple management interventions to ensure sustainability while continuing trade.

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