

**CROCODILE
SPECIALIST
GROUP
NEWSLETTER**

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CROCODILE SPECIALIST GROUP NEWSLETTER

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IUCN - Species Survival Commission

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COVER PHOTOGRAPH: Black caiman (*Melanosuchus niger*): Photograph: Virginia Parachu.

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The CSG Newsletter provides information on the conservation, status, news and current events concerning crocodylians, and on the activities of the CSG. The Newsletter is distributed to CSG members and to other interested individuals and organizations. All Newsletter recipients are asked to contribute news and other materials.

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We thank all patrons who have donated to the CSG and its conservation program over many years, and especially to donors in 2009-2010 (listed below).

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USA.
Indonesian Crocodile Farmers Association, Indonesia.
Vic Mercado, Microlab, Philippines.
J. Perran Ross, Gainesville, FL, USA.
San Antonio Zoological Society, USA.
Virginia Aquarium, Virginia Beach, VA, USA.

20th CSG Working Meeting

The 20th CSG Working Meeting was convened on 13-17 September in Manaus, Brazil, and was preceded by a CSG Steering Committee meeting on 12 September.

The CSG is extremely grateful to the State Government of Amazonas, SEPROR (Secretaria de Produção Rural) and IDAM (Institute for Sustainable Development of Agriculture and Forestry of the State of Amazonas) which hosted the meeting. The Organizing Committee, Sônia Canto (SEPROR), Bill Magnusson (INPA), Ronis da Silveira (UFAM), Sônia Alfaia (SEPROR), Paula Mafra (SEPROR), José Max Dias Figueira (IDAM), Leandro Lopes de Souza (IDAM), Bianca Abecassis (IDAM), Ana Paula Batista (SEPROR) and Bruno Pereira Regis, together with their support staff did a marvellous job in preparing and running a wonderful meeting. We are most grateful for the support of the Deputy Eron Bezerra and Dr. Edson Barcelos, who believed in the success of the event from the outset, and the current Secretary Dr. Ferdinando Barreto, who managed resources directly with Governor Omar Aziz.

None of this would have been possible without the generous financial support of the major sponsors; Bank of Amazonia (printing of certificates, badges, etc.), the Sustainable Amazon Foundation (simultaneous translation), and DueDesign, who created the logo of the 20th Working Meeting.



Photograph: Virginia Parachu.

Steering Committee Meeting (12 September) Minutes

1. Opening

The Chairman, Grahame Webb, opened the meeting at 0830 h. Agenda papers were available in advance online, with some spare copies and late papers for members and observers.

Steering Committee members present were: Grahame Webb, Dietrich Jelden, Alejandro Larriera, Tom Dacey, Perran Ross, Charlie Manolis, Alvaro Velasco, Carlos Piña, Alfonso Llobet, Luis Bassetti, Samuel Martin, Allan Woodward, Jorge Saieh, John Caldwell, Paolo Martelli, Kent Vliet, Val Lance, Phil Wilkinson, Christine Lippai, Miryam Venegas-Anaya, Sergio Medrano-Bitar

Apologies were received from: Ralf Sommerlad, Bruce Shwedick, Enrico Chiesa, Kevin van Jaarsveldt, Ruth Elsey, Don Ashley, Jiang Hongxing, Toshinori Tsubouchi. Jerome Caraguel, Bernardo Ortiz, Jon Hutton, Hank Jenkins, Tomme Young, Yoichi Takehara, Janaki Lenin

Observers present were: Matt Shirley, Colin Stevenson, Eddy Even, Kevin Wallace, Rene Hedegaard, Simone Comparini, Hesiquio Benitez, Martin Vargas Prieto, Ricardo Francisco Freitas Filho, Luis Chilaule, Maria de la Paz Lopez, Manuel Muñoz, Gisela Poletta, Pablo Siroski, Melina Simoncini, Guillermo Principe, Maria Josefina Boned, Lucia Fernandez, Josefina Iungman, Marina Virginia Parachu Marco, Michael Martin, Rob Gandola, Ashley Holland, Anthony Roberts, Luis Sigler, Jonathan Perez, Juan Fernando Martinez, Luis Philippe Martinez, Jeffery Lang, Hideki Sakamoto, Mitsuko Takehara, Brian Jeffery, Patrick Delaney, Eric Langelet, Hernando Zambrano, Julian A. Mendrano.

1.1. Chairman's Report

The Chairman welcomed everyone and thanked the workshop organisers, including representatives of Government, academic institutions, industry and NGOs.

The meeting held one minutes' silence for two long-serving members who have passed away recently - John Thorbjarnarson and Jack Cox. Kent Vliet advised the meeting of the John Thorbjarnarson Memorial Fund for reptile projects, established through the Wildlife Conservation Society.

The Chairman drew attention to the activities of the CSG over the past two years and the forthcoming years, highlighting:

- CSG Executive Committee meeting, Darwin, 16-17 October 2009;
- 2nd West Africa Regional Meeting, Burkina Faso, 2-6 March 2010;
- CITES CoP15, Qatar, 13-25 March 2010;
- International Meeting on Human-Crocodile Conflict, Kota Kinabalu, Sabah, 23-25 June 2010;

- CSG reviews in Madagascar and Cuba;
- Proposed *Crocodylus siamensis* workshop, Thailand, March 2011; and,
- 21st CSG Working Meeting, Manila, May 2012.

The Chairman informed the meeting of the following deliberations of the Executive Committee meeting held on 11 September 2010:

- Proposed Capacity Building Manual;
- Incorporation of the International Association of Crocodile Specialist (IACS) to handle the financial affairs of the CSG (see Agenda item SC.1.5);
- Reviewing and Broadening of the CSG membership;
- The effect of the Global Financial Crisis recession on the conservation and management of crocodilians and the results from the 83 responses to the CSG questionnaire;
- Results of the Colombia morphometric study, which will be presented at the Working Meeting;
- Current difficulties with the CSG website and the need to transfer it to an alternative service provider;
- Proposed utilization of the funding obtained by the Tomistoma Task Force to advance the proposal for declaration of the Lake Mesangat area, East Kalimantan, Indonesia, as a RAMSAR site; and,
- Review of the “Crocodila Journal”.

Actions:

- *Allan Woodward was requested to chair a working group on the Capacity Building Manual and report back to the Executive before the end of the Working Meeting.*
- *Charlie Manolis was requested to chair a working group on the proposal for “occasional papers” and report back to the Executive before the end of the Working Meeting.*
- *Executive Officer was requested to circulate the paper on Reviewing and Broadening of the CSG Membership to all Steering Committee members for their information.*

The Chairman thanked Perran Ross for taking over responsibility for the CSG Red List Authority, following the loss of John Thorbjarnarson.

The Chairman drew attention to the large agenda and indicated that agenda papers would be taken as read and opened for discussion and questions.

1.2. Minutes and Actions from CSG SC Meeting, Santa Cruz, Bolivia (2 June 2008)

All outstanding actions from the Bolivia meeting were reported in the minutes or addressed as separate agenda items in the papers of the meeting. Completion of actions from the last CSG SC meeting was noted.

1.3. Executive Officer’s Report

The EO highlighted:

- CSG membership of 434 (51 countries) in August 2010;

- Reviews and meetings;
- EO travel; and,
- SRAS (Agenda item SC.6.1)

1.4. Financial Report

The financial report highlighted the current balance of around \$US424,317. The Chairman thanked the CSG donors, particularly the industry members, some of whom were present at the meeting. He pointed out that a central goal of building CSG financial reserves was to ensure that the CSG could be sustained indefinitely from interest, rather than raising and spending all funds annually.

1.5. Incorporation of IACS

The Executive Officer gave an outline of the background and action taken to establish a separate legal entity, “International Association of Crocodile Specialists” (IACS), to be responsible for the financial affairs of the CSG, as agreed at the Working Meeting in Bolivia. The initial Board of Management of IACS consists of Grahame Webb, Dietrich Jelden, Alejandro Larriera, Charlie Manolis, Perran Ross, Yochi Takehara and Tom Dacey.

2. Regional Reports

2.1. South and East Africa

The Regional Chairman for South and East Africa, Rich Fergusson, presented his report and drew particular attention to the following:

- South Africa - continuing investigations of the pansteatitis deaths in the Olifants, Letaba and Sabie Rivers;
- Mozambique crocodile management plan has been approved, but not yet implemented;
- Recent surveys undertaken in Tanzania, Namibia and Uganda;
- Congo DR - some recent work has been undertaken by CSG member Joe Wasilewski; and,
- Egypt - Management of *C. niloticus*. Presentation was made by Mohamed Ezat, Nile Crocodile Management Unit, Egyptian Environmental Affairs Agency. Egypt is seeking CSG advice and assistance on: development of an Action Plan for Crocodile Management Program in Egypt; and, development of regulations and controls for the involvement of the private sector in the future sustainable utilisation of crocodiles.

2.2. West Africa Regional Report

The report highlighted the 2nd West African Regional meeting held in Burkina Faso, 2-6 March 2010. A summary report of the meeting was published in CSG Newsletter [29(1): 5-7] and the proceedings of the meeting are now available in the CSG website. The Regional Chairman, Samuel Martin, requested that the

name for this and composition of the region be changed from “West Africa” to “West and Central Africa”. This request was approved.

2.3. East and Southeast Asia Regional Report

Neither of the Joint Regional Chairs was able to attend the meeting. Their report highlighted:

- Philippines - two significant reintroductions of *C. mindorensis* (Mindanao and Dicitian Lake, Isabela Province);
- Thailand - proposed *C. siamensis* meeting to be held at Mahidol University, Bangkok, May 2011;
- Indonesia - proposed listing of Lake Mesangat wetlands in East Kalimantan as a RAMSAR site; and,
- Malaysia - successful International Workshop on Human-Crocodile Conflict was held in Kota Kinabalu, Sabah, 23-25 June 2010.

A report on *A. sinensis* (Agenda item SC.2.3.1) by Jiang Hongxing highlighted following progress:

- Reintroduction achievements in Gaojinmiao, Anhui, and Shanghai areas;
- Enhanced status of wild alligators in Anhui Province; and,
- Captive breeding status.

A detailed presentation (Agenda item SC.2.3.2) was made by representatives of Anhui Forestry Department, Anhui Province, China, highlighting:

- Status of habitat protection;
- Status of Chinese Alligator releases into the wild; and,
- Conservation findings.

A detailed report (Agenda item SC.2.3.3) was provided by Adam Starr, FFI Cambodia, highlighting:

- Conservation in community-managed crocodile sanctuaries;
- Baseline population surveys in other parts of Cambodia;
- Establishment of breeding facilities for reintroduction/supplementation projects;
- New emerging major threats - hydroelectric dam developments and economic land concessions; and,
- Development of a 5-year strategic plan for establishment of secure and viable populations of Siamese crocodiles.

2.4. North America regional Report

The report, provided by the Joint Regional Chairs, Ruth Elsey and Allan Woodward, highlighted:

- Deepwater Horizon oil spill;
- Skin production figures for 2008 and 2009;
- Various State reports;
- Reclassification issues under the US Endangered Species Act; and,
- CITES issues.

Clarification was sought on progress with the proposed reclassifications under the US Endangered Species Act for *Crocodylus moreletii* (Mexico) and *Caiman latirostris* (Argentina). However, as there were no representatives present from the US Fish and Wildlife Service, no further information was available.

2.5. South Asia and Iran Regional Report

The report provided by Janaki Lenin, who was unable to attend the meeting, highlighted:

- Nepal - “Lacoste” funding \$US500,000 to WWF Nepal for the Gharial project;
- India - the operation of the Gharial Conservation Alliance became untenable and has now been made a program of the Madras Crocodile Bank;
- India - proposed final Gharial SRP meeting, together with a CSG regional meeting proposed for early 2011;
- Sri Lanka - renewed efforts to undertake research and conservation activities; and,
- Bangladesh - appears to be little happening to further mugger and saltwater crocodile conservation.

Whilst it was noted that a final SRP meeting, together with a regional CSG meeting was proposed in early 2011, no further information was available.

Paolo Martelli, Vice Chair of the Veterinary Science group, advised that he had conducted a second follow up veterinary training course following the mass die-off of Gharials in the Chambal River in 2008.

The Chairman sought the views of members on the possibility of a CSG review of Gharial programs throughout the range. There was consensus on this suggestion and a working group was established, under chairmanship of Jeff Lang and Perran Ross, to consider this suggestion and report back to the Executive.

2.6. Australia and Oceania

The report provided by Regional Chairman Charlie Manolis, highlighted:

- Northern Territory - Management program for *C. porosus* was recently approved by Federal Minister, with exclusion of the “safari hunting” component;
- Analysis of long-term survey data from 12 major river systems indicates that the *C. porosus* population has increased 20+ fold in abundance and 100+ fold in biomass since protection in 1971;
- East Timor - a CSG fact-finding mission was undertaken in September 2009; and,
- Solomon Islands became a Party to CITES in 2007. HCC continues to be a major issue and additional funding is still required to carry out population surveys and develop a management program.

2.7. Europe

Deputy Chairman Dietrich Jelden presented the report,

highlighting that the African crocodile survey database developed by UNEP-WCMC is now available online at: www.crocsurveys.net.

This database contains information on more than 1000 surveys of crocodiles (*C. niloticus*, *C. cataphractus* and *O. tetrapsis*) in Africa undertaken since 1956. The surveys can be viewed in a list, or in a Google map of Africa, both of which are fully searchable by country, location, species, date and author. The summary data is, in most cases, accompanied by a downloadable PDF of the original source document.

Jon Hutton has requested that CSG members provide any additional information and feedback.

Action: Members were requested to provide their comments to the Executive Officer before the end of the Working Meeting.

2.8. Latin America and Caribbean Regional Report

The report was presented by Deputy Chairman, Alejandro Larriera, highlighting:

- Human-Crocodile Conflict has now become an issue in the LA&C region with the Black caiman;
- Bolivian Scientific Authority recently resigned from its responsibility as the CITES Scientific Authority;
- Joint CITES and CSG visit to Paraguay for inspection of skin stockpiles;
- Chairman received a letter from GECV (Crocodile Specialist Group of Venezuela), concerning the apparent demise of the Orinoco crocodile conservation program; and,
- Colombia - the impact of the global financial crisis has caused a 50% reduction in exports of *Caiman crocodilus fuscus* over the past two years.

Action: CSG Chairman to write to the Venezuelan Management Authority seeking clarification of what has happened with the Orinoco crocodile conservation program. (see Letter 1).

A presentation (Agenda item SC.2.8.1) was made by Hesiquio Benítez Díaz, Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO)-CITES Scientific Authority, Mexico, regarding the development of the *Crocodylus moreletii* Monitoring Program (MCMP) and Procedures Manual. Mexican authorities are looking for CSG guidance and support to progress both these issues.

3.1. Vietnam Review

The report from the Vietnam CITES Management Authority on the implementation of recommendations of the 2008 CSG review was included in the agenda papers, and it was noted that there had been some

progress to date.

3.2. Cambodia: Update on Implementation of Recommendations

The report from Fisheries Administration of Cambodia on implementation of the recommendations of the 2005 CSG review was included in the agenda papers, however, it was noted that there had been rather limited progress over the past two years.

Action: The proposed *C. siamensis* meeting, to be held in Bangkok, March 2011, should include a one and a half day workshop on how to manage the shared resource between the relevant range States. Such meeting must include the management and enforcement authorities from Thailand, Cambodia, Vietnam, Laos and China. Executive Officer to note and include in draft agenda.

3.3. Madagascar Review

The report prepared by CSG Regional Vice Chair for West Africa, Christine Lippai, indicated that recent advice from the CITES Secretariat was that the Malagasy authorities have yet to provide a report to CITES Secretariat (due by 30 September 2010).

3.4. Cuba Review

The report provided by Roberto Soberon, Regional Vice Chairman LA&C Region, indicated the level of progress that Cuba has been able to achieve since the CSG review was undertaken in November 2008 with respect to:

- *Crocodylus acutus* (wild populations);
- *Crocodylus acutus* (farming);
- *Crocodylus rhombifer* (wild populations);
- *Crocodylus rhombifer* (farming); and,
- *Caiman crocodilus*.

A letter was sent to the Cuban authorities, congratulating them on the progress with the recommendations of the review, and urging them to continue their efforts with the conservation of *C. acutus* and *C. rhombifer* (see Letter 2).

3.5. Colombia Morphometric Project

The Chairman provided an overview of the situation that has developed with the crocodile captive breeding program in Colombia and the obvious laundering of wild skins through some of the farms. Wildlife Management International recently completed a morphometric study in Colombia which will provide the ability to identify the actual size of a caiman from applying a formula to a small piece of the skin, whether raw, wet blue, crust or tanned. A comprehensive draft report has been circulated for review, and should be finalized soon.

4. Thematic Vice Chair Reports

4.1. CITES

The report was briefly introduced by the Chairman, in the absence of “Hank” Jenkins, highlighting the outcomes of CoP15 held in Doha, Qatar, March 2010:

- Transfer of the Mexican and Belize populations of *C. moreletii* to Appendix II, with a zero export quota for commercial trade in wild specimens;
- Transfer of the Egyptian population of *C. niloticus* to Appendix II, with a zero export quota for commercial trade in wild specimens;
- Amendment of Resolution Conf. 12.3 in respect of Universal Tagging System and Trade in Small Crocodilian Leather Goods;
- Amendment of Resolution Conf. 11.12 on Universal tagging for the Identification of Crocodilian Skins;
- Extension of the Standing Committee Working Group on Personal and Household effects until CoP16; and,
- Amendment of Resolution Conf. 11.16 (Rev. CoP15) on Ranching and Trade in Ranches Specimens.

4.2. IUCN

Vice Chair, Perran Ross, presented the report, highlighting:

- Quadrennium review of Specialists Group Chairs and members;
- Appointment of Simon Stuart as chairman of the Species Survival Commission; and,
- Establishment of SSC Steering Committee of 26 members.

4.3. Industry

The report provided by Vice Chair Don Ashley, highlighted:

- The market for all crocodilian skins remains difficult due to a combination of factors, including the global financial crisis, strict quality standards, declining manufacturing and customer bases;
- CITES issues: Universal Tagging and Small Leather goods; Personal Effects; CITES Appendix changes for *C. moreletii* and *C. niloticus*; Business roundtable; Streamlined permitting.
- California trade bans;
- Sustainable trade concerns;
- Future potential industry initiatives;
- Legal trade and illegal trade concerns; and,
- Louisiana - BP oil spill effects.

4.4. Trade Monitoring

John Caldwell presented the report, highlighting:

- 2009 trade data reports will not be available until after October 2010;
- Reports on trade in crocodile skins up to 2008 were completed (IACTS 2009 and 2010 refer) as were crocodilian meat exports up to 2009;

- 2008 reports from Brazil and Papua New Guinea are outstanding; and,
- The proposed crocodilian farming database is not proceeding.

4.5. Veterinary Science

Dr. Paolo Martelli presented the report, highlighting:

- Group reorganized - Dr. Fritz Huchzemeyer handed over the post of Vice Chair to Dr. Paolo Martelli;
- Ongoing problem of passive members;
- Mission of the Veterinary Science group has been revised and expanded;
- A postmortem guide and form were posted on the CSG website;
- Training provided for Indian veterinarians in postmortem techniques;
- Two Yahoo discussion groups established; and,
- Dr. Paolo Martelli was invited to accompany the Kruger Park Scientific Services team in their investigations of the mortality along the Olifants River - however resolution of the problem is not apparent.

4.6. Red List Authority

The report was presented by Vice Chair Perran Ross, highlighting:

- Perran Ross appointed to take over responsibility for the Red List Authority, following the unfortunate death of John Thorbjarnarson; and,
- Need to review and analyse Red List Assessments for crocodilians and have the information inputted into the SSC Species Information System database.

Action: Perran Ross to convene a small working group to meet during the course of the working meeting to undertake the review of RL Assessments.

4.7. Zoos and Community Education

Vice Chair Kent Vliet presented the report, highlighting:

- Continuing to build their listserv network through Google listserv;
- Identification and appointment of zoo professionals to the CSG;
- Several very active collaborators in North America, Europe, Australia and India;
- Involvement of zoos and other living institutions in successful fundraising and effective public education; and,
- Concern about the exportation of endangered crocodilian species to private and commercial institutions.

4.8. General Research

Vice Chair Val Lance presented the report, highlighting that the crocodile genome project is progressing and

that they have been very busy. A number of researchers continue to produce high quality papers and crocodylian science is healthy and continues to grow.

4.9. Legal Affairs

The report had been prepared by Tomme Young, who was unable to attend the meeting. Main issues highlighted:

- Charter for establishment of a legal entity to manage the financial affairs of the CSG (International Association of Crocodile Specialists) has been incorporated (Agenda item SC.1.5); and,
- IUCN's Congress met in Barcelona (October 2008), taking a number of decisions that might ultimately have impact on the CSG.

5. Task Force/Working Group Reports

5.1. Tomistoma Task Force

The report had been prepared by the TTF Chair, Bruce Shwedick, who was unable to attend the meeting. The Chairman advised that the TTF had been very good at fundraising, however, there needs to be a strategic approach taken for the implementation of effective conservation actions for Tomistoma (eg the proposal to have the Lake Mesangat wetlands in East Kalimantan declared a RAMSAR site). It was agreed that there was a need to set new goals for the TTF.

Action: The Chairman to contact Bruce Shwedick and other TTF members for further discussions on the role of the TTF.

5.2. Human-Crocodile Conflict

The report was presented by Richard Fergusson, who highlighted:

- The working group did not formally meet in Bolivia and hence the connection and motivation of members seem to have waned;
- There had been some good achievements: Completion of Nikhil Whitaker's work in India and the offshore islands; publication through FAO/IGF of a detailed set of guidelines on the prevention and management of HCC; successful International HCC workshop held in Kota Kinabalu (June 2010); and,
- The working group's activities show that some common principles exist: similarity in actual attacks, but management and mitigation strategies differ; HCC is a major factor in determining management approaches; numerous HCC mitigation options, but few implemented practically on a wide scale; the HCC database is a useful tool for identifying risk activities.

Action: Richard Fergusson was requested to hold a working group meeting and report back to the Chairman on possible options to progress the activities of the HCC Working Group.

6. General Business

6.1. Student Research Assistance Scheme

The report presented by the Executive Officer Tom Dacey, highlighted:

- 30 applications approved to date, one application under consideration.
- Preliminary report provided by e-mail to SRAS donors (Bergen Aquarium and Rene Hedegaard, Perran Ross), outlining the successful applicants, their photos and projects.
- Details of most successful applications are now on the CSG website.
- Most final reports received have also been posted on the website. Quality of reports varies greatly, and in retrospect more specific guidelines should have been provided.

6.2. CSG Website

The Executive Officer Tom Dacey provided an update on latest developments with the CSG website and the need to transfer the website to an alternative service provider/host.

Actions: The current service provider is to be thanked for his efforts but advised that his inability to manage the website in a timely manner, in accordance with directions from the CSG Executive, is now constraining and delaying CSG activities. Such changed circumstances are to be expected when the circumstances of volunteers change, but the CSG itself must continue to move forward. Executive Officer and Charlie Manolis to talk with an alternative service provider with the intention of having the CSG website transferred from its current location to a CSG-controlled domain and website host/servers.

6.3. Castillos Award

The Chairman advised that the Executive Committee had considered several nominations and the successful recipient would be announced at the farewell dinner on the evening of 16 September.

7. Outcomes from the CSG Executive Committee Meeting on 11 September 2010

See Agenda item SC.1.1 Chairman's Report.

8. Next CSG Working Meeting (2010)

The 21st CSG Working Meeting will be held in Manila, Philippines (tentative dates 7-11 May 2012).

The meeting closed at 1730 h.

[Minutes of the Steering Committee meeting are available from the CSG Executive Officer (csg@wmi.com.au), and will soon be available at "www.iucncsg.org/ph1/modules/Publications/reports.html"].

Letter 1

Ing. Alejandro Hitchert
Ministro para el Poder Popular del Ambiente
Caracas
Venezuela

El Grupo de Especialistas en Cocodrilos (CSG) de la Unión Mundial para la Naturaleza (IUCN), está conformado por más de 400 personas de 51 países, todos son voluntarios y reúne a investigadores, profesores universitarios, personalidades de gobierno, representantes del comercio, curtidores, ONGs, veterinarios y profesiones afines.

Hemos trabajado conjuntamente a manera de apoyo y asesoramiento a diferentes gobiernos latinoamericanos en los últimos años, a pedido de sus autoridades gubernamentales, a los fines de sugerir acciones en la conservación y uso sustentable de los cocodrilos, entre los cuales le podemos citar los siguientes casos: con Bolivia el programa de aprovechamiento comercial del Caiman yacare, con Cuba en el análisis de la información de campo, diseño y preparación de la solicitud del cambio de Apéndice CITES de la poblaciones del *Crocodylus acutus*, en Brasil con el diseño y preparación de la solicitud del cambio de Apéndice CITES del *Melanosuchus niger* y con el gobierno de Argentina en el diseño de la propuesta de cambio de Apéndice CITES para el *Caiman latirostris*.

En el caso de Venezuela, hemos seguido muy de cerca el programa de Aprovechamiento Comercial del *Caiman crocodilus* (Baba) y del programa de Conservación del *Crocodylus intermedius* (Caimán del Orinoco), participando en reuniones realizadas en los últimos 10 años en la planificación y evaluación de ambos programas.

Recientemente nos hemos reunido en la ciudad de Manaus, Brasil, en el marco de la 20a reunión del trabajo del CSG, donde uno de los temas que fueron discutidos fue la situación del programa de conservación del Caimán del Orinoco, donde se observa una disminución de las actividades que se venían realizando en conjunto con el Ministerio del Ambiente, en lo que se refiere a la coordinación de las reintroducciones de animales criados en cautiverio, apoyo financiero a las diferentes instituciones que crían al Caimán del Orinoco, lo que se traducirá en una reducción en la cantidad y calidad de los animales reintroducidos anualmente.

Se ha puesto de manifiesto, además, que la población de *C. intermedius* del río Cojedes, la más importante del país, ha declinado con respecto a los niveles que mantenía hace 20 años.

Estos programas que ha implementado Venezuela por más de 10 20 años, han sido tomados como ejemplo internacional en diversos países de Latinoamérica y del mundo, por lo que vemos con preocupación su ejecución en el tiempo y que se haya perdido un poco la productiva relación que existía entre el gobierno, las ONG y los entes privados que constituían una de las fortalezas del programa.

Es por esto, que deseamos ratificarle nuestro deseo de poder

colaborarles en la búsqueda de acciones que permitan el logro de los objetivos del Programa de Conservación del Caimán del Orinoco en Venezuela.

Quedo a sus órdenes y le saluda atentamente

Prof. Grahame Webb
Presidente del Grupo de Especialista en Cocodrilos IUCN/SSC

cc: Director de la Oficina Nacional de Diversidad Biológica
MPPA

Letter 2

Manaus, 14 de septiembre de 2010
Comandante de la Revolución Guillermo García Frías,
Director General Empresa Nacional Flora y Fauna

Estimado Comandante,

Me dirijo a usted en relación a la misión concretada por parte de nuestro Comité Ejecutivo en Noviembre de 2008, a partir de vuestra generosa invitación, en la que nuestro equipo tuvo la ocasión de conocerle y de discutir con usted las recomendaciones para el manejo en cautividad y en vida silvestre de los cocodrilos cubanos, lo que generó una importante lista de acciones a seguir. En el presente marco de la XX Reunión de Trabajo del Grupo, que se está celebrando en Manaus, Brasil, nos hemos puesto al tanto de la implementación por parte de Cuba de esas recomendaciones, lo que sabemos que en gran medida ha sido posible gracias a su esfuerzo y compromiso personal.

Por medio de esta queremos expresarle nuestro reconocimiento por todo lo que se ha podido avanzar en este sentido, y a la vez exhortarle a continuar trabajando por el perfeccionamiento del manejo para la conservación y el uso sustentable de los cocodrilos de Cuba.

Reviste especial interés para nosotros el trabajo por la preservación del cocodrilo cubano; y reconocemos como un hecho positivo a la mayor participación en este valioso esfuerzo que compete ahora a Flora y Fauna, con el traspaso a su administración del territorio y de la granja de cocodrilos de la Ciénaga de Zapata. En este contexto, resulta de vital importancia la implementación de las recomendaciones de los talleres sobre prioridades de conservación para el cocodrilo cubano realizados en 2006 y 2008 en Ciénaga de Zapata, así como la colaboración internacional. Por nuestra parte, estamos en la mejor disposición de cooperar en la identificación de fuentes de colaboración y aval a sus proyectos.

Sin otro particular, y agradecido por vuestra atención, le saludo con mi mayor consideración.

Yours sincerely,
Dr. Grahame Webb
Chairman, IUCN-SSC-Crocodile Specialist Group

CSG Working Meeting (13-17 September 2010)

Attendance at the working meeting consisted of around 200 people from 27 countries (Australia, Argentina, Bolivia, Brazil, Canada, China, Colombia, Cuba, Denmark, Egypt, France, Germany, Guyana, Hong Kong, Ireland, Italy, Japan, Malaysia, Mexico, Mozambique, Netherlands, Panama, Papua New Guinea, South Africa, USA, United Kingdom, Venezuela). In particular, there was good representation from Latin America.

Oral presentations were organised into discrete sessions (Management Programs, Populations, Genetics, Disease, Human Dimension, Markets, Conservation, Reproductive Biology, General Biology, Physiology), together with a poster session.

In addition, the CSG's Veterinary Science (Paolo Martelli), Zoos and Community Education (Kent Vliet) and Human-Crocodile Conflict (Richard Fegusson) groups met during the course of the meeting.

No CSG meeting would be complete without the various social activities, and this meeting was no exception. The welcome function featured folk music by IMBAUBA (Regional Tree), and traditional dancing by "Boi Bumba", and the farewell dinner was held at the Fellice Restaurant.

Auction

The auction once again proved to be a popular event, and auctioneer Carlos Piña skillfully extracted a record \$US4087 for various articles donated to the auction. Auctioned items included two of the late John Thorbjarnarson's framed photographs of an Orinoco Crocodile and a Chinese Alligator.

Auction funds will be contributed towards the conservation of *Tomistoma schlegelii* and *Crocodylus siamensis*, and specifically directed towards the CSG's efforts to list Lake Mengasat (Kalimantan, Indonesia) as a RAMSAR site.

Castillos Award

Robinson Botero-Arias of Brazil was awarded the Castillos Award for his significant contribution to crocodilian biology, management and conservation in the Latin American region.

Field Trip

On the last day of the meeting, participants were taken on a field trip by bus and ferry to the Bem Vindo, Tiwa Amazonas Ecoresort, located on an island within the "blackwater" Negroes River. Here a most enjoyable relaxing day was spent lazing around the pool, enjoying the local cuisine, beverages and local wildlife.

Other

During the course of the meeting, two important issues relating to the management and sustainable use of crocodilians in Brazil were discussed. The first issue related to the potential impact on proposed dams on Pantanal wetlands (Letter 3), and the second related to legislation relating to the processing of caiman meat for human consumption in Amazonas State (Letter 4).

Letter 3

16 September 2010
Mr. Cristiano E. Zinato
Presidente da Camare Technica e Analize de Projeto
Conselho Nacional de Recursos Hidricos
Ministerio de Meio Ambiente
Brazil
Email: cristiano.zinato@mma.gov.br

Dear Mr. Zinato,

During the 20th Working Meeting of the IUCN SSC Crocodile Specialist Group, held in Manaus, Brazil, 12-17 September, attended by some 200 participants from 26 countries, the Brazilian plans to construct over 100 hydroelectric dams in the Pantanal, were discussed.

While understanding the need to address the problem of power generations in remote areas, serious concern was expressed about the proposed impacts of such dams would have on the Pantanal wetlands, which is a rich source of biodiversity, including species such as *Paleosuchus* sp. and *Caiman yacare*.

We implore the Government to ensure that the ongoing construction of these dams is associated with objective and through scientific assessments of the impacts on the wetland biodiversity. It is important to ensure to that they do not result in irreversible loss of species and habitats to the long-term detriment of all Brazilians.

Yours sincerely,
Dr. Grahame Webb
Chairman, IUCN-SSC-Crocodile Specialist Group

Letter 4

16 September 2010
Mr. Ferdinando Barreto
Secretário de Estado da produção Rural
Governo do Estado do Amazonas
Brazil
Email: jfbarreto@sepror.am.gov.br

Dear Mr. Barreto,

The IUCN-SSC Crocodile Specialist Group (CSG) commends

the Brazilian Federal Government and the Government of the State of Amazonas on their efforts to implement the sustainable use of caimans in sustainable-use conservation units. Legal harvests can be an important tool for reducing illegal hunting, which according to several presentations at the 20th CSG Working Meeting, is common in many areas of the Amazon.

Several presenters at the meeting noted that current legislation may be overly restrictive. While it is important to have effective protection to increase depleted populations, it is also important to ensure that once these populations recover, that they can be used sustainably and legally to benefit local peoples. Legal harvests need to be monitored so that they do not have unwanted effects on natural populations, but overly restrictive legislation can be counterproductive. Local people will often ignore legislation that is not truly reflective of the status of a common species. Crocodylians are exploited sustainably in many parts of the world, and the details of management vary between programs, depending on local conditions. Overly restrictive legislation can actually impede local support for conservation.

One of the principle impediments to the sustainable exploitation of crocodylians in the State of Amazonas appears to be inappropriate legislation regarding meat processing. In most regions of the world, such as the USA, Australia, Venezuela and Bolivia, crocodylian products for consumption are treated as “seafood”. Being cold-blooded animals with white flesh, the requirements for processing are similar to those for any large carnivorous fish. However, Brazilian Federal legislation presently requires processing similar to that required for cattle, which is not only inappropriate, but very expensive.

Treating crocodylians as though they were cattle is inappropriate for several reasons. Simpler processing results in high quality products suitable for human consumption, as has been shown in several studies in the State of Amazonas. Crocodylians are wild animals that are severely stressed by being held captive during transport to processing facilities. Maintaining animals alive for long periods after capture is not only cruel, it reduces the quality of the meat for human consumption.

Besides being cruel and reducing the quality of the meat, these requirements also make sustainable use economically unviable in most Amazonian reserves, which are remote from processing facilities. The present effective sustainable use of Arapaima (*Arapaima gigas*), a large carnivorous fish with flesh that is so similar to that of caimans that caiman meat is often sold clandestinely as Arapaima, shows that high-quality products for human consumption can be produced in remote reserves using standard techniques for handling fish.

The CSG recommends that the relevant authorities review the legislative requirements for sustainable use programs, especially in relation to meat processing and other procedures that may be unnecessarily restricting the development of industries that are important for local people, for the

Brazilian economy, and for creating conservation awareness in Amazonian communities. We wish your program every success.

Yours sincerely,
Dr. Grahame Webb
Chairman, IUCN-SSC-Crocodile Specialist Group

cc Nádia Ferreira D’ávila, Secretária de Estado do Meio Ambiente e Desenvolvimento Sustentável-SDS, Governo do Estado do Amazonas. Email: gabinete@sds.am.gov.br

cc Vera Lúcia Ferreira Luz, Chefe do Centro de Répteis e Anfíbio do Instituto Chico Mendes-ICMBIO, Governo Federal. Email: vera.luz@icmbio.gov.br



Figure 1. Robinson Botero-Arias celebrates after receiving the Castillos Award.



Figure 2. From left: Mark Merchant, Brian Jeffery and Jeff Beauchamp.



Figure 3. Alejandro Larriera attempts to prise the microphone from the CSG's auctioneer, Carlos Piña.



Figure 4. Alejandro Larriera, Alba Imhof and children, Juan and Julietta; the whole family, including the children, presented research work at the meeting.



Figure 5. Tom Dacey and Mohamed Ezat.



Figure 6. From left: Peter Taylor, Anthony Roberts, Ashley Holland, Fernando Li and Mike Martin.



Figure 7. From left: Andres Seijas, Alfonso Llobet and Alvaro Velasco.

21st CSG Working Meeting

The 21st CSG Working Meeting will be held in Manila, Philippines, on 22-25 May 2010. A Steering Committee meeting will be held on 21 May.

A website is currently being developed, and further details will be provided as they become available.

CSG Workshop on Siamese Crocodile

A "CSG Workshop on Siamese Crocodiles (*Crocodylus siamensis*)", jointly hosted by the Thailand Department of Fisheries and Mahidol University, will be held at Mahidol University (Bangkok, Thailand) on 28-31 March 2011.

Information on the agenda (currently under review) will be provided as details become available.

Tom Dacey, *CSG Executive Officer*, <csg@wmi.com.au>.

Crocodile Symposium in 2011

A mini-crocodile symposium is proposed to be hosted at San Diego Zoo, San Diego, USA, in October 2011. Dr. Val Lance will coordinate the symposium. emails will follow soon.

African Crocodile Survey Database Launched

The Beta version of the CSG's crocsurveys.net, also known as the African Crocodile Survey Database (www.crocsurveys.net) has been launched. The database contains information on more than 1000 surveys of *Crocodylus niloticus*, *C. cataphractus* and *O. tetrapsis* in Africa undertaken since 1956.

Surveys can be viewed in a list, or in a Google map of Africa, both of which are fully searchable by country, location, species, date and author. In most cases the summary data is accompanied by a downloadable PDF of the original source document. Users can immediately search and view the summary results, but if they want to download the documentation they are obliged to register. By registering they also agree to upload any additional data they may have.

The site also contains some basic information on survey methodology and a blog where users can exchange experiences. We hope that this resource finds some favour amongst CSG members. In particular we would be interested to hear if there is interest in extending this beyond the African species. Sincere thanks are extended to Daniela Lainez and Jennifer Phillips-Campbell for making this whole venture possible.

Jon Hutton, *Director, UNEP World Conservation Monitoring Centre, 219 Huntingdon Road, Cambridge, CB3 0DL, UK.*

Obituaries

The CSG expresses its sincere condolences to the families of two CSG members who passed away recently.

On 23 September, Malcom Douglas (69) died following injuries sustained during a vehicle accident on his property outside of Broome, Western Australia. Malcolm was well known in Australia and overseas, as a result of the dozens of documentaries he produced on his outback adventures over more than three decades. His first wildlife documentary "Across the Top" (1976) established Malcolm's credentials as the first "crocodile hunter". In 1983 he and wife Valerie opened a Crocodile Park in Broome, through which Malcolm directed his efforts on the conservation of crocodiles and other endangered species of wildlife.

On 15 October 2010, Harold Nugent (USA) died after a long illness. Known as the "Alligator Man" to thousands of school children, Harold voluntarily presented an alligator conservation program to schools in Florida. In recognition of his significant contribution, in 2003 Harold was named Volunteer of the Year for the Florida Park Service, and in

2008 the Alachua Conservation Trust awarded him its annual Conservation Steward, which is given to people considered to be "role models in the field of land conservation, historic conservation, and environmental education". The award reflects Harold significant contribution to public education on alligators. Harold is survived by wife, Susan.

Regional Reports



Europe

MANAGING THE EUROPEAN POPULATION OF *CROCODYLUS RHOMBIFER* ON A GENETIC BASIS. For those involved with crocodylian conservation, the Cuban crocodile (*Crocodylus rhombifer*) is arguably one of the most threatened species. The species has one of the smallest ranges of any extant species of crocodylian, with a principle stronghold in Zapata Swamp (around 3000-6000 animals in 360 km²) and a possible population in Lanier Swamp on the Isle of Youth (around 4000 animals in 35 km²) (IUCN Redlist 2010).

In 2008, the Red List status of *C. rhombifer* was reassessed and 'upgraded' from endangered to critically endangered prompted by an alarming decline in the size of the population. Several reasons were cited for an 80% decline over three generations, including: habitat loss through charcoal burning; illegal hunting which increased since the 1990s; and, hybridisation predominately with *C. acutus*, which is a threat both in the wild and in captivity. To create an insurance population, then hybridisation in captivity is of both interest and concern.

I took over as Curator of Lower Vertebrates and Invertebrates at Paignton Zoo Environmental Park (PZEP) in 2008/09 and inherited a diverse collection including *C. rhombifer* (1.3.0). I was struck by the diversity in morphology in the four animals that we have and as a flagship species for the zoo, felt it deserved more investigation. Unfortunately, all too often, we 'know' what species we have but most of those informed guesses are based predominately on morphological characteristics. When dealing with the future of species, perhaps we should presume less and ask more? Jeremy Weaver at Texas Tech University, USA, agreed to carry out the genetic verification for PZEP. We have one animal left from which to take blood samples, but the results from two of the three crocodiles was disturbing; one was a *C. acutus* x *C. rhombifer* hybrid (wild type), while the other had extremely strange parentage and appears to have been crossed with *C. palustris*. One of three animals was confirmed as a pure Cuban crocodile.

Cuban crocodiles are not common in zoological collections but the degree of genetic diversity demonstrated in PZEP's crocodiles was alarming and a scenario that has the potential to be played out across the rest of Europe. In my opinion, for zoological collections to play a genuine role in conservation we should aim to maintain genetically viable insurance populations, carry out active research within our collections and above all be active *in-situ*. We realised early on with advice from Ralf Sommerlad, that the results we witnessed at PZEP were more than likely going to be repeated throughout Europe, and considering the importance of the species, that active management would be required in order to certify a genetically accurate population. Therefore the ESB (European Studbook) was proposed and accepted by EAZA (European Association of Zoos and Aquaria) in July 2010.

Obviously the studbook is a management tool but I believe a good program is much more than management and should strive to push the boundaries of its remit. The primary aim is to register all possible Cuban crocodiles in Europe, genetically test those animals which are breeding and then cast the net wider to determine potential breeders. The European population must remain viable, both genetically and in terms of cohort structure. While developing the studbook, we will also be looking to the AZA (American Association of Zoos) and aiming to begin a co-operative program which may allow both the European and American populations to be treated as a metapopulation facilitating gene flow. For me, the icing on the cake would be coupling the captive management with *in-situ* field work and an increasing collaboration with the Crocodile Specialist Group; we know very little about wild Cuban crocodiles and there are some exciting new products which could give us a huge insight into their behaviour and ecology.

So to answer the question posed at the beginning, the point of the ESB is to begin managing the European captive population of *C. rhombifer* on a genetic basis so we know what we have. Then we can look at expanding our conservation efforts for this critically endangered species in the wild.

Mike Bungard, Curator of Lower Vertebrates and Invertebrates, Paignton Zoo Environmental Park, Totnes Road, Paignton, Devon TQ4 7EU, <Mike.bungard@paigntonzoo.org.uk>.

Latin America and the Caribbean

Jamaica

CROCODILE MEAT BECOMING POPULAR! There is limited information available on the status of the American crocodile (*Crocodylus acutus*) population in Jamaica, or on management initiatives that may be in place for the species.

It was thus not surprising that concerns were raised when a media report indicated that crocodiles, were being illegally taken in Jamaica, mainly for their meat. The article quoted residents who indicated that crocodile meat was becoming popular, to the extent that a "Croc Wednesday" party was being held weekly, with crocodile meat on the menu. The

meat is even considered by some people to have "viagra-like" qualities when eaten.

Source: Crystal Harrison, *J'cans Chew into Croc Tail*, Jamaica Star, 23 September 2010.

Venezuela

DISTRIBUTION, ABUNDANCE AND POPULATION STRUCTURE OF CUVIER'S DWARF CAIMAN (*PALEOSUCHUS PALPEBROSUS*) IN EASTERN LLANOS, ANZOÁTEGUI STATE, VENEZUELA. Cuvier's Dwarf Caiman (*Paleosuchus palpebrosus*) is the world's smallest crocodylian. The size of adult individuals ranges from 90 to 120 cm (Medem 1953; Brazaitis 1973; Magnusson 1990, 1992). It is currently listed as "Insufficiently Known" in the Venezuela Fauna Red Book (Rodríguez and Suárez-Rojas 2008).

Paleosuchus palpebrosus is one of the least studied of crocodylian species. According to Medem (1976) and Magnusson (1990) the main reason for the lack of popular interest and scientific knowledge on population ecology is the low commercial value of the species, due to the belly skin containing bony plates, which reduces its market value. Most published information deals with distribution (geographical and altitudinal), morphological characteristics, diet, management and breeding in captivity, and inclusion in biodiversity lists. In Venezuela there are no records of reproductive activity (Seijas 2007).



The goal of this study was to record population size, structure and distribution in areas disturbed by oil operations in the southwest of Anzoátegui State, and specifically about 20 km from San Diego de Cabrutica (8° 24' 55" N, 64° 53' 03" W). This study contributes to medium- and long-term knowledge of the environmental quality of the area and enriches the understanding of the population ecology of this species. This information will also be useful in the design of actions and strategies aimed at conservation and management of *P. palpebrosus*.

Fieldwork was carried out in the headwaters of the Canjilones, Negro, Claro and Mapire Rivers, including the Claro and Mapire Rivers basin. Surveys were carried out at night and on foot. Flashlights and pilot lights were used to locate Dwarf caimans. The rivers were slow flowing through coastal forest

and palm (*Mauritia flexuosa*) habitats. It should be noted that these areas are threatened by factors associated with illegal land use by rural populations and by oil extraction activities.

There are two 6-month seasons in these areas: a rainy season from May to October and a dry season from November to April. Average annual temperature is 26°C and the average annual rainfall is 890 mm.

After capture, Dwarf caimans were measured, weighed, sexed and marked, before being released back at their site of capture. Locality and description of microhabitat were also recorded for each capture. Individuals were classified in three different groups according to snout-vent length: juveniles up to 20 cm; sub-adults between 20.1 cm and 40 cm; and larger adults above 40 cm (Campos *et al.* 1995). To establish whether these individuals were spread in the river uniformly, randomly or in groups, their distribution in sub-areas was plotted and distances between individuals measured.

During the course of the fieldwork between June 2008 and February 2009 four rivers were partially explored, with 64 km being covered. Dwarf Caiman were present in all rivers surveyed. Of the 66 *P. palpebrosus* sighted, 48 were captured. Relative densities in different rivers varied between 0.28 and 2.30 ind/km. Similar densities were recorded by Seijas (2007) in Venezuela, Campos *et al.* (1995) in Brazil, and Rueda-Almonacid *et al.* (2007) in Colombia.

Low and medium densities of Dwarf Caiman were recorded in most of the rivers studied except in the River Negro, where high densities were registered, mainly composed of groups of juveniles and sub-adults, which indicates a reproductively active population. Nevertheless, no signs of nests in this area were found, as the wooded margins of the rivers were not explored. Overall size structure for all areas surveyed was 7% (N= 4) juveniles, 35% (N= 22) sub-adults and 58% (N= 36) adults. Only four individuals were classified as “eyes only”, without being able to estimate their length. Sex ratio was biased towards males (60.0%).

The spatial distribution of the population tended towards uniform distribution in the Negro River and random in the Claro and Canjilones Rivers. There seemed to be more territorial interaction among adult males in the Negro River, which would imply that individuals would be distributed in a uniform way along the river. The adult males captured presented wounds, scars, fallen scales and mutilations of toes, tails and feet, all of which suggest fighting for territory.

In contrast the female population showed no evidence of fighting, suggesting greater tolerance. The random spatial arrangement recorded in the Canjilones and Claro Rivers could indicate a lower level of interaction among individuals. This is consistent with with the greater average distance between individuals registered in these rivers.

To assess the effect of oil extraction on the Dwarf caiman population in the area studied, more fieldwork along the Canjilones and Negro rivers, where higher numbers were recorded, is required in the short- and medium-terms. This

will afford us a better understanding of the variation over time of the population studied. Furthermore, to establish whether this particular species can be considered a bio-indicator of anthropic disruption, additional fieldwork research on the population ecology of the Dwarf Caiman in surrounding areas with different degrees of disturbance will be necessary.

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RARE ABNORMAL *CROCODYLUS ACUTUS* HATCHLING. On 26 June 2010, in Laguna de Tacarigua National Park, northeast Venezuela, and specifically at Playa Escondido (UTM 20 N 1132121 E 0290245), Park Officers Reinaldo Madrid and Franklin Prado found a clutch

of *Crocodylus acutus* eggs. Of the 23 eggs/shells located, 22 are assumed to have hatched successfully, but one egg produced an interesting abnormal full-term hatchling, which died around 20 minutes after hatching. The hatchling had one head, 8 legs and 2 tails (Fig. 1). The skeleton and viscera were fused throughout most of the trunk.

Webb and Manolis (1989) reported on a *C. porosus* hatchling that resulted from the fusion of two embryos. Youngprapakorn *et al.* (1995) described this type of malformation to be the consequence of genetic and/or environmental effects.

The National Park Laguna de Tacarigua has one of the most important *C. acutus* populations in Venezuela, and is constantly monitored by Park officers. The park is not part of the American Crocodile Reintroduction Program of the Biodiversity National Office of the Ministry of Popular Power of Environment (MPPA), and the natural wild population is relatively undisturbed. However, 10 years ago the area suffered flooding after the rupture of a dam, and all of the areas around the park are under agricultural production, and thereby subject to use of chemicals. The abnormal specimen was lodged in the Terrarium of Parque del Este in Caracas, directed by Biologist Saul Gutierrez.



Figure 1. Abnormal *C. acutus* hatchling. Photograph: Alvaro Velasco.

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Alvaro Velasco B. <velascoalvaro@tutopia.com>.

South Asia and Iran

Nepal

GHARIAL HATCHING STATUS IN 2010, CHITWAN NATIONAL PARK, NEPAL. This report summarizes

incubation success for wild and captive-laid Gharial (*Gavialis gangeticus*) eggs by the Gharial Conservation Breeding Center (GCBC), Chitwan National Park Kasara, in 2010. The Gharial Monitoring Centre (GMC) is situated on an island in the Naranyi River, and can only be reached by boat - it is about 4 km from the nearest village and 45 km from GCBC.

Wild Nests: One nest from the Rapti River and 6 nests from the Narayani River were collected and incubated. Experienced nest watchers, hired from local fishing communities, observed nesting areas during the nesting period, and were thus able to record precise laying dates. Nesting occurred at night, and nests were located the following morning from tracks in the sand. Tracks were usually obliterated the next day by the activity of Gharials on the banks or by wind action, and so nests not located the day after laying were not identifiable until the time of hatching (see later). Wild nests were laid between 24 March and 1 April 2010 (Table 1).

Nests were guarded until collection, which in 2010 was carried out in the third week of April. In previous years collection occurred in the second week of April, however Wildlife Week activities (14-20 April 2010) meant collection was delayed this year. Nest depth ranged from 30-35 cm to the top layer of eggs and 60-65 eggs to the bottom layer of eggs, and nest width was 30-35 cm.

Captive Nests: Of the 12 adult female Gharial at GCBC, 10 (83.3%) laid eggs, between 29 March and 7 April 2010. Three males, two adults and one sub-adult, are also held at GCBC.

Incubation/Hatching: Collection sites for Naranyi River eggs were 45 to 100 km from the GCBC. They were transported by boat to GMC and re-buried horizontally in natural sand bank habitat near the centre. Naturally cracked eggs were not incubated. The sand was lightly watered to maintain humidity around the eggs. Near the time of hatching, keepers would hit the sand and listen for hatchling calls from within the nests.

The Rapti River nest was transported by boat and re-buried in a breeding enclosure at GCBC (13 km from the site of collection), close to a captive nest. It was hatched by one of the captive female Gharials.

Captive-laid eggs were left in situ at GCBC. Nests are mainly protected by females, although males were sometimes involved. Interestingly, males may take a leading role in the care of hatchlings, producing hissing sounds when keepers or even female Gharials approach. Hatchlings also responded to the hissing vocalizations of males, going to them rather than a female. After one week, hatchlings were relocated to separate hatchling ponds.

Hatchlings: Generally, hatchlings begin eating small fresh fish at night after about two months of age, after which time they will also feed during the day. They are fed every second day. To ensure that all animals get food, all hatchlings are force-fed. Experience has shown that after 3 months animals that are feeding readily by themselves are larger than those that have not initiated feeding and which are relying on being force-fed. At this stage, animals are graded into different pens

on the basis of size, and larger animals are no longer force-fed; small animals continue to be force-fed until October. Vitamin supplement (0.2 ml or 1-2 drops per hatchling) is also provided by syringe into the mouth every second day, until November.

During winter, the hatchling pond is covered to provide a greenhouse effect (warmer), and to reduce mortality. The pond is cleaned daily, with the removal of uneaten food and cleaning of surfaces with wire brushes. Once per week potassium permanganate is added to the water to control bacteria. During the rainy season (June-September), twice per month the hatchling's teeth are brushed using a toothbrush, and they bathed/cleaned in water treated with potassium permanganate, to control teeth and skin fungus. It is during the rainy season that problems with fungi are encountered with hatchlings.

Excluding infertile eggs, hatching success was relatively high (86.6% of 425 fertile eggs incubated produced live hatchlings). Hatching success for captive-laid eggs (81.7%) was slightly lower than that for wild eggs (87.7%). The cause of mortality of full-term hatchlings is unknown, although red ants were responsible in the case of one nest.

Most nests hatched within 67 to 75 days. One nest hatched after 87 days, and this prolonged incubation is considered to be due to the shaded (cool) conditions in which it was laid. The female was smaller than the others, and may have been forced to lay her eggs in a suboptimal area.

Of the three totally infertile wild nests, one contained a low number (19) of small eggs, possibly reflecting a female nesting for the first time. The reasons why 3 of the 7 wild nests were infertile is unclear, although a lack of adult males is a potential factor to consider. In January, prior to the nesting season, a survey reported 8 and 4 adult female Gharial and in the Narayani and Rapti Rivers respectively. One adult male was sighted in the Naranyi River and one in the Rapti River during the same survey. During the mating season, males frequently moved upstream in the Narayani and Rapti Rivers to where females are residing. According to literature, wild Gharial mating occurs in December-January, and it has been recorded in February in captivity. In the Rapti River, two nests were located after hatching; 16 hatchlings were collected and housed at GCBC.

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Table 1. Results of incubation of wild and captive-laid Gharial nests in 2010. # = possibly affected by *Ficus semicordata* roots; *= hatchlings probably killed by red ants.

SN	Lay Date	Location	Clutch Size Size	Hatch Date	Incubation Period (d)	Hatchlings (% of eggs)	Late (full-term) Deaths	Infertile Eggs
GCBC Kasara								
1	29 March	GCBC	43	3 June	67	35 (81.4%)	2 (4.7%)	6 (14.0%)
2	30 March	GCBC	42	6 June	69	36 (85.7%)	1 (2.4%)	5 (11.9%)
3	31 March	GCBC	32	8 June	70	12 (37.5%)	1 (3.1%)	19 (59.4%)
4	31 March	GCBC	31	10 June	72	19 (61.3%)	4 (12.9%)	8 (25.8%)
5	1 April	GCBC	28	12 June	74	22 (75.6%)	3 (10.7%)	3 (10.7%)
6	4 April	GCBC	29	13 June	71	22 (75.9%)	4 (13.8%)	3 (10.3%)
7	4 April	GCBC	50	14 June	72	37 (74.0%)	8 (16.0%)	5 (10.0%)
8	4 April	GCBC	39	15 June	75	10 (25.6%)	4 (10.3%)	25 (64.1%)
9	4 April	GCBC	45	18 June	75	35 (77.8%)	8 (17.8%)	2 (4.4%)
10	7 April	GCBC	32	2 July	87	13 (40.6%)	4 (12.5%)*	15 (46.9%)*
Sub-totals			371			241 (65.0%)	39 (10.5%)	91 (24.5%)
Means			37.1		73.2	63.5%	10.4%	
Narayani River								
1	30 March	Bhelauji	30	8 June	71	20 (66.67%)	8 (26.7%)	2 (6.7%)
2	31 March	Bhelauji	35	8 June	70	30 (85.71%)	4 (11.4%)	1 (2.9%)
3	1 April	Darasinge	34	8 June	69	30 (88.2%)	1 (2.9%)	3 (8.8%)
4	24 March	Bhelauji	45 (5 c)	-	-	-	-	45 (100%)
5	30 March	Darashinge	32 (1 c)	-	-	-	-	32 (100%)
6	1 April	Khoriea muhan	19	-	-	-	-	19 (100%)
Sub-totals			195			80 (41.0%)	13 (6.7%)	102 (52.3%)
Means			32.5		70.0			
Rapti River								
1	31 March	Charahara	38	12 June	73	34 (89.5%)	3 (7.9%)	1 (2.6%)
Sub-totals			38		(73.0)	34 (89.5%)	3 (7.9%)	1 (2.6%)
Totals			604			355 (58.8%)	55 (9.1%)	194 (32.1%)

Pakistan

THREATS AND POPULATION ASSESSMENT OF MARSH CROCODILE AT DASHT RIVER, GWADER. The Pakistan Wetlands Programme (PWP) is an initiative of the Pakistan's Ministry of Environment, and is being implemented by WWF-Pakistan. The program is focused on the conservation of globally significant wetlands and associated biodiversity, while alleviating poverty.

The Makran Coastal Wetlands Complex (MCWC) extends westwards along Baluchistan's Makran Coast, from the Basol River to Jiwani on the border with Iran. This complex supports a range of cetacean species such as finless porpoises and hump-backed dolphins. Local communities are dependent on fishing and port activities that have led to pressures on marine biodiversity through over-harvesting and pollution. A lack of alternate resources for fuel, fodder and timber has led to unsustainable utilization of mangroves in the Dasht estuary and dune vegetation elsewhere on the coastline.

Only the Marsh crocodile (*Crocodylus palustris*) is currently confirmed to exist in Pakistan (Ahmad 1986; Ghalib *et al.* 1981; Javed *et al.* 2004; Khan and Mirza 1976). The species is widely distributed in its former range from Dasht in the extreme west of Pakistan to Assam in northeastern India and also, in Sri Lanka. In Pakistan, Muggers are distributed in Balochistan including the Hub, Hingol and Dasht Rivers (Minton 1966). The species is regarded as near extinct in Pakistan, and is listed in the IUCN Red List as Vulnerable and included in Appendix 1 of CITES (da Silva and Lenin 2010).

Here, we present data on the distribution of Mugger in Balochistan. Information was gathered through a scientific survey format for data collection, developed in collaboration with crocodile experts (Mr. Saeed Baloch, Sindh Wildlife Department). This involved direct day and night surveys of 21 ponds in the Makran region (ie Dasht River) on a daily basis, from 2 November 2007 to 29 January 2008. The ponds are small-medium in size (70 to 500 m long), and have both permanent or seasonal fresh water. The main source of fresh water for the ponds is the Dasht River, which receives water from the Kech and Nehang Rivers. Interviews with local communities, including women who are usually engaged in washing of clothes and utensils at these ponds, were also undertaken. Vegetation of the area consists of *Tamarix* spp., *Indigofera oblongifolia*, *Sesbania sesban*, *Saccharum* spp., *Typha* spp., *Cynodon dactylon* and *Acacia senegal*.

Based on the surveys and interviews, the *C. palustris* population in 2008 is estimated as 175 adults, sub-adults and juveniles at the 21 sites, situated in the lower region of the Dasht River, from Gabd Gwader District to Lodi Aab Kech District. There is limited historical information to compare with our results. In 2004, the Pakistan Zoological Department reported sightings of 4 *C. palustris* at two pools in the Dasht River - these same pools revealed 1 sighting and 3 footprints (total= 4 individuals) during our survey.

Crocodiles in the Dasht River are considered to be facing

known threats, including:

- Illegal killing, particularly of crocodiles that have taken domestic stock (goats, sheep, camels, etc.). Two dead (shot) crocodiles were sighted during the study at Dasht and Jiwani.
- Habitat loss.
- A number of impoundments dried up during the long period of drought (1999-2004), and is believed to have resulted in major crocodile population decline (Javed *et al.* 2005).

Potential threats include:

- Introduction of soap and bleach into ponds as a result of cleaning of clothes and utensils is also considered a potential threat.
- Smuggling of juvenile crocodiles into neighbouring countries.
- Netting is undertaken in most ponds containing crocodiles, resulting in entanglement and killing of crocodiles. One mortality recorded in 2009 at Dasht.

Some factors have the potential to benefit the *C. palustris* population. The Mirani Dam, constructed in 2006 in the lower regions of Dasht, is likely to provide a source of fresh water throughout the year. In addition, the introduction of freshwater fishes in Mirani Dam (aquaculture initiatives introduced by the Provincial Fisheries Department) may provide a food source for crocodiles.

The PWP has directly supported the Dasht community through:

- introduction of a drip irrigation system;
- demonstration of alternate energy sources based on wind and solar was installed in the village for electrification of houses. The aim was to minimize the pressure (eg habitat destruction) on natural resources;
- hiring of a local research student to undertake the crocodile population study;
- involvement of school children in the conservation of crocodiles (eg organized activities such as painting, quizzes, competitions, visits to field sites);
- organized study tour for community members of Metang and Zarin bug villages Dasht to captive breeding centre at Sindh (developed by Sindh Wildlife Department); and,
- mobilization of community members for formation of their Zarin Bugg and Metan village conservation committee to protect their ecosystem, including Marsh crocodiles (eg declaration of crocodile ponds/nesting sites as community protected areas for conservation of crocodiles and other biodiversity).

There is a need to develop a crocodile management program for the Dasht River, the successful implementation of which will ultimately depend on the interest and ongoing involvement of the local community. Ongoing monitoring of *C. palustris* is considered an important element of any program.

Acknowledgments

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India

CROCODYLIAN AND FRESHWATER RESEARCH AND CONSERVATION PROJECT, UTTARAKHAND, INDIA (2010-2015). Surveys in Corbett Tiger Reserve (CTR) in Uttarakhand, India, in 2008, revealed a viable Gharial (*Gavialis gangeticus*) population of more than 100 individuals, including 10 adult males and 32 adult females. Breeding of the Gharial was recorded here for the first time in over three decades, establishing CTR as home to the third largest breeding meta-population of *G. gangeticus* in India.

The species has showed adaptability to the altered environs of a lake-like habitat, from one of a free-flowing river, and is probably the only record of a viable meta-population of the species in a lake. During these surveys Gharial were found to

co-exist with Muggers (*Crocodylus palustris*) and freshwater turtles.

To learn and understand more about these species in the CTR, the Uttarakhand Forest Department has granted permission to undertake research and conservation initiatives for an initial period of 5 years, from June 2010 to June 2015. Besides the CTR, various potential areas would be surveyed for the reintroduction and rehabilitation of these species within the state of Uttarakhand. It is envisioned that an effective species management plan for the Gharial would be one of the main outcomes of this project.

The project being implemented by Subir Mario Chowfin, who undertook Gharial surveys in the CTR in 2008 is being supported by The Gadoli and Manda Khal Wildlife Conservation Trust, an NGO based in Uttarakhand. A valuable grant of \$US5000 has been made available by The Mohamed bin Zayed Species Conservation Fund for training field staff and nature guides from CTR to assist in census, monitoring and nesting surveys of Gharial, Mugger and freshwater turtles in the reserve.

Weekly updates about the project would be made available on The Wildlife Chronicles (<http://www.subirchowfin.blogspot.com>), a blog being maintained by Subir Chowfin.

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East and Southeast Asia

Vietman

Crocodile farmers are lobbying Government for the establishment of a crocodile breeders association. Ton That Hung, Director of Hoa Ca Crocodile Company, has sent a document to the Ministry of Agriculture and Rural Development (MARD), requesting permission to set up an association, to be named "VietCroc". This follows on from the CSG review in 2008, which recommended the establishment of an industry association, which was viewed as a means through which industry and Government could communicate more effectively. In a progress report on implementation of the CSG review recommendations, MARD reported in July 2010 that a staff member had been assigned to liaise with industry on the formation of an association. In June 2010ba 27-farmer group had been established to advance the initiative.

A formal association will allow members to share experience, information and technical support. Currently, skin and production represent a relatively low proportion of overall production, estimated at around 600,000 crocodiles raised annually on a variety of small-, medium- and large-scale farms, based mainly in the Mekong delta. An association may serve as a catalyst to develop an industry which can produce high quality products for overseas markets. Such

value-adding could greatly increase the current annual export earnings from crocodiles of around \$US2.5-3.0 million.

Sources: VietNamNet Bridge, 20 September 2010 (<http://english.vietnamnet.vn/biz/201010/Crocodile-breeders-association-to-be-set-up-in-Vietnam-940160>); Jelden, D.C., Manolis, C., Tsubouchi, T. and Nguyen Dao, N.V. (2008). *Crocodile Conservation, Management and Farming in the Socialist Republic of Viet Nam: a Review with Recommendations*. Crocodile Specialist Group: Darwin; unpublished MARD report to CSG (July 2010).

Science



Recent Publications

Cupul-Magaña, F.G., Rubio-Delgado, A., Reyes-Núñez, C., Torres-Campos, V. and Solís-Pecero, L.A. (2010). American crocodile (*Crocodylus acutus*) attacks in Puerto Vallarta, Jalisco, Mexico: presentation of five cases. *Cuad. Med. Forense*. 16(3): 153-160.

Abstract: Five cases of non-fatal crocodile attacks on people in the region of Puerto Vallarta, Jalisco, Mexico (2007-2010) are presented. In four cases the victim suffered amputation of upper or lower extremity, but only in one case the victim resulted in bitten on the arm. With the documentation of these five cases, the number of attacks by American crocodile (*Crocodylus acutus*) in the coast of the Mexican state of Jalisco for the past 52 years is between 30 and 31. The results show an increase in crocodile attacks from 0,57 to 0,59 per year. We describe the cases and suggest possible explanations for the crocodile's attacks.

Siroski, P.A., Merchant, M., Parachú Marcó, M.V., Piña, C.I. and Ortega, H.H. (2010). Characterization of the serum complement activity of the Broad-snouted caiman *Caiman latirostris* (Crocodylia: Alligatoridae). *Zoological Studies* 49(1): 64-70.

Abstract: The sheep red blood cell (SRBC) hemolysis assay was used to detect and characterize complement-system activity of broad-snouted caiman (*Caiman latirostris*) serum. The hemolytic activity of caiman serum was inhibited by 2 classic inhibitors (EDTA and heat) suggesting the existence of complement-system activity. In addition, we found that the capacity of *C. latirostris* serum to disrupt SRBCs was concentration, temperature, and kinetics dependent. Hemolytic activity was detected from a very low concentration (<10%) of caiman serum and increased until 100%. Temperature influenced the activity of the serum by disrupting SRBC membranes. The serum showed a peak of hemolysis between 30 and 40°C, within which lies the optimal temperature caimans prefer during thermoregulation for normal

physiological processes. Hemolytic activity rapidly occurred at 2 min, and maximum activity was detected at 60 min. These observations reflect previously reported findings in other crocodylian species (*Alligator mississippiensis*, *Crocodylus johnstoni* and *C. porosus*), thus adding to the knowledge of the role of the complement system in immunological activities of crocodylians.

Pantoja-Lima, J.M., Rebelo, G.H. and Pezzuti, J.C.B. (2010). Spectacled caiman (*Caiman crocodylus*) and Black caiman (*Melanosuchus niger*) populations in the Abufari Biological Reserve, Amazonas, Brazil. *Rev. Colombiana cienc. Anim.* 2(1): 34-44.

Abstract: Caiman population studies were carried out during the 2001 and 2003 dry seasons at the Abufari Biological Reserve (ABR), situated in lower Purus River, 450 km southwest of Manaus, to assess the distribution and abundance of caimans along different habitats. The Purus River is a white-water river, which during wet season is continuous with the floodplain (complex riparian streams and lake habitats). Spotlight surveys for counting caimans covered 33.3 km of the Purus River, and 28.3 km of lakes and tributaries. Of the 1217 caimans counted, 872 were identified at the species level (76% Black caiman, 24% Spectacled caiman). The relative abundance of caimans observed in 2001 was higher than in 2003, but this difference was not significant. One third of the caimans observed were above minimum reproductive size. The caiman distribution based on distribution and abundance is described by three clusters that correspond to habitats where there is high biomass (*M. niger*), intermediate biomass (*M. niger* and *C. crocodylus*), and low biomass (*C. crocodylus*). Human-caiman interactions measured by the disturbance index were higher on the main river and in the neighborhood of settlements than in stream channels, beaches and remote areas. However, the caiman populations in the lower Purus River were notable in that Black caiman abundance was higher when compared with other Amazon studies. Further studies on caiman population are necessary to evaluate the sex ratio and mainly the reproductive sites of these species. It is also important to insert the local community in conservation research programs of caimans in such a way as to promote sustainable use.

Espinal, M.R. and Escobedo-Galván, A.H. (2010). *Crocodylus acutus* (American Crocodile). *Nesting ecology*. *Herpetological Review* 41(2): 210-211.

Hsi-yin Shan, Yen-nien Cheng and Xiao-chun Wu (2010). First nearly complete crocodylian, *Tomistoma penghuensis* sp. nov. (Crocodylidae: Tomistominae), from the Miocene of Taiwan. (Journal unknown).

Abstract: A new crocodylian, *Tomistoma penghuensis* sp. nov., is reported on the basis of a fairly preserved skeleton from the Yuwentao Formation near Neian, Shiyu, Penghu Islands. It is the first associated-to-articulated crocodylian skeleton collected in Taiwan area. The specimen includes the skull,

mandible and much of the postcranial skeleton. It is estimated to be about 5 m in total length. In addition, a well preserved deer (?) skull was found from the quarry beneath the dorsal vertebrae 3 to 6 of the crocodylian skeleton, which may have reflected an interesting, predator/prey phenomenon. According to the radioisotopic studies of the basalt interbedded with the Yuwentao Formation, the age of *T. penghuensis* ranges from 10 to 14 Ma. As with other tomistomines, *T. penghuensis* has an elongated and narrow snout. It shares with *T. schlegelii* (the only extant species of Tomistominae) the presence of two teeth within the range of the maxillary-ectopterygoid suture and the maxillary-ectopterygoid suture closely against the tooth row. It shares with *T. lusitanica* Antunes, 1961 (Miocene, Portugal) a triangular choana. It is similar to *Toyotamaphimeia machikanense* Kamei & Matsumoto, 1965 (Middle Pleistocene, Japan) in that the maxillary tooth 7 is the largest and the maxillae clearly bulge laterally across the 7th teeth. *T. penghuensis* can be diagnosed by the combination of the following characters: the sharply triangular choana caudally positioned, with its posterior margin well beyond the posterior edge of the pterygoid flange, the presence of a ventral ridge along the midline of the pterygoids, the presence of five maxillary teeth within the range of the suborbital fenestra, and the similar anterior extension of the lacrimal, prefrontal and jugal. *T. penghuensis* is temporarily assigned to a new species of *Tomistoma* based on the aforementioned features. A detailed study of the tomistomine is in progress, which will further clarify its taxonomic status as well as its phylogenetic relationship within Tomistominae.

Unlu, I., Kramer, W.L., Roy, A.F. and Foil, L.D. (2010). Detection of West Nile virus RNA in mosquitoes and identification of mosquito blood meals collected at alligator farms in Louisiana. *J. Med. Entomol.* 47(4): 625-633.

Abstract: Since 2001, alligator farms in the United States have sustained substantial economic losses because of West Nile virus (WNV) outbreaks in American alligators (*Alligator mississippiensis*). Once an initial infection is introduced into captive alligators, WNV can spread among animals by contaminative transmission. Some outbreaks have been linked to feeding on infected meat or the introduction of infected hatchlings, but the initial source of WNV infection has been uncertain in other outbreaks. We conducted a study to identify species composition and presence of WNV in mosquito populations associated with alligator farms in Louisiana. A second objective of this study was to identify the origin of mosquito blood meals collected at commercial alligator farms. Mosquitoes were collected from 2004 to 2006, using Centers for Disease Control light traps, gravid traps, backpack aspirators, and resting boxes. We collected a total of 58,975 mosquitoes representing 24 species. WNV was detected in 41 pools of females from 11 mosquito species: *Anopheles crucians*, *Anopheles quadrimaculatus*, *Coquillettidia perturbans*, *Culex coronator*, *Culex erraticus*, *Culex nigripalpus*, *Culex quinquefasciatus*, *Mansonia titillans*, *Aedes sollicitans*, *Psorophora columbiae* and *Uranotaenia lowii*. The blood meal origins of 213 field-collected mosquitoes were identified based on cytochrome B sequence identity. Alligator blood was detected in 21

mosquitoes representing six species of mosquitoes, including *Cx. quinquefasciatus* and *Cx. nigripalpus*. Our results showed that mosquitoes of species that are known to be competent vectors of WNV fed regularly on captive alligators. Therefore, mosquitoes probably are important in the role of transmission of WNV at alligator farms.

Guderley, H. and Seebacher, F. (2010). Thermal acclimation, mitochondrial capacities and organ metabolic profiles in a reptile (*Alligator mississippiensis*). *J. Comp. Physiol. B.*

Abstract: Reptiles thermoregulate behaviourally, but change their preferred temperature and the optimal temperature for performance seasonally. We evaluated whether the digestive and locomotor systems of the alligator show parallel metabolic adjustments during thermal acclimation. To this end, we allowed juvenile alligators to grow under thermal conditions typical of winter and summer, providing them with seasonally appropriate basking opportunities. Although mean body temperatures of alligators in these groups differed by approximately 10°C, their growth and final anatomic status was equivalent. While hepatic mitochondria isolated from cold-acclimated alligators had higher oxidative capacities at 30°C than those from warm-acclimated alligators, the capacities did not differ at 20°C. Cold acclimation decreased maximal oxidative capacities of muscle mitochondria. For mitochondria from both organs and acclimation groups, palmitate increased oligomycin-inhibited respiration. GDP addition reduced palmitate-uncoupled rates more in liver mitochondria from warm- than cold-acclimated alligators. In muscle mitochondria, carboxyatractyloside significantly reduced palmitate-uncoupled rates. This effect was not changed by thermal acclimation. The aerobic capacity of liver, skeletal muscle and duodenum, as estimated by activities of cytochrome c oxidase (COX), increased with cold acclimation. At acclimation temperatures, the activities of COX and citrate synthase (CS) in these organs were equivalent. By measuring COX and CS in isolated mitochondria and tissue extracts, we estimated that cold acclimation did not change the mitochondrial content in liver, but increased that of muscle. The thermal compensation of growth rates and of the aerobic capacity of the locomotor and digestive systems suggests that alligators optimised metabolic processes for the seasonally altered, preferred body temperature. The precision of this compensatory response exceeds that typically shown by aquatic ectotherms whose body temperatures are at the mercy of their habitat.

Hamlin, H.J., Lowers, R.H., Albergotti, L.C., McCoy, M., Mutz, J. and Guillette, L. Jr. (2010). Environmental influence on yolk steroids in American alligators (*Alligator mississippiensis*). *Biol. Reprod.*

Abstract: The egg yolk serves as a significant source of maternally derived steroids that are available to the embryo during early development. Altered deposition of yolk steroids can change the developmental trajectory of the embryo and have long lasting or permanent consequences. Alligators from contaminated environments have shown significant

reproductive and developmental dysfunction, and it is unclear if altered deposition of yolk steroids could be a contributing factor. Alligator eggs were collected from Lake Woodruff (a reference lake), Lake Apopka (a site of known agricultural contamination) and the Merritt Island National Wildlife Refuge (MINWR) (home of the Kennedy Space Center and a site of heavy metal contamination). The yolks of eggs at embryonic stages 12 (prior to sex determination) and 24 (post sex determination) were evaluated for concentrations of progesterone, 17-beta estradiol and testosterone. Yolk concentrations of progesterone were significantly lower at embryonic stage 12 in eggs from Lake Apopka and MINWR when compared to eggs from Lake Woodruff. Yolk concentrations of 17-beta estradiol were significantly lower at embryonic stage 12 in eggs from MINWR when compared to the other two sites. Reductions in yolk 17-beta estradiol concentrations from embryonic stage 12 to 24 were significantly attenuated in eggs from MINWR, versus that of Lakes Woodruff and Apopka. This study suggests that altered deposition of yolk steroids, and possibly differential utilization by the embryo, could be a contributory mechanism in the reproductive and developmental abnormalities seen in alligators from contaminated locales,

Eme, J., Gwalthney, J., Owerkowicz, T., Blank, J.M., Hicks, J.W. (2010). Turning crocodilian hearts into bird hearts: growth rates are similar for alligators with and without right-to-left cardiac shunt. *J. Exp. Biol.* 213(15): 2673-2680.

Abstract: The functional and possible adaptive significance of non-avian reptiles' dual aortic arch system and the ability of all non-avian reptiles to perform central vascular cardiac shunts have been of great interest to comparative physiologists. The unique cardiac anatomy of crocodilians - a four-chambered heart with the dual aortic arch system - allows for only right-to-left (R-L; pulmonary bypass) cardiac shunt and for surgical elimination of this shunt. Surgical removal of the R-L shunt, by occluding the left aorta (LAo) upstream and downstream of the foramen of Panizza, results in a crocodilian with an obligatory, avian/mammalian central circulation. In this study, R-L cardiac shunt was eliminated in age-matched, female American alligators (*Alligator mississippiensis*; 5-7 months of age). We tested the hypothesis that surgical elimination of R-L cardiac shunt would impair growth (a readily measured proxy for fitness) compared with sham-operated, age-matched controls, especially in animals subjected to exhaustive exercise. While regular exercise caused a decrease in size (snout-to-vent length, head length and body mass), elimination of the capacity for R-L cardiac shunt did not greatly reduce animal growth, despite a chronic ventricular enlargement in surgically altered juvenile alligators. We speculate that, despite being slightly smaller, alligators with an occluded LAo would have reached sexual maturity in the same breeding season as control alligators. This study suggests that crocodilian R-L cardiac shunt does not provide an adaptive advantage for juvenile alligator growth and supports the logic that cardiac shunts persist in crocodilians because they have not been selected against.

Mansfield, J.H. and Abzhanov, A. (2010). Hox expression in the American alligator and evolution of archosaurian axial patterning. *J. Exp. Zool. B Mol. Dev. Evol.* 314B.

Abstract: The avian body plan has undergone many modifications, most associated with adaptation to flight and bipedal walking. Some of these modifications may be owing to avian-specific changes in the embryonic Hox expression code. Here, we have examined Hox expression in alligator, the closest living relative of birds, and an archosaur with a more conservative body plan. Two differences in Hox expression between chick, alligator, and other tetrapods correlate with aspects of alligator or bird-specific skeletal morphology. First, absence of a thoracic subdomain of Hoxc-8 expression in alligator correlates with morphological adaptations in crocodilian thoracic segments. Second, Hoxa-5, a gene required to pattern the cervical-thoracic transition, shows unique patterns of expression in chick, alligator, and mouse, correlating with species-specific morphological patterning of this region. Given that cervical vertebral morphologies evolved independently in the bird and mammalian lineages, the underlying developmental mechanisms, including refinement of Hox expression domains, may be distinct.

Langley, R.L. (2010). Adverse encounters with alligators in the United States: an update. *Wilderness Environ. Med.* 21(2): 156-163.

Abstract: Severe injuries and fatalities can occur from an alligator attack. Encounters with alligators appear to be increasing in the United States. This review provides information from alligator attacks reported in the United States as well as infections that may occur after an alligator bite. Telephone interviews were conducted with state wildlife offices in all Southern states in order to collect information on the number of alligator bites, nuisance calls, and the estimated alligator population of each state. Detailed information from alligator attacks in Florida is presented, including basic demographic information on the victims and description of the types of injuries and the activity of the victim at the time of injury. Additional information regarding the size and behavior of the alligator involved in the attack is also provided in many cases. There have been 567 reports of adverse encounters with alligators with 24 deaths reported in the United States from 1928 to 1 January 2009. In addition, thousands of nuisance calls are made yearly and the number of nuisance calls as well as the alligator population is increasing in many states. Injuries from encounters with alligators may range from minor scratches and punctures to amputations and death. The larger the alligator, the more likely that serious injury will occur. As the human population encroaches on the habitat of the alligator, attacks and nuisance complaints will continue to occur. A uniform reporting system among states should be developed to obtain more complete information on alligator encounters. Guidelines have been developed by many state wildlife officials to reduce adverse encounters with alligators.

Nelson, T.C., Groth, K.D. and Sotherland, P.R. (2010). Maternal investment and nutrient use affect phenotype of American alligator and domestic chicken hatchlings. *Comp. Biochem. Physiol. A Mol. Integr. Physiol.* 157(1): 19-27.

Abstract: Maternal investment by oviparous amniotes, in the form of yolk and albumen, and the mechanisms by which embryos use available energy and nutrients have a profound effect on embryo and, consequently, hatchling phenotype. Nutrient provisioning and uptake vary within and among oviparous taxa, avian and non-avian reptiles, due to differences and similarities in environment, behavior, and phylogeny. Eggs of crocodylians, the closest extant relatives to modern birds, are ideal models for examining modes of embryonic development, especially with regard to nutrient uptake, in non-avian reptiles and comparing them with those of birds. In this study, we investigated egg composition, embryo growth, and nutrient use in the domestic chicken (*Gallus gallus*) and American alligator (*Alligator mississippiensis*). We explored egg composition by separating and weighing components of fresh eggs. We measured embryo growth and nutrient usage by dissecting embryos and by obtaining samples of liquid from the amnion, digestive tract, and yolk sac throughout the last half of incubation. Variation in albumen mass contributed most to egg mass variation in chicken eggs, whereas alligator eggs were composed almost equally of yolk and albumen, although larger eggs contained proportionally more albumen and less yolk than smaller eggs. Both chicken and alligator albumen were mostly water (87% and 96%, respectively) although chicken albumen contained over three times more solid mass per gram than alligator albumen. In both species, yolk contained a high proportion of solids. Larger eggs produced larger hatchlings in both chickens and alligators, but albumen solids contributed to embryo mass only in chicken embryos. However, intact albumen proteins appeared in the stomach in embryos of both species. While the final disposition of albumen in alligators is unclear, variation in maternal investment of yolk at oviposition was responsible for nearly all of the variation in alligator hatchling phenotype, while both yolk and albumen contributed to chicken hatchling mass.

Larsson, H.C., Heppleston, A.C. and Elsey, R.M. (2010) Pentadactyl ground state of the manus of *Alligator mississippiensis* and insights into the evolution of digital reduction in Archosauria. *J. Exp. Zool. B Mol. Dev. Evol.* 3148.

Abstract: The three-fingered state of the avian manus poses intriguing questions about the evolution of digit reduction. Although digit reduction in most tetrapods appears to be the product of straightforward digit loss, avian digit reduction may have occurred with a dissociation of digit position from digit identity. The three digits of birds have the ancestral identities of I, II, and III but develop from an early pentadactyl ground state from digital anlage 2, 3, and 4. A series of hypotheses have been proposed in an attempt to explain this disparity, including a recent suggestion that the anteriormost condensation visible in the avian limb bud is in

fact a vestigial structure from a hexadactyl ancestral ground state. We investigated this proposal by presenting sets of compatible evolutionary developmental trajectories starting from a hexadactyl state to test hypotheses of digit reduction. The development of skeletogenic mesenchymal condensations in a crocodylian, the closest extant relative to birds, is used to identify any extra precartilaginous digital vestiges. A developmental series of *Alligator mississippiensis* forelimb buds reveal only five digital anlagen, supports a pentadactyl ground state for the archosaurian manus, and rejects portions of the evolutionary developmental trajectories proposed. This condition lends further support to the contribution of a homeotic transformation during digit reduction in avian ancestry to account for the dissociation between digital identity and developmental position.

Fujiwara, S., Taru, H. and Suzuki, D. (2010). Shape of articular surface of crocodylian (Archosauria) elbow joints and its relevance to sauropsids. *J. Morphol.* 271(7): 883-896.

Abstract: The determination of area and shape of articular surfaces on the limb bones of extinct archosaurs is difficult because of postmortem decomposition of the fibrous tissue and articular cartilages that provide the complex three-dimensional joint surfaces *in vivo*. This study aims at describing the shape of the articular cartilages in the elbow joints of six crocodylian specimens; comparing its structure with that of four birds, three testudines, and five squamates; and comparing the shapes of the surfaces of the calcified and the articular cartilages in the elbow joints of an *Alligator* specimen. The shapes of the articular cartilages of crocodylian elbow joint are shown to resemble those of birds. The humerus possesses an olecranon fossa positioned approximately at the midportion of the distal epiphysis and bordering the margin of the extensor side of the articular surface. The ulna possesses a prominent intercotylar process at approximately the middle of its articular surface, and splits the surface into the radial and ulnar cotylae. This divides the articular cartilage into an articular surface on the flexor portion, and the olecranon on the extensor portion. The intercotylar process fits into the olecranon fossa to restrict elbow joint extension. Dinosaurs and pterosaurs, phylogenetically bracketed by Crocodylia and Aves (birds), may have possessed a similar olecranon fossa and intercotylar process on their articular cartilages. Although these shapes are rarely recognizable on the bones, their impressions on the surfaces of the calcified cartilages provide an important indication of the extensor margin of the articular surfaces. This, in turn, helps to determine the maximum angle of extension of the elbow joint in archosaurs.

Farmer, C.G. (2010). The provenance of alveolar and parabronchial lungs: insights from paleoecology and the discovery of cardiogenic, unidirectional airflow in the American alligator (*Alligator mississippiensis*). *Physiol. Biochem. Zool.* 83(4): 561-575.

Abstract: Birds and mammals evolved greater aerobic abilities than their common ancestor had. This required

expansion of the cardiopulmonary system's capacity for gas exchange, but while directional selection for this expanded capacity resulted in extremely similar avian and mammalian hearts, strikingly different lungs arose, and the reasons for this divergence in lung morphology are not understood. In birds, gas exchange occurs in the lungs as air moves through small tubes (parabronchi) in one direction; in mammals, air flows tidally into and out of the alveoli. Here, I present a scenario for the origin of both the alveolar and parabronchial lungs that explains when and how they could have arisen by a gradual sequence of steps. I argue that (1) the alveolar lung evolved in the late Paleozoic, when high levels of atmospheric oxygen relaxed selection for a thin blood-gas barrier within the lung; (2) unidirectional flow originated in the ectothermic ancestral archosaur, the forerunner of birds and crocodylians, to enable the heart to circulate pulmonary gases during apnea. This hypothesis would be supported by a demonstration of unidirectional flow in the lungs of crocodylians, the extant sister taxon of birds. Airflow in the lungs of juvenile alligators was measured during apnea using dual thermistor flowmeters, and cardiac activity was measured with electrocardiography. Coincident with each heartbeat, a pulse of air flowed in the pulmonary conduit under study with a bias in the direction of movement, yielding a net unidirectional flow. These data suggest the internal structures requisite for unidirectional flow were present in the common ancestors of birds and crocodylians and may have preadapted the lungs of archosaurs to function advantageously during the oxygen-poor period of the early Mesozoic.

Barros, T., Jiménez-Oraá, M., Heredia, H.J. and Seijas, A.E. (2010). Artificial incubation of wild-collected eggs of American and Orinoco crocodiles (*Crocodylus acutus* and *C. intermedius*), Guárico and Zulia, Venezuela. *Conservation Evidence* 7: 111-115.

Abstract: During 2009, wild eggs of two Venezuelan crocodylians (Orinoco crocodile *Crocodylus intermedius* and American crocodile *C. acutus*) were collected and artificially incubated using low-technology methods under basic conditions. Hatch success was 53.7% for *C. intermedius* eggs, and 65.6% for *C. acutus* eggs. Overall, 316 hatchlings were obtained from a total of 521 eggs (60.7% hatch success). These results compare favourably with similar artificial incubation trials, but incubation time for *C. acutus* eggs (87 to 102 days) was rather longer than the typical incubation period for the species (around 82-83 days). This may be indicative of a low incubation temperature; if so, most of the hatchlings may have been females. Only as these young mature will their sex be determinable. Hatchlings were taken to captive-rearing facilities where they will be maintained until they reach a suitable size for release into the wild. Participation of local people in this project was considered a very important factor in its success, and had additional conservation benefits including raising public awareness of the plight of crocodile populations and problems of over-exploitation in the study areas.

Gramentz, D. (2010), Zum Schreckruf juveniler *Crocodylus rhombifer* Cuvier, 1807 und *Crocodylus siamensis* Schneider, 1801. *Sauria*, Berlin 32(3): 39-46.

Abstract: The distress calls of juvenile *Crocodylus rhombifer* and *Crocodylus siamensis* were compared and analysed as to frequency, call length, call structure, sound intensity. The results are presented in oscillograms, audiospectrograms and three-dimensional images.

Da Silveira, R., Ramalho, E.E., Thorbjarnarson, J.B. and Magnusson, W.E. (2010). Depredation by jaguars on caimans and importance of reptiles in the diet of jaguar. *Journal of Herpetology* 44(3): 418-424.

Abstract: The jaguar (*Panthera onca*) is the largest Neotropical felid and in many parts of its range reptiles form a significant but relatively minor component of its diet. However, in the seasonally flooded varzea forests of the Amazon, terrestrial mammals, which form an important component of jaguar diet in other habitats, are largely absent and jaguars switch to alternative prey, including arboreal mammals and reptiles. In the Mamirauá Sustainable Development Reserve in the western Brazilian Amazon, we document predation by jaguars on two species of caiman (*Caiman crocodilus* and *Melanosuchus niger*), which are abundant in this varzea habitat. The smaller *C. crocodilus* seems to be particularly vulnerable because of its size and tendency to spend more time on land than the larger *M. niger*. Jaguars not only kill and eat caiman but are also a significant predator on eggs of both species. We place our findings into the context of jaguar predation on reptiles by reviewing studies of jaguar diet in a variety of biomes.

Meganathan, P.R., Dubey, B., Batzer, M.A., Ray, D.A. and Haque, I. (2010). Molecular phylogenetic analyses of genus *Crocodylus* (Eusuchia, Crocodylia, Crocodylidae) and the taxonomic position of *Crocodylus porosus*. *Molecular Phylogenetics and Evolution* 57: 393-402.

Abstract: The genus *Crocodylus* consists of 11 species including the largest living reptile, *Crocodylus porosus*. The current understanding of the intrageneric relationships between the members of the genus *Crocodylus* is sparse. Even though members of this genus have been included in many phylogenetic analyses, different molecular approaches have resulted in incongruent trees leaving the phylogenetic relationships among the members of *Crocodylus* unresolved inclusive of the placement of *C. porosus*. In this study, the complete mitochondrial genome sequences along with the partial mitochondrial gene sequences and a nuclear gene, C-mos were utilized to infer the intrageneric relationships among *Crocodylus* species with a special emphasis on the phylogenetic position of *C. porosus*. Four different phylogenetic methods, Neighbour Joining, Maximum Parsimony, Maximum Likelihood and Bayesian inference, were utilized to reconstruct the crocodylian phylogeny. The uncorrected pairwise distances computed in the study, show

close proximity of *C. porosus* to *C. siamensis* and the tree topologies thus obtained, also consistently substantiated this relationship with a high statistical support. In addition, the relationship between *C. acutus* and *C. intermedius* was retained in all the analyses. The results of the current phylogenetic study support the well established intergeneric crocodylian phylogenetic relationships. Thus, this study proposes the sister relationship between *C. porosus* and *C. siamensis* and also suggests the close relationship of *C. acutus* to *C. intermedius* within the genus *Crocodylus*.

Rödger, D., Engler, J.O., Bonke, R., Weinsheimer, F. and Pertel, W. (2010). Fading of the last giants: an assessment of habitat availability of the Sunda gharial *Tomistoma schlegelii* and coverage with protected areas. *Aquatic Conserv: Mar. Freshw. Ecosyst.* 20: 678-684.

Abstract: The Sunda gharial *Tomistoma schlegelii* is, with 2500-3000 remaining specimens, one of the least studied and at the same time most endangered crocodile species. Inhabiting peat swamps in Southeast Asia, threats affecting the species are mainly associated with habitat loss and illegal hunting. The effectiveness of the existing reserve network in Southeast Asia for the protection of the Sunda gharial was assessed by combining spatially explicit habitat analyses derived from land cover information with species distribution modelling. Subsequently, possible improvements of the existing reserve network are derived from the habitat availability analyses. The results of the spatially explicit analyses indicate that suitable habitats for the Sunda gharial in Southeast Asia, ie peat swamps and riverine forests, are highly fragmented. Spatial coverage of remaining habitats with protected areas fulfilling IUCN standards generally varies among regions and is best in Indonesia. However, large, currently unprotected suitable areas remain in Sumatra. Establishment of 10 additional, already proposed reserves may improve the protection of major parts of the remaining suitable habitats of the Sunda gharial. According to the results of this study, the reserve network protecting this species could be significantly improved by expanding it to include 7 national reserves not currently listed by the IUCN and an additional 10 reserves that have recently been proposed. Improvements and extensions of the existing reserve networks in Southeast Asia are pivotal to guarantee the long-term survival of the Sunda gharial.

Hekkala, E.R., Amato, G., DeSalle, R. and Blum, M.J. (2010). Molecular assessment of population differentiation and individual assignment potential of Nile crocodile (*Crocodylus niloticus*) populations. *Conservation Genetics* 11(4): 1435-1443.

Conservation and management of widespread species can be improved if populations exhibiting genetic differentiation are recognized as local management units. Specimens of Nile crocodile (*Crocodylus niloticus*) corresponding to major river drainage systems from Eastern Africa and Madagascar, and a small set of samples from Western Africa, were analyzed using multilocus genotyping to evaluate the potential to discriminate

among locations and to assign individuals to population of origin. Populations from all sampled regions exhibited marked levels of genetic and genotypic differentiation as assessed by significant F_{ST} values and Bayesian analysis of population structure. At the regional level, the majority (94%) of all specimens were successfully assigned to the population of origin using only four microsatellite loci. Three populations sampled within Madagascar required the use of 12 loci for successful assignment of greater than 84%. Our findings demonstrate a need for alternative management strategies that consider the biogeographic sub-structuring of Nile crocodiles associated with major river drainages in Africa and Madagascar.

Bezuijen, M. (2010). *Crocodylus siamensis* (Siamese Crocodile). *Diet. Herpetological Review* 41(1): 68-69.

Submitted Articles

ORDER CROCODYLIA LOVERIDGE, 1946, RECOMMENDED. It is currently and correctly accepted that *Crocodylus niloticus* is the type-species of *Crocodylus* Laurenti, 1768, which is the eponym of the Crocodylinae subfamily, the Crocodylidae family, and the order Crocodylia (the crocodylians group including fossils). However, in contrast to the current belief, we have newly become convinced that Crocodylia Loveridge, 1946, is the most appropriate authorship of this order. Our reasons for rejecting the status quo are complex and technical, and will (we hope) soon be detailed in Kischlat *et al.* (in prep.), and thus we are not here justifying an immediate change; but rather we wish merely to make the case for Crocodylia Loveridge, 1946, on its own merits.

One of the factors requested by the Code of Zoological Nomenclature, including for modern high-level taxa, is that the new name should be distinguished as different from, and thus replacing some older alternative taxon. It must be clear that the name is not a casual spelling variation. The "Order Crocodylia" in Loveridge (1946) satisfies this criterion, because in the Loveridge (1945) first edition, he employed the "Order Loricata" with the same exact text, illustrations and pagination. Clearly Loveridge (1946) changed his mind about Loricata, and consciously substituted his own Crocodylia in its place as the name of the order with the "Family Crocodylidae" (employed by Loveridge in both 1945 and 1946) and the genus *Crocodylus* in it.

In addition to examples of *Crocodylus* species in the region (*C. porosus*, *C. palustris*, *C. siamensis*, *C. novaeguineae* and *C. mindorensis*), the text in Loveridge (1945, 1946) included *Gavialis gangeticus*, *Tomistoma schlegelii*, *Alligator sinensis*, and also the New World caymans group as being in the order of crocodylian reptiles. Although Loveridge (1945, 1946) was editorially limited to only those living forms that were relevant to American troops in the southeastern Asia and adjacent Pacific Ocean military zone, he acknowledged that many living reptile groups have long fossil records. It

is a remarkably good approximation of the crown clade Crocodylia, meaning the living representatives of the order.

The order Crocodylia Loveridge, 1946, is spelled in the alphabet prescribed by the Code, and is not an unmodified vernacular word such as Crocodile (nor merely a plural noun, nor an adjective referring to the members of a genus), but rather is latinized in an appropriate way for an order (it has the Code recommended suffix -ia), and was considered to be valid for its taxon in Loveridge (1946, which applied the principle of Binominal Nomenclature) at the time of its proposal. It is not a junior synonym of Loricata, and to the contrary, Loricata was considered inappropriate for this reptile group by Loveridge (1946), correcting himself in the second printing, and starting afresh with an eponym of *Crocodylus Laurenti* (a genus actively employed by Loveridge, and which has not been suppressed), based on *Crocodylus niloticus* (in the tradition of L.H. Stejneger and T. Barbour, and later K.P. Schmidt). We are certain that Crocodylia Loveridge, 1946, is not an accidental misspelling of Crocodilia.

Further, Arthur Loveridge's Crocodylia satisfies the Code's request that any new name should be clearly distinguished from taxonomic groups closely related, or similar in appearance, to it. The crocodilian order was separated from the turtles, and also from the snakes and lizards in Loveridge's illustrated key to the major living reptilian groups, and there was an added remark that "any scaly four-legged reptile that is not a crocodile or turtle" is a lizard. As key characters, the Crocodylia have their "body not enveloped in a bony shell; anal opening longitudinal; body more or less strongly protected by horny shields which on the back, and sometimes on the belly, overlie bony plates." This key qualifies as a description or definition that states in words those characters that are purported to differentiate the taxon, including separately distinguishing crocodiles from the tuatara of New Zealand (which has a third eye, and a transverse anal opening).

The "Class Reptilia" was defined by Loveridge (1945, 1946) as backboned animals ("Phylum Vertebrata") having a dry skin usually covered by scales or shields, and whose young or hatchlings, or at birth, are lung-breathers substantially resembling their parents. Their name is derived from reptilis, in reference to the creeping habits of some forms. Reptiles are cold-blooded and are distinguished from the jawed fishes by the absence of fin rays, and are structurally separated from the Amphibia by some details of skeleton and internal organs (heart, lungs, kidneys).

The "Order Crocodylia" from Loveridge (1946) has many strengths, and we recommend its consideration for active employment.

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CAPINÉ'S KAYMAN AND *CROCODYLUS NILOTICUS*.

We believe that Laurenti (1768) knew about the Nile crocodile in Egypt from reading about it in books. He thus knew about: how they lie in ambush in shallow water, looking very much like a log, and wait for something the size of a deer or pig to come for a drink; that once grasped, the prey gets dragged into the water and violently drowned; that crocodiles feed relatively infrequently and have stomach stones (gastroliths) which increase their weight and thus their predatory power; and, that *Crocodylus niloticus* has the habit of stashing whole prey under water, to soften it before eating. Also, Laurenti (1768) knew that the crocodile of Egypt has five fingers but only four toes; and although the front and hind feet have claws, only the two back feet have webbing between their digits.

The Nile crocodile has always been known to have an impressive number of pointed teeth, and to grow to a remarkably large adult size; and, the written description of large aggregations of Egyptian crocodiles sunning themselves on the sandy shores of the Nile and nearby rivers is ancient; as is also knowledge about their habit of digging a hole in the soil for depositing the eggs, which incubate with heat from the sun; and when the hatchlings emerge, they make their way directly to the water. Further, and significantly, Laurenti (1768) believed that Egyptian crocodiles normally copulate belly-to-belly, and that the wife afterwards lies helpless on her back, belly-up and vulnerable until her husband rolls her over; and there is a famous story about how a supine female *C. niloticus* was killed by some men from a sailing boat on the Nile River.

Given that Laurenti (1768) knew the belly-to-belly crocodile copulation story from Egypt, he identified two pictures of South American smooth-fronted caymans (said to be from Sri Lanka) as *C. niloticus* because they appeared to illustrate this rumored phenomenon of the female lying supine and helpless on her back. However, complicating this scenario, Seba (1734) cited L. de Capiné's then recent book about the Caribbean Sea as an example of one among many sources for the belly-to-belly and helpless female rumor. It is relevant that Capiné (1702) was news in Seba's time, while in contrast the story from Egypt was old. We think that Seba (1734) was making his own book as modern and interesting as possible.

The crocodile from Egypt was already known, but it was news that similarly big crocodiles had been reported by sailing ships returning from Sri Lanka. Similarly, Seba (1734) was an opportunist by turning what probably started as dorsal and ventral views into the famous male and female pair (plate 105, Figs. 3 and 4 respectively). Neither Seba (1734) nor Laurenti (1768) thought that Seba's (1734, pl. 105 Figs. 3-4) pair of male and female crocodilians were from the New

World. Rather, the species was distinctly Old World, and thus the belly-to-belly copulation with the female on her back and helpless phenomenon that was being illustrated in Seba (1734) was in no direct way connected to Capiné (1702), except that Capiné's book was one recent publication where the story had been told.

Louis de Capiné left Brest, France, in 1688, and his ship crossed the Atlantic to the island of Martinique, where they stayed for 11 days, and then sailed to Hispaniola, stopping at the larger island for a fairly long time, before proceeding to Colombia by way of Cuba. There is nothing in the Kaymans section in his account of Hispaniola that Capiné could not have read in a book about the African crocodile, and yet he was correctly reporting that something very much like *C. niloticus* (actually *C. acutus*) lives in the San Domingo and Haitian region. The fancy old font in which it is printed makes Capiné (1702) difficult to translate, but thanks to Norna Ross, we provide the following from pages 10-12, titled "Kaymans".

"But to get to bigger animals, I must first mention those horrible animals the Kayman, which are the kind of crocodiles that this island is full of. They there [in Hispaniola] have been seen of such horrible sizes, with a length of seventy [unit unclear], and a thickness of twelve [unit unclear]. Really, men don't need to remember about their large bodymass, but about their cunning and slyness; [unclear]. When they because of hunger get pressed, they place themselves on the side of a river mostly in the shallow water, where the deer habitually come to drink, or itself to [unclear]. Here it stays without making a single move, looking like an old tree that has fallen into the water. So it lies to wait, expecting that a wild pig, or cow, [unclear] has come to drink, or itself to [unclear]. Soon they attack with great speed on the prey, and after themselves towing it into the water, let themselves so become heavier.

"Yet a bigger sign of their cunning is this. Three or four days is the Kayman in such a way determined, he doesn't eat food, but being in the river, he guzzles a hundred or two pounds of stones, which adds heaviness to his natural strength, that is unusually big, helps serve himself there to make reassured of an offer [of prey]. [unclear] lets the prey lay for four or five days under the water untouched, because Kaymans cannot eat the littlest bit off it before it has become rotten. [an unclear sentence about skins of animals, even after hanging to dry, can be macerated in water, weighted down by stones for a few days until the hair falls out]

"These badly mannered animals have seventy-two large and very sharp teeth; thirty-six in the upper, and just as many in the lower jaw. Their four legs are equipped with big sharp claws, where of the two front each has five, from each other divided as fingers; compared with the two hind legs which have only four, which are divided by a thin skin, similar to waterbirds. In the breeding lies the female on her back; and cannot come back on her belly, it gets helped by the male, to not get caught in that posture, and get killed.

"Next, when the seed has done its work, they congregate themselves on the sandy bank of the river, which lies against

the southern sun. In this sand they lay their eggs, which they cover up, and which only by the heat of the sun will hatch. With haste come the young out of the egg, they walk though a natural [unclear] to the water."

It is perplexing that Capiné's Hispaniolan crocodile was portrayed as living in rivers, as opposed to being an oceanic coastal animal. We suspect that he saw *C. acutus* from a distance (or just heard about them), and decided that it was the same basic phenomenon as *C. niloticus*, and embellished his report about the Caribbean with African crocodile details from the literature. We do not know if Laurenti (1768) had seen Capiné (1702, or an earlier version in French), but we confidently assert that when he looked at the Seba (1734: plate 105, figs. 3-4) pictures of a upright "male" and a supine "female" crocodilian species, Laurenti (1768) firmly believed that its habitat was Old World, and he expanded the Indian subcontinental region to also and explicitly include Egypt, where the crocodile wife was known to lie on her back during copulation, and to afterwards be helpless unless righted by her husband, as exemplified by the story about men from a sailing boat who, on a sandy island in the Nile River, killed an adult *C. niloticus* which they thought was a female.

The pair of Seba (1734: plate 105) crocodilian pictures shows the dorsal (fig. 3) and ventral (fig. 4) views of one species (today *Paleosuchus trigonatus*), and the artist was remarkably accurate about many details. The fingers and toes are correct for the modern crocodile, and the distinctly longitudinal slit of the cloacal opening is evident, providing a dichotomous key character that separates the crocodile group from the lizards (and snakes and turtles) and the tuatara.

The relationship between Capiné's Kayman and *C. niloticus* Laurenti, 1768, is complex, yet merely tangential, because Seba's citing of Capiné (1702) about the story did not influence Laurenti in 1768, but Seba's story about the supine female did.

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