

CROCODILES

**Proceedings of the Second Working Meeting of Crocodile Specialists
Sponsored and arranged by the Survival Service and Ecology Commissions
of IUCN**

**with the support of the Natal Parks, Game and Fish Preservation Board
and the New York Zoological Society,
and held at Ndumu and Lake St. Lucia, Zululand,
20-27 March 1973**



**International Union for Conservation of Nature and Natural Resources
1110 Morges, Switzerland
OCTOBER 1973**

IUCN
NS
SP
No. 041

C R O C O D I L E S

Proceedings of the Second Working Meeting of Crocodile Specialists

Sponsored and arranged by the Survival Service and Ecology
Commissions of I U C N

with the support of the Natal Parks, Game and Fish Preservation Board
and the New York Zoological Society,
and held at Ndumu and Lake St. Lucia, Zululand,

20 - 27 March, 1973

Published with the financial assistance of the
New York Zoological Society

International Union
for Conservation of Nature and Natural Resources
1110 Morges, Switzerland

OCTOBER 1973

2-88032-0 0 9 - 7

SECOND WORKING MEETING OF CROCODILE SPECIALISTS

PAPERS AND PROCEEDINGS

CONTENTS	Page
List of participants and contributors	6
Introductory Message from the Director General of IUCN, Dr. Gerardo Budowski	7
Summary of the Meeting	9
Papers presented at the Meeting:	
A. Conservation review 1971-73	10
A.1. North America	
A.1.1. Population status surveys of the American alligator in the south-eastern United States, 1972. Robert H. Chabreck	14
A.1.2. The status of <u>Crocodylus acutus</u> in southern Florida. James H. Powell, Jr.	22
Discussion.	25
A.2. Central America	
A.2.1. Crocodilians of Central America, including Mexico and the West Indies. James H. Powell, Jr.	27
Discussion.	32
A.3. South America	
A.3.1. Summary of the surveys of the status of crocodilian species in South America undertaken by Professor F. Medem. Presented by Dr. F. Wayne King	33
Discussion.	36
A.4. Africa	
A.4.1. Crocodile status report for the Province of Natal, R.S.A., Senegal, Togo, Swaziland and Mali. A.C. Pooley	37

CONTENTS (continued).

Page

A.4.2. Crocodile status report for Rhodesia. R.I.G. Attwell	... 41
Discussion.	... 44
A.5. Australia and Oceania	
A.5.1. Crocodile Conservation review - Australia. H.R. Bustard	... 45
A.5.2. Recent developments in Papua New Guinea. M.C. Downes	... 48
Discussion.	... 49
A.6. Asia	
A.6.1. Regional situation report - Asia. R.E. Honegger	50
A.6.2. External trade statistics for undressed crocodile skins from Malaysia and Singapore - A correction. F. Wayne King	... 55
Discussion.	... 58
B. Controlled breeding as a means of reducing pressure on wild populations of crocodilians	
B.1. Stocks and captive breeding, 1969-1972. R.E. Honegger	... 59
B.2. Current trends in alligator farming in the south- eastern United States. R.H. Chabreck	... 63
Discussion.	... 66
B.3. Management of the Papua New Guinea Crocodile Industry. M.C. Downes	... 67
Discussion.	... 69
C. Supplementary papers on conservation and ecology	
C.1. Some aspects of crocodile conservation-education. A.C. Pooley	... 70
Discussion.	... 75

CONTENTS (continued)

Page

C.2. The Convention on International Trade in Endangered
Species of Fauna and Flora in relation to
crocodile conservation. F. Wayne King ... 76

Discussion. ... 80

C.3. Notes on the ecology of the Lake St. Lucia
crocodile population. A.C. Pooley ... 81

Discussion. ... 91

Appendix: The Literature of Crocodile Husbandry.
M.C. Downes ... 93

SECOND WORKING MEETING OF CROCODILE SPECIALISTS

Participants

Dr. H.B. Anthony (in the Chair),
The Natal Parks, Game and Fish
Preservation Board,
Box 662,
Pietermaritzburg, Natal, R.S.A.

Mr. R.I.G. Attwell,
Department of National Parks and
Wildlife Management,
P.O. Box 8365,
Causeway, Salisbury, Rhodesia.

Miss Mona Björklund (Convener &
rapporteur),
Executive Officer,
Commission on Ecology,
IUCN, 1110 Morges, Switzerland.

Dr. H. Robert Bustard (Group
Secretary),
Applied Ecology Pty. Ltd.,
P.O. Box 26,
Woden, A.C.T. 2606,
Australia.

Dr. Robert H. Chabreck (Consultant),
School of Forestry & Wildlife
Management,
101 Forestry Building,
Louisiana State University,
Baton Rouge, Louisiana 70803, U.S.A.

Mr. M.C. Downes,
Wildlife Section,
Department of Agriculture, Stock
& Fisheries,
P.O. Box 2417,
Konedobu,
Papua, New Guinea.

Mr. R.E. Honegger (Rapporteur),
Zürich Zoo,
Zürichbergstrasse 221,
8044 Zurich,
Switzerland.

Dr. F. Wayne King,
New York Zoological Society,
The Zoological Park,
Bronx Park,
Bronx, N.Y. 10460., U.S.A.

Mr. A.C. Pooley,
Ndumu Game Reserve,
P.O. Ndumu,
Zululand, Natal, R.S.A.

Mr. James H. Powell,
1110 Kokomo Street,
Plainview, Texas 79072, U.S.A.

Colonel J.W. Vincent,
The Natal Parks, Game and Fish
Preservation Board,
Box 662,
Pietermaritzburg, Natal, R.S.A.

Other Contributors

Dr. Gerardo Budowski,
Director General, IUCN,
1110 Morges, Switzerland.

Dr. Howard W. Campbell,
College of Arts and Sciences,
Department of Zoology,
University of Florida,
Gainesville,
Florida 32601,
U.S.A.

Professor Federico Medem,
Instituto "Roberto Franco",
Apartado Aereo 2261,
Villavicencio (Meta),
Colombia.

INTRODUCTORY MESSAGE

from

Dr. Gerardo Budowski,
Director General of IUCN, Morges, Switzerland

For the second time I feel very unhappy not to be present on the occasion of a meeting of crocodile specialists. Crocodile conservation is a subject to which IUCN devotes great attention and, in close collaboration with the World Wildlife Fund, aims to carry out a series of projects throughout the world for safeguarding the crocodilians - many of which are at present endangered.

My own first experiences with the crocodilians go back to the 1940s in Venezuela, Colombia and nearby Brazil, where I had ample opportunities to see the burgeoning hunting operations which have today led to the virtual disappearance of crocodiles over wide areas. A similar situation is found throughout the world.

Of course, the maintenance of species is still our main concern - and you will certainly review progress on IUCN's Red Data Book on reptiles - but it should not be the only one. We seek nothing less than the recognition of the crocodiles as useful animals, of great interest to science and to education, ecologically important as a vital link in natural relationships, and economically valuable natural resources in themselves. Crocodilians can and should contribute to the overall essential natural balance and quality of life - as important assets to man and his environment. I do not want to be unrealistic and I am the first to acknowledge that we still have to go a long way to reach this objective, but your Working Group, more than any other entity, can greatly contribute to making our common goal easier to reach.

Since your last meeting, two years ago, new developments have taken place, many of them spurred by your activities. Better surveys are being promoted throughout the world. In Latin America Professor Medem's inventories in various countries have led to worthwhile action. Some promising initial results have also been achieved with a small breeding stock of Morelet's crocodile in Mexico. But continuous depletion of crocodilian species in African countries has also been reported: although there has been some progress in restocking in Natal, the overall picture appears very grim in natural habitats and, of course, this is why so much emphasis has been put on breeding programmes based on experience accumulated throughout the world.

Farming crocodiles in captivity or semi-captivity may ultimately prove to be an effective tool to alleviate pressure on wild crocodiles. Whether this can best be realised through

small farms as in New Guinea or through large breeding centres as in Bangkok and Ndumu may well be worth examining in relation to all the social, cultural and economic conditions of the various regions.

Major development of the crocodile leather industry is, undoubtedly, a very grave potential threat, and any moves to promote this industry without carefully planning the utilization of resources should be critically reviewed by your Group. We are, for instance, apprehensive about the scheme to build up a large leather industry in Sudan under the aegis of UNIDO, since at this stage there seems to be no reliable information as to the availability of a sustained supply of the basic resource.

Finally, there are legal aspects, both at a national level, such as the action being undertaken to introduce new legislation in Botswana, Rhodesia, Mozambique and some Latin American countries, and on an international level. In this last-mentioned respect, the most important development has been the recent signing of a Convention on trade in endangered wild fauna and flora, resulting from the international conference just concluded in Washington D.C. The convention includes two appendices of scheduled species, which will be coming before you for review. As you will see under Appendix 1, 18 species of crocodilians and their products will be virtually eliminated from trade, while another 9 species are severely restricted under Appendix 2. I very much hope that this meeting will support this Convention and carefully consider the two appendices, so that if need be recommendations can be made for modifications in future revisions, which are provided for under the terms of the Convention.

In concluding, I should like to extend a very special expression of thanks to the New York Zoological Society, which has made this meeting possible. As you know, the New York Zoological Society was also the key organization for the first meeting of crocodile specialists held two years ago at the Bronx Zoo in New York. If, as we hope, the crocodilians eventually recover their rightful place in the balance of nature, much credit will certainly go to the Society, which at critical moments has been able to rally financial and moral support to make these meetings possible and thus to generate effective programmes for action.

Our thanks also go to the Natal Parks Board for making facilities available at Ndumu. There is no doubt that the next few days will be an important landmark in international scientific co-operation in a cause which can benefit all mankind. I wish you every possible success in your deliberations.

SUMMARY OF THE MEETING

1. Introduction

Dr. H.B. Anthony, a Founder Member of the Natal Parks, Game and Fish Preservation Board, opened the meeting by welcoming the participants on behalf of the Board. An introductory message from the Director General of IUCN was read by Miss M. Björklund, Executive Officer of IUCN's Commission on Ecology, and the apologies of members of the Survival Service Commission's (SSC) Crocodile Specialists' Group unable to attend the meeting were presented. Dr. Anthony was elected Chairman of the meeting and Mr. R.E. Honegger and Miss Björklund as the rapporteurs.

The Agenda as adopted after some amendments included several items relating to Group procedures and policies, which are briefly mentioned in the immediately following section of this Summary. They were recorded in detail in the Group's Minutes and, together with supporting memoranda, including two especially prepared for the meeting by Mr. M.C. Downes (on the Group's functions) and by Dr. R.H. Chabreck (on endangered species programmes in general), and six recommendations mainly directed to future organization of Group activities, were referred for consideration by the SSC and the secretariat officers concerned.

Sections 3 - 5 of this Summary, under the three general headings into which the papers submitted for the meeting were grouped, cover the scientific discussions, decisions made and advice given, thus bringing up to date the Group's assessment of crocodile conservation problems and studies. It should be noted, however, that, on the Group's recommendation, points made in discussion arising directly from one or more of the papers contributed, are summarized at the end of the paper(s) concerned. The account which follows is therefore mainly confined to supplementary discussions and agenda items on which only verbal reports are given.

2. Group business

Membership and special committee or individual appointment matters discussed, included:-

- (a) Dr. H.B. Cott's request to be relieved of the chairmanship of the Group, regretfully noted;
- (b) recommendations for the appointment of new members and consultants to the group, referred to the SSC;

- (c) agreement by Mr. J.H. Powell to take over compilation of the Group's Newsletter and by Dr. F.W. King to arrange for its duplication and distribution, in succession to Mr. A.C. Pooley;
- (d) appointment of sub-committees or individuals to - draft the recommendations arising from the meeting; advise on the revision and classification of the crocodilian Red Data Book sheets; prepare a (popular) Red Book on crocodiles; complete or undertake IUCN monographs on selected species; and to bring to fruition the captive breeding projects for certain species (Crocodylus cataphractus, C. moreletii, C. rhombifer, C. intermedius, Caiman crocodilus apaporiensis, Gavialis gangeticus and Osteolaemus tetraspis) at the Crocodile Foundation, Bangkok, and, for the first and last-mentioned, also at Ndumu (see Part 4 below).

Main topics of discussion were the procedures and classification problem involved in the preparation of the IUCN Red Data Book sheets for crocodilian species, in the light of a verbal progress report presented by Mr. Honegger, and secondly the general functions of the Group itself, based on Mr. Downes's paper to which reference has already been made. There was also a good deal of discussion of plans for future publications. Various recommendations were drawn up accordingly for submission to SSC.

It was recommended that the Third Meeting of the Group should be held at IUCN Headquarters, Morges, in May or early June, 1975.

3. Conservation review: 1971 - 1973

As previously indicated, the discussions on the reports submitted about the changes that had taken place since the First Meeting of the Group in 1971, are recorded after each regional paper or group of papers in Section A of these Proceedings.

Altogether ten reports were presented and some seventeen decisions, recommendations and suggestions were recorded. In the absence of Professor Medem, Dr. Wayne King summarized the latest information received from him about the South American crocodilians and arrangements were agreed for improving the circulation of future reports to Group members and IUCN secretariat officers concerned. In other regions, the countries at present causing anxiety to the Group and in which IUCN/SSC intervention to promote remedial action was recommended, seemed to be mostly African (Mali, Zambia, Natal and Swaziland), although in the Central America region additional conservation measures in Mexico were also considered to be particularly important.

4. Controlled breeding of crocodiles

Three papers were presented under this head and, in addition, Mr. M.C. Downes submitted a Bibliography of all published references to 'crocodile husbandry' (in the broad sense of keeping or 'farming' crocodiles and the conditions required to achieve success). The Bibliography, selected from a comprehensive working guide to 'the Literature of the Living Crocodilians', the preparation of which is being financed by the New York Zoological Society with a view to publication by the Department of Agriculture, Stock and Fisheries of Papua New Guinea towards the end of 1973, was welcomed by the Group as a most valuable contribution. It is included as an Appendix to the Proceedings.

The recommendations arising from the discussion of the papers were concerned with the problems involved in the breeding of the Cuban crocodile C. rhombifer, the status of which was believed to be somewhat precarious and, in particular, with the problem arising from its reported hybridization with C. acutus.

In subsequent discussion a proposal was endorsed for the preparation of a list or register of crocodile farms, indicating their various objectives and modes of operation. This would be organized by Mr. Pooley, to whom all available information should be directed (zoo breeding units qualify for consideration if serving an effective educational purpose). The first stage would be to produce a check-list, supported by a tentative ranking list, for the consideration of IUCN/SSC, only such farms as are recommended by the group and accepted by IUCN being finally registered. It would be desirable for ranking to be up-dated annually, implying on-site inspection and the regular review of farm objectives and assessment of the educational content of an operation. The Group would, of course, keep a copy of the register and its Newsletter might well be a convenient vehicle for publishing additions or other changes to the list.

There was also considerable discussion of the Crocodile Foundation, the endangered species breeding project established at the Yangprapakorn Crocodile Farm, Bangkok, following the recommendation of the Group's first meeting in 1971. Progress had not been as good as expected, since so far only C. novaeguineae, a species whose status was not considered critical, had been shipped to Thailand. Approaches made to AAZPA and to holders of crocodile collections in the U.S.A. had indicated general support for such projects and some interesting facts had come to light; for example, there are 11 specimens of the black caiman Melanosuchus niger in 11 different U.S. zoos, all of them animals suitable for propagation purposes, if only they could be brought together in one or several locations.

The Group considered that high priority should now be given to sending a few key species, especially C. moreletii, to the Bangkok farm, and it was understood that Mr. Yangprapakorn was ready to pay transport costs: an early approach should be made to the Thailand authorities with a view to easing importation formalities. Reference was also again made to the captive breeding by the Foundation of C. rhombifer, of one or more African species and of Alligator sinensis, though Bangkok was possibly too warm for the last-mentioned and an alternative possibility was to arrange for zoo exchanges to build up a stock for a breeding project in Australia. In general, the value of such exchanges should not be discounted, though zoo breeding units were unlikely to be able to mount such large-scale recovery programmes as were possible at the Yangprapakorn Farm or Ndumu Rearing Station. Another recommendation of the Group was that these two institutions should be replicated in South America as soon as possible, although Professor Medem's proposal for a C. intermedius breeding station had not yet received the hoped for support.

Meanwhile, one of the highest priorities was still the 1971 recommendation for the survey, capture and breeding in the Thailand and Zululand farms of Osteolaemus tetraspis and C. cataphractus, for which an application to W.W.F. for a \$7000 grant had already been made and was fully supported. It was also strongly recommended that Recommendation 6 of the 1971 meeting, urging Game Department involvement in rearing and re-stocking projects, should be followed up by letters to individual departments. Mr. Attwell was asked to draft suitable letters and furnish the necessary background information. The possibility of obtaining stocks from Ndumu should also be brought to the attention of suitable countries. In this connection approaches from Rhodesia and Uganda were reported, but it was felt that the latter country should be able to rely on its own stocks. Finally, a major NYZS project in Florida was noted, which hopefully should result in a crocodile survival centre in two years' time.

5. Other aspects of crocodile conservation and ecology

A number of other interesting papers and contributions were presented. The former covered:- some of the peculiar difficulties of conservation education in relation to crocodiles and the specialized techniques which were advocated or already being tried to overcome them; the important changes in the general crocodile conservation situation which is likely to come about when the international Convention to control trade in wild fauna and flora recently negotiated at Washington D.C. is ratified and brought into force (discussion of this item suggested that some modifications in the allocation of crocodile species to the Appendices of the Convention, providing for varying degrees of control, may in due course have to be recommended by the Group); and, thirdly, tied in

with the 'Scientific Day' of the meeting and a visit to St. Lucia Bay, a paper reviewing the current status and ecology of the very important C. niloticus population of the area.

Two other matters based on verbal contributions received attention. It was noted that the preparation of a policy statement on the crocodile hide industry was still not completed, but agreed that further efforts should now be made to obtain a consensus of the Group's views on the subject. Meanwhile, the Group had been specifically asked for their comments on the UNIDO crocodile tannery project in the Sudan. The general view was that considerably more consultation should take place before the project is implemented. Dr. King reported that the chief Sudanese delegate at the Convention negotiations had seemed genuinely interested in the conservation of the crocodile resources of his country and thought that a reasonable population of C. niloticus still existed, but also mentioned that there is a tremendous international trade in crocodile skins in the Sudan and it was estimated that 90 percent came from outside the country. In view of this and the obvious fact that a tannery in the Sudan is therefore unlikely to sustain itself from the crocodile resources inside the country, an essential prerequisite of the project, meriting careful consideration and any assistance which can be given by the Group, might well be the establishment of a crocodile farm.

The other topic discussed, based on a verbal report by Mr. Attwell, was the value to conservation of the capture of nuisance animals and their translocation. Such operations usually had a favourable reaction from the public and Press and they were now made relatively simple by the use of the drug flaxedil as an immobilisation agent, which had more or less eliminated casualties (see the report by Loveridge and Blake in Arnoldia 40(5) of Nov. 72).

Crocodile Specialists,
Second Meeting
Paper A.1.1

POPULATION STATUS SURVEYS OF THE AMERICAN ALLIGATOR IN THE SOUTHEASTERN UNITED STATES

Robert H. Chabreck
School of Forestry and Wildlife Management,
Louisiana State University, Baton Rouge, Louisiana 70803, U.S.A.

This survey was begun in 1971 with the idea of establishing a base line from which gross changes in the population status of the American alligator (Alligator mississippiensis) could be detected. The count is not randomized and the data collected cannot be used for comparing populations between states or counties within states. The main function of the survey will be to evaluate differences between years and, even then, comparisons can only be made in areas where observations have been repeated periodically and where the method of surveying has been standardized.

METHODS AND MATERIALS

The range of the American alligator includes all or parts of 8 states; consequently, the survey can only be made with the cooperative efforts of a large number of individuals. Personnel of the various State Game Departments and National Wildlife Refuges make most of the counts. University personnel, students and other interested persons also assist in the survey and provide input from key locations. The following is a general description of the guidelines developed for the survey:

Cooperative Alligator survey

A survey is planned to determine annual trends in the population of the American Alligator. Night counts will be made in selected areas and over predetermined survey lines.

The survey line should be about 10 miles long and in suitable alligator habitat. A detailed description of the survey line should be provided, so that effort can be easily duplicated by others in later years.

The count should be made during the dark of the moon and should begin about one hour after sunset. Alligators can

be classified while travelling along at a fairly rapid pace. However, the observer should adjust the speed to make certain that animals are not overlooked.

The number of alligators seen should be tabulated by one-foot size classes. The distance from the nose to the eye in inches provides a reliable estimate of the total length in feet.

One count of the survey line is to be scheduled each year, thus requiring only a few hours of time from each cooperator. Multiple counts will be made in a special study to determine the variation in the procedure.

The count should be made when the temperature is above 70°F and on any day from May to October. Counts in following years should be made on approximately the same date.

This survey was planned for developing an index to the alligator population in different parts of its range. Annual counts of alligators along the survey lines may be used as a means of determining population trends. The survey is not intended as a means of determining total numbers of alligators in any state or locality and information must be gathered for a period of years before any trend will be evident.

Since the survey will not be used to determine a total number of animals in a given area, random selection of lines is not essential. Survey lines should be established in the areas with suitable alligator habitat and preferably areas having alligator populations. It is not essential that alligators be found on the survey line.

Lines selected for counts should be on water bodies which are representative of the area, and will reflect annual changes in alligator population. Areas given intensive protection, such as areas on refuges (particularly those adjacent to refuge headquarters) will not reflect hunting pressure.

The areas selected for the survey should be in habitat conditions which will remain fairly unchanged year after year. Shallow water areas which may be dry at certain times should be avoided; also areas which may be blocked by vegetation, such as water hyacinth (Eichhornia crassipes), should not be used. The lines may be established on marshes, rivers, lakes or swamps, in fact counts in all habitat types (in relation to their abundance) would be ideal.

The main point about the survey is that the procedure used along a particular line be standardized. The exact route should be checked about the same time each year, using similar equipment and the same observer, if possible.

In addition to the areas surveyed in 1971, the counts were expanded in 1972 to include areas not previously

surveyed. As shown in Table 1, 93 lines were counted in 1972, an increase of 37 over the previous year. The total number of miles surveyed was increased from 773.85 in 1971 to 1023.8 in 1972. Many of the areas added in 1972 were on the outer edge of the alligators' range and will provide valuable information after a period of years.

RESULTS

The results of the 1972 survey are set out in Table 2. During 1972, 4,025 alligators were observed along the survey lines. Even though this was an increase from the 3,964 observed in 1971, the alligators per mile actually declined as a result of the additional survey routes. Many of the new survey routes were in areas on the margin of the alligators' range and contained low populations; hence, the lower average for 1972.

On a number of lines counted in 1971, less alligators were observed in 1972. Most cooperators attributed this decline to the abundant rainfall during 1972, which raised water levels in streams and lakes and caused alligators to disperse into backwater areas. On other lines a greater number was observed in 1972 than 1971. However, the observations should be continued over a period of years before any conclusions can be drawn from the surveys.

Table 1. Location and intensity of areas surveyed for alligator, 1972

State	No. Lines surveyed	No. Miles surveyed
Alabama	8	146.0
Arkansas	1	9.0
Florida	12	96.9
Georgia	6	52.0
Louisiana	32	281.6
Mississippi	3	31.0
South Carolina	10	131.8
Texas	21	275.5
TOTAL	93	1,023.8

Table 2. The number of alligators by size classes counted at night along selected water courses in 1972.

State	County or Parish	Date	Observer(s)	Dist. Surveyed (miles)	Size Class (ft.)			Allig./mile
					0-6'	6'- Ukn.		
Alabama	Choctaw	7/7	Osborn & McMullan	11.0	6	1	2	0.82
"	Mobile & Baldwin	5/25	Peters & Britton	31.0	198	21	24	7.84
"	Mobile & Baldwin	5/2	Peters & Britton	9.6	3	0	7	1.04
"	Mobile & Baldwin	6/5	Peters & Britton	19.4	98	5	33	7.01
"	Mobile & Baldwin	5/16	Peters & Britton	31.0	20	0	15	1.13
"	Mobile & Baldwin	6/8	Peters & Britton	31.0	137	11	9	4.42
Ala.-Ga.	Barbour & Stewart	8/15	Wise & Estes	10.0	2	2	1	0.50
"	"	8/22	Milton & Bowers	3.0	2	0	1	1.00
Arkansas	Hempstead	8/15	Sunderland & Carter	9.0	0	0	2	0.20
Florida	Broward	6/9	Schortemeyer	15.3	111	11	10	8.63
"	Citrus & Hernando	6/29	Grabill & Widner	12.0	127	7	0	11.17
"	Lee	9/1	LeBuff & Barber	8.8	20	1	1	2.50
"	Palm Beach	6/28	Martin & Doebel	7.0	119	78	75	38.86
"	Palm Beach	8/1	Martin & Doebel	13.0	232	110	103	34.23
"	Franklin	8/16	Vickery & Braswell	1.3	3	1	2	4.62
"	Franklin	8/15	Vickery & Braswell	1.5	6	1	0	4.67

Table 2 (continued)

State	County or Parish	Date	Observer(s)	Dist. Surveyed (miles)	Size Class			Allig./mile
					0-6'	6'-	Ukn.	
Florida	Wakulla	8/9	Gidden & Hagan & Bridges	10.0	81	47	21	14.90
"	Brevard	9/6	Bond & West	11.0	16	0	10	2.36
"	Brevard	9/6	Baker & Bennett	3.1	5	0	0	1.61
"	Brevard	8/30	West, Parish Baker, Fields	3.9	22	0	4	6.67
"	Volusia	7/7	Hoffmann & Carper	10.0	60	0	7	6.70
Georgia	McIntosh	8/8	Odum & Sires	10.0	7	0	0	0.70
"	McIntosh	8/10	Odum & Sires	10.0	9	0	0	0.90
"	Montgomery & Jeff Davis	8/7	Bearden & Clements	10.0	1	0	0	0.10
"	Catham	5/31	Hight	3.0	34	1	35	23.33
"	Ware	7/12	Metzen	8.0	71	23	54	18.50
"	McIntosh	8/26	Givens & Hagan	11.0	87	46	15	13.45
Louisiana	Concordia	8/31	Marshal & Linscum	4.1	0	0	0	0
"	Catahoula & La Salle	8/30	Emfinger & Tradwell	10.0	0	0	0	0
"	St. Charles	8/14	Callahan & Dares	10.0	90	15	0	10.5
"	Caddo	8/23	Smith, Martin & Menefee	10.0	8	8	0	1.6
"	Bossier	8/31	Smith & Martin	3.0	0	1	0	0.3
"	Red River & Bossier	8/28	Kimble & Taylor	7.0	0	0	0	0
"	Morehouse	8/16	Taylor & Riddle	5.0	1	0	0	0.2

Table 2 (continued)

State	County or Parish	Date	Observer(s)	Dist. Surveyed (miles)	Size Class (ft.)			Allig./ mile
					0-6'	6'-	Ukn.	
Louisiana	Ouachita	8/18	Taylor & Sanderson	5.0	0	0	0	0
"	Morehouse	8/17	Taylor & Sanderson	10.0	1	0	1	0.2
"	Ouachita	9/1	Taylor & Riddle	10.0	7	1	5	1.3
"	Iberia	5/1	Joanen & McNease	9.5	121	61	67	26.2
"	Cameron	7/31	Joanen & McNease	10.0	10	5	9	2.4
"	Cameron	8/1	Joanen & McNease	10.0	5	16	21	4.2
"	Calcasieu	8/6	Lowery	10.0	10	1	0	1.1
"	Calcasieu	8/10	Lowery	10.0	3	0	0	0.3
"	Cameron	8/14	Lowery	10.0	37	10	0	4.70
"	St. James	8/8	John & Moore	9.0	2	0	2	0.44
"	Jefferson	8/10	John & Moore	2.0	1	1	7	4.50
"	St. Bernard	8/17	John & Assavedo	9.0	0	0	2	0.22
"	Cameron	9/8	Walther & Blihovde	10.0	51	9	28	8.80
"	Cameron	7/12	Roberts	9.0	63	16	21	11.11
"	St. Tammany	6/24	Joanen	10.0	5	1	3	0.90
"	St. Tammany	7/29	Joanen	10.0	17	1	2	2.00
"	St. Tammany	8/7	Joanen	10.0	6	3	2	1.10
"	St. Tammany	8/30	Joanen	10.0	8	2	3	1.30
"	Rapides	8/11	Harrison & O'Neal	4.5	0	0	1	0.20
"	Rapides	8/4	Harrison & O'Neal	8.0	0	0	0	0

Table 2 (continued)

State	County or Parish	Date	Observer(s)	Dist. Surveyed (miles)	Size Class Allig./		
					0-6'	6'- Ukn.	mile
Louisiana	Natchitoches	8/14	Harrison & O'Neal	4.5	0	0	0
"	Assumption	8/13	Chabreck & Nichols	10.0	0	0	0
"	Avoyelles	8/7	Britt & Blackwell	21.0	11	1	26
"	Avoyelles	8/9	Britt & Blackwell	11.0	3	0	6
"	Plaquemines	6/12	Henson & Barte	10.0	5	3	2
Mississippi	Issaquenna	8/16	Chandler & Herring	9.0	0	1	1
"	Hancock	8/9	Chandler, Lewis & Cameron	10.0	12	3	6
"	Washington	8/10	Blihorde, Dale & Williams	12.0	3	4	3
South Carolina	Barnwell	9/7	Murphy & Marchinton	33.0	3	20	2
"	Berkeley	8/10	Taylor & Fountain	5.0	0	0	0
"	Clarendon	8/9	Strickland, Taylor & Fountain	5.0	4	0	0
"	Jasper	6/21	Hight, Hagan, Noseworthy	24.0	0	0	200
"	Charleston	6/30	Doshier & Oliveros	3.0	0	0	93
"	Charleston Colleton Dorchester	6/30	Bara & Crosby	16.7	2	0	0
"	Georgetown	7/19	Bara & Pluto	20.0	1	2	0
"	Georgetown	7/3	Bara & Barrineau	16.3	0	0	0
"	Beaufort	6/22	Bara & Moore	2.0	15	1	3
"	Berkley	7/13	Bara & Walker	6.8	31	0	12

Table 2 (continued)

State	County or Parish	Date	Observer(s)	Dist. Surveyed (miles)	Size Class (ft.)		Allig./mile	
					0-6'	6'-Ukn.		
Texas	Chambers	Sept.	Smith	12	17	1	30	4.00
"	Chambers	Sept.	Smith	8	5	1	1	0.88
"	Chambers	Sept.	Smith	10	29	19	8	5.60
"	Jefferson	Sept.	Smith	5	58	1	16	15.00
"	Jefferson	Sept.	Smith	5	0	0	87	17.40
"	Jefferson	Sept.	Smith	3.5	83	8	15	30.29
"	Liberty	Sept.	Smith	20	0	0	0	0
"	Chambers	Sept.	Smith	5	0	0	0	0
"	Orange	Sept.	Smith	30	0	0	0	0
"	San Jacinto	Sept.	Smith	8	2	0	2	0.50
"	Newton & Orange	Sept.	Smith	27	0	0	0	0
"	Orange	Sept.	Smith	10	4	1	3	0.80
"	Orange	Sept.	Smith	3.5	19	9	16	12.57
"	Brazoria	Sept.	Smith	25	1	0	2	0.12
"	Brazoria	Sept.	Smith	15	1	0	0	0.07
"	Brazoria	Sept.	Smith	15	0	0	0	0
"	Hardin	Sept.	Smith	20	4	3	0	0.35
"	Jasper	Sept.	Smith	11	0	0	2	0.18
"	Hardin	Sept.	Smith	8	0	0	1	0.13
"	Tyler	Sept.	Smith	26	2	1	3	0.23
"	Chambers	7/12	Bloom	8.5	20	16	12	5.6
"	Cameron & Hidalgo	5/22	Ryan	/	1	1	0	
"	Brazoria	8/28	Ivy	/	0	0	0	
"	Aransas	8/9	Ditto, Dunn, Fears & Giezentanner	/	4	2	1	
TOTAL				1023.8	2256	612	1157	

/ The survey technique is not applicable in these areas and a count was made at scattered water areas but distance surveyed could not be ascertained. Data not included in the totals.

Crocodile Specialists,
Second Meeting
Paper A.1.2

THE STATUS OF CROCODYLUS ACUTUS IN SOUTHERN FLORIDA

James Powell
1110 Kokomo Street, Plainview, Texas 79072, U.S.A.

ABSTRACT

In Florida, Crocodylus acutus is rapidly disappearing from unprotected areas, but making a slow comeback in the Everglades National Park. John Ogden, the Park naturalist, is currently conducting an intensive study of the species. There are plans to build up the crocodile population of the Park to its maximum natural level.

The total number of wild Crocodylus acutus in Florida today is estimated at less than 500 individuals. Over half of these, and 80% of the active nest sites, are believed to be located within the Everglades National Park. Outside the Park the crocodile populations are in a seemingly inexorable decline, primarily owing to habitat destruction resulting from an expanding human population, both on the mainland and in the Keys. Very few active nests remain in unprotected areas, and sightings in such areas have become infrequent.

Within the Everglades National Park the population, though small, seems for the moment relatively secure, and even increasing.

The present range of the American crocodile in southern Florida seems largely confined to an area of coastal mangroves approximately 22 miles long by 12 miles wide, extending from lower Biscayne Bay south and east around the tip of the peninsula to central Florida Bay. Most known nesting sites are concentrated along the northern shore of Florida Bay in an area approximately 10 miles long by 3 miles wide, and lying completely within the boundaries of the Everglades National Park. An isolated population may still occur in the Key Deer National Wildlife Refuge in the Lower Keys.

Accompanied by John Ogden, the Park naturalist, I visited all known crocodile nesting sites within the Park in August, 1972. These were as follows:-

Davis Creek: this site has had nesting through the '60's. Two marl nests, both presumably by the same 9-foot female. One nest was opened and found to contain 41 bad eggs. Old, collapsed den also at this site.

Mud Creek: one large marl nest. Active den further up the creek.

Alligator Point: one "sand" (actually, pulverized shell) nest, the scene of a successful hatching in late July, 1972. Clutch size - 74 eggs: 12 bad, the rest believed to have successfully hatched.

Madeira Point: one very large shell sand nest, 25 feet in diameter at the base.

Madeira Beach: also the scene of a successful hatching this year.

Taylor River: here we discovered two previously unknown nests, and a den. One of the nests had apparently had a recent successful hatching, as at least seven baby crocodiles were counted swimming nearby.

Black Betsy Key: this is now the only known nesting site among the islands of Florida Bay, all the previously mentioned sites being on the mainland. Formerly, nesting sites were concentrated on the islands. The recent shift to the mainland is a puzzle about which there are various theories. It may be related to real estate development on Key Largo, which has destroyed most of the fresh-water habitats which some students (e.g. Neill) believe necessary to juvenile C. acutus, and to which hatchlings from the islands may have migrated for this phase of their development.

Davis Creek and Mud Creek have been closed to public entry in order to prevent disturbance of nesting crocodiles by fishermen. Now that nesting has been confirmed for Taylor River, it will probably be closed, too.

The crocodiles of the lower Florida Keys are proving elusive. When I visited the Key Deer National Wildlife Refuge in August, 1972, Jack Watson, the Refuge Manager, said there were four nests on Little Pine Key, and that he estimated the total crocodile population of the Refuge at 12-20 individuals - a conservative estimate if all four nests are active. While Little Pine Key was believed to be the only island in the Refuge to have nests, crocodiles had also been observed on Howe, Johnson, Sugarloaf, and Big Pine Keys. On Friday night, 18 August 1972, a 7-foot (estimated) individual was allegedly observed in the boat basin at Refuge Headquarters.

Some time later John Ogden also visited the Key Deer Refuge and talked with Mr. Watson, receiving essentially the same account I did. Mr. Ogden then spent two full days on

Little Pine and Howe Keys, but without finding any nests, or any sign of crocodiles. He plans to return in March or April, 1973, when nest building should be underway and crocodiles most active on land.

Mr. Ogden, supported by the National Park Service, is currently conducting an in-depth study of C. acutus in Florida aimed at determining factors affecting nesting success, and to quantify habitat requirements of different age groups. Also involved is a rearing and restocking program similar to that now being carried out by Tony Pooley at Ndumu, South Africa. 1972 goals included: studies of behaviour of adult crocodiles at nest sites using motorized cameras; measurements of temperatures and moisture conditions in and near nests; and continued search for unknown nest sites. The camera study has been spectacularly successful in demonstrating the complex role of adults in preparing the nests, and in aiding the young from eggs and nests. Further camera studies are planned for 1973, as well as radio tracking of juvenile crocodiles to better determine habitat requirements. All in all, this is one of the most sophisticated and ambitious studies of crocodilian ecology in progress anywhere.

In the overall picture of crocodilian conservation, I consider the establishment of adequate sanctuaries second in importance only to abolishing the market for crocodilian products. Such sanctuaries should be adequate not only in degree of protection, but also in extent - i.e. they should embrace insofar as possible an entire ecosystem; and they should be established at as many points as possible throughout each species' range. In this connection, I discussed with John Ogden the possibility of making the Everglades National Park such a sanctuary for C. acutus. This would involve essentially building up the crocodile population of the Park to its maximum natural carrying capacity. Exactly what this capacity is is uncertain: almost certainly not less than 1,000 individuals, probably not over 2,000. Much will depend on whether the vast wilderness area of mangrove forest in the west, or Gulf Coast, section of the Park proves suitable for stocking. At the conclusion of his study, in approximately two years, John Ogden expects to know how many crocodiles the Park can support, and which areas are suitable habitat.

Mr. Ogden was enthusiastic over the sanctuary idea, and I strongly recommend its endorsement by IUCN. Admittedly, C. acutus in southern Florida is at the geographical periphery of its range, and refuges near a species' heartland are theoretically more ideal. However, I believe the advantages of political stability more than compensate. Ndumu in South Africa is near the southern limit of C. niloticus' range, yet today it is one of this crocodile's most secure strongholds. Poaching no longer seems a major problem in the Everglades National Park, but this satisfactory situation may quickly deteriorate should the present trend towards re-opening legal outlets in the U.S.A. for crocodilian products continue - a trend which I view with grave alarm.

Crocodile Specialists,
Second Meeting,
Section A.1.

NORTH AMERICAN REPORTS:
DISCUSSION

There was a consensus on the need for the elaboration and standardization of survey techniques: these can be refined during the course of a survey, but every effort must be made to maintain a basis for comparison throughout, and no substantial alteration of methods should be made during the course of a project. It was also agreed that long-term surveys are essential: two-year surveys are not long enough for any conclusions to be drawn, three years may reveal a trend, but the basic minimum if significant results are to be achieved was thought to be ten years.

Dr. Wayne King gave a verbal summary of an alternative system of censusing alligator populations, based on a paper by Thompson and Gidden (1972: J. Wildl. Mgmt. 4(36) pp. 1081-1088), which relies on the territorially-spaced basking habit of alligators along the banks of waterways. This system is estimated to give results of 90 percent reliability and, in general, it was noted that at least in some areas censuses carried out by day are more accurate than those undertaken at night.

Poaching of crocodilians was considered to be definitely on the decrease in North America, due to the better enforcement of Federal legislation, the threat of seizure by Federal authorities of poachers' records, and the absence of a commercial market. Some 140 cases of poaching were, however, currently being prosecuted in the Courts.

Attacks by alligators on human beings were briefly discussed: in fact only three confirmed attacks, none fatal, had been reported in the Press as having taken place in Florida in recent years. The reasons for such attacks were under investigation, but they could have been due to the defence of territories by males or of nests by females, assuming alligators had come to regard people as threats. There was no doubt that human activities in alligator habitats were tending to expand, so that there may inevitably be a greater risk of accidents, provided of course that the alligator population remains constant. The Group recognized the difficulty of explaining such attacks to the public, but the need to do so if accidents are to be avoided.

Concerning the range of C. acutus in Florida, Dr. King mentioned that in the 1800s an adult specimen had been killed as far north on the east coast as Volusia County on the Indian River. Within the past two years a single specimen had been sighted not much further south, near the Jupiter inlet. As for the reported population on Big Pine Key, he had personally sighted a specimen in 1959, in the saltmarsh mangrove zone of that island. The Group nevertheless recommended that the fullest support be given to the continuation of Mr. John Ogden's research on the species in the Everglades National Park and to the project for making use of the Park as a sanctuary for building up the stock to the maximum carrying capacity, which had been provisionally estimated at between 1000 and 2000 individuals of this species.

Crocodile Specialists,
Second Meeting
Paper A.2.1

CROCODILIANS OF CENTRAL AMERICA, INCLUDING MEXICO AND
THE WEST INDIES: DEVELOPMENTS SINCE 1971

James Powell
1110 Kakomo Street, Plainview, Texas 79072, U.S.A.

ABSTRACT

This paper summarizes, country by country, changes in the status of crocodilians in Central America (including Mexico and the West Indies) since the first working meeting of the Crocodile Specialists Group in New York in March, 1971. Lack of an entry for a country indicates I have no new data from that country. Repetition of information already contained in my 1971 paper (1) has been avoided.

Mexico

In May, 1972, I made the following field observations in northeastern Mexico:

Crocodiles, presumably the long-snouted northern form of Crocodylus moreletii, still occur sporadically in the rivers and lagoons in the vicinity of Ciudad Valles, in eastern San Luis Potosi state, but they are nowhere common enough to be an observable part of the fauna. Hunting guides very familiar with the countryside report sighting an adult about every six months.

At least one local plantation currently protects a small crocodile population in an artificial irrigation reservoir. On private property, they are relatively safe from poachers. There may be other similar semi-captive populations in the area.

A wild crocodile population, again presumably of the northern moreletii, apparently still exists somewhere in southern Tamaulipas, for the hide buyer in Ciudad Mante continues to receive hides of adult specimens. At the time of my visit I was shown a six-foot hornback, with fresh blood on it, which had been brought in only two days before. I was

also shown a tanned, ten-foot hornback brought in six months before. Attempts to obtain information on the location of this population were unsuccessful, as my informant became evasive and uncommunicative, and would only say that the area was very remote. In Mexico, a surviving crocodile population is a substantial financial resource, and its location is usually a carefully guarded secret.

It is probable that crocodiles still occur in the Soto la Marina River, Tamaulipas, immediately upstream from the town of Soto la Marina. During daytime observations on the river I did not see any specimens, and attempts to explore by night were thwarted by heavy rains. However, the local people were unanimous in their assertions that "alligators" still occurred upstream from the town. Downstream, the river widens into a brackish estuary, and crocodiles were said to become rare or non-existent. C. acutus might occur in these lower reaches, as well as in the saline lagoons around La Pesca. I had no opportunity to investigate these areas.

I have no direct data on how far up the Soto la Marina and its tributaries crocodilians may range today. Although commercial hunting no longer seems to be practised in this area, older residents with whom I talked could remember that in the 1930's, when crocodiles were still common enough to make hunting profitable, great "alligator hunts" often extended upriver to Padilla and Abasolo, near the 24th parallel.

Barring the unlikely eventuality that this Soto la Marina crocodilian population might prove to be the southernmost stand of Alligator mississippiensis, it probably represents the northernmost occurrence of a crocodile (moreletii?) on the Gulf Coast of Mexico.

Crocodile belly hides are now being locally made into belts, which are sold to tourists along the Pan-American Highway for 100 pesos (\$8.00 U.S.) each.

In the summer of 1972, Dr. Howard Campbell also conducted field studies of crocodilians in Mexico. The following is a brief summary of his findings, arranged by study area (2).

Pacific Coast: Mazatlán, Sinaloa and localities to the north and south.

The following areas were investigated: to the north of Mazatlán - Dimas, at the mouth of the Rio Piaxtla; La Cruz, near the mouth of the Rio Elota; along the coast to the north of La Cruz in the lagoons behind the Peninsula de Quevedo; the vicinity of El Dorado in the Rio San Lorenzo marshes; and the Bahía de Pabellón. No evidence was found of breeding populations of C. acutus in this region, though judging from local reports such populations probably existed until a few years ago and extermination has been recent. Occasional young adults may still exist as far north as El Dorado.

Study areas to the south of Mazatlán were: Laguna del Caimanero, surveyed both from El Waiamo at the relatively developed northern end, and from Agua Verde at the wilder southern end near the mouth of the Rio Baluarte; and the northern portion - between Agua Verde and Teacopán - of an extensive marsh and lagoon system extending south from Agua Verde to the vicinity of Tuxpan, Nayarit.

There is more evidence of crocodile populations in these areas than in those to the north, particularly between Agua Verde and Teacopán. There were reports of limited commercial hunting, and also of nests, though Dr. Campbell was unable to locate the latter.

An extensive area of prime crocodile habitat exists to the south of Teacopán in the vast mangrove regions known as the "Marismas Nacionales". Though not studied during this survey, the Marismas merit careful exploration.

Pacific Coast: vicinity of San Blas, Nayarit.

Crocodiles are more numerous here. Dr. Campbell personally counted eleven field sightings ranging in size from 18 inches to seven feet. The local attitude toward crocodiles seemed more positive. Even better crocodile populations were reported to the south of San Blas, between Playa Miramar and Las Varas in the marshes associated with the Rio Chila and in the upper reaches of the Rio Ameca upstream from Puerto Vallarta, but these were not confirmed in the field.

Atlantic drainage: Veracruz.

Field work in this area was made extremely difficult by heavy rains and flood waters. C. moreletii is scarce but probably present in the Rio Papalcapan near its headwaters in Oaxaca. Two subadult C. acutus, but no C. moreletii, were located in the Laguna de Alvarado. Five juvenile crocodiles of indeterminate species were observed during a three hour period in flooded pastures near Lerdo de Tejada.

Immediately prior to Dr. Campbell's visit to Lago de Catemaco, agents of the Mexican government had visited the area and confiscated adult specimens of C. moreletii held in captivity by a local merchant. This resulted in a hostile and uncommunicative attitude on the part of the local inhabitants. Two nests were reported, one said to be drowned by high water. Neither could be verified in the field. The local attitude toward crocodiles seemed positive - the reptiles were considered to be a tourist attraction. Most hunting pressure was said to be from tourists who illegally bribe boatmen to take them on shooting cruises on the lake.

Dr. Campbell spent a total of five days and six nights on the Rio Coatzacoalcos and its tributaries on the Isthmus

of Tehuantepec. In spite of very bad weather which resulted in difficult travel and poor visibility, a total of 23 crocodile sightings were obtained, all of specimens between one and two meters in length. Even allowing that some of these may represent duplicate sightings of the same animal, Dr. Campbell estimates that a minimum of six separate animals - and probably considerably more - were observed. It is possible that the high water levels resulted in a dispersal of the crocodiles, making them appear rarer than they actually are.

Jamaica

The estimate of 2,000 individuals as the total number of Crocodylus acutus in Jamaica should be considered as only approximate, as the statistical margin of error for the survey involved can be upwards of $\pm 1,000$. The proposed joint field study by the University of Florida and the Jamaican Government of the species' ecology has been abandoned indefinitely. The grant money has been returned to the funding organization(s) with apologies that it could not be used for the intended purpose. The present Jamaican Government does not seem interested in conserving crocodiles except as a renewable economic resource. Jamaica would appear to be one of the few exceptions to the world-wide rule that commercial hunting is the crocodiles' principal enemy. Here, habitat destruction may be a greater problem. Already crowded, Jamaica has a rapidly growing human population, and land reclamation projects on the island's south shore are steadily eroding the crocodile's range.

Traditionally, the range of C. acutus in Jamaica is confined to the south shore of the island, although there have been recent isolated reports from the north shore. As crocodiles are often exhibited in resort hotels, these reports probably represent released or escaped captives. It is still questionable whether there is an established breeding population in the north (3).

Cuba

Information from this country is difficult to obtain, but there would appear to be real doubt that Crocodylus rhombifer is receiving adequate protection in the crocodile sanctuary in the Zapata Swamp. Individuals of this species and C. acutus are crowded together into the corrales with no attempt to duplicate natural conditions. There is strong evidence that hybridization is occurring on a scale that threatens to absorb C. rhombifer.

A captive gene pool is at best a pitiful substitute for a wild population, and I do not ordinarily advocate captive

breeding projects. The function of the IUCN Survival Service Commission is - or should be - to save wild animals and plants. However, in view of the extreme urgency of this situation, i.e. the unusual interest of C. rhombifer as a species, and the presently pessimistic outlook for its survival in a wild state in its natural range, I believe a captive breeding population - preferably, multiple captive breeding populations - should be built up. From such populations it is hoped that it will eventually be possible to restock the species' natural range, should improving political conditions make this practical.

A few individuals of C. acutus are reported to still exist in a truly wild state in Cuba. I have no data on their exact locations.

Trinidad and Tobago

On page 78 in my 1971 paper, I erroneously stated that Caiman crocodilus crocodilus does not occur on Tobago. This species is found on the island.

References

- (1) James H. Powell, Jr., 1971. The status of crocodilians in the United States, Mexico, Central America and the West Indies. IUCN Publications new series, Supplementary Paper No. 32, pp. 72 - 82.
- (2) Dr. Howard Campbell, University of Florida, in litt.
- (3) Dr. Francis L. Rose, Texas Technological University, Lubbock, Texas, in litt.

Crocodile Specialists,
Second Meeting,
Section A.2.

CENTRAL AMERICAN REPORTS:
DISCUSSION

In view of the fact that Mexico still has crocodile populations but no crocodile sanctuaries, it was recommended that IUCN should press for the establishment of the latter. It would probably be wise to emphasize the possibility of long-term profitable use, since the enforcement of purely protective legislation was always likely to be difficult. The Group also considered that, if crocodiles were eventually to be commercially 'farmed', a 10-year re-stocking programme would be essential. Only in this way would a sound basis be provided for a crocodile products industry capable of playing a role in meeting potential demands of the already established and expanding tourist trade.

As to the presumably precarious status of the Cuban crocodile C. rhombifer to which the Paper had referred, it was generally agreed that at this stage the establishment of a sanctuary was not a practical solution. It might well involve problems of ecological consequences and other dangers, if translocation to areas outside the species' existing range were involved and too little is known of its precise habitat requirements, temperature tolerance etc. Instead, the less expensive suggestion of establishing captive breeding nuclei was endorsed, one at least of them, as Dr. Bustard pointed out, preferably and ideally in Cuba itself. However, as this might not be possible at the present time, the alternative of obtaining a few specimens from zoos, including the Havana Zoo, about which there seemed to be no difficulty, should certainly be explored, with a view to setting up one or more breeding units elsewhere.

Crocodile Specialists,
Second Meeting
Paper A.3.1.

SUMMARY OF THE SURVEYS OF THE STATUS OF CROCODILIAN
SPECIES IN SOUTH AMERICA UNDERTAKEN BY PROFESSOR F. MEDEM,
Instituto Roberto Franco, Apt. Aereo 2261,
Villavicencio (Meta), Colombia.

Presented by Dr. F. Wayne King,
New York Zoological Society, Bronx, N.Y. 10460, U.S.A.

SOUTH AMERICA (Venezuela, French Guiana, Guyana, Surinam,
Trinidad and Tobago, Ecuador and Peru)

Professor Medem's South America surveys to date have covered the above-mentioned countries. He will visit Brazil and the southern part of the continent during 1973 and 1974. During these trips Professor Medem contacts government officials in the various countries to gather information on conservation laws and hunting regulations, as well as statistics on the numbers of crocodilian hides tanned or exported. He also promotes the need for well-founded conservation programmes for crocodilians. He gets good newspaper coverage of his work in most countries.

Venezuela

The status of the true crocodiles is much grimmer than had been thought. Crocodylus acutus is completely absent from most of the area of its former distribution. Several small isolated populations and scattered individuals still exist. A captive-breeding programme is being established for the species. Crocodylus intermedius is in even more danger of extinction than C. acutus because of its restricted distribution in the Orinoco drainage. Although it is completely protected by law, there needs to be more vigorous enforcement of the law. Sanctuaries need to be established for the species. Caiman crocodilus crocodilus and C.c. fuscus are still relatively abundant. Neither is endangered in Venezuela. The status of both species of Paleosuchus is largely unknown because of their limited ecological distribution and near absence from the hide trade. All species of crocodilians are protected by a total ban on hunting.

Guyana

Caiman c. crocodilus is still abundant in most areas, but there has been a visible decline in numbers due to habitat change associated with the extensive development of rice fields. The species is not protected by law, but there is no large scale hide hunting. A few individuals are shot by sportsmen, and young are stuffed and sold as tourist curios. Melanosuchus was formerly abundant in the Rupunini district, but has been shot out by hunters from Boa Vista, Brazil. The species is slowly coming back under the provisions of a 5-year prohibition on commercial hunting. The species is still scarce and the protection should be continued indefinitely. Both species of Paleosuchus are scarce, but not endangered. They should be protected because of their limited ecological distributions.

Surinam

Caiman c. crocodilus is not protected by law, but no commercial hunting occurs. Occasional specimens are shot as vermin and for sale as tourist curios. The populations are as close to an untouched state as occurs anywhere today. For this reason Surinam would be an excellent site for studies on this species. The animal is abundant in most suitable habitat. Melanosuchus does not occur in the country, contrary to earlier reports in the literature. Both species of Paleosuchus are protected by an Ordinance passed in 1954 and amended in 1970. Neither are in danger of extinction. The government is amenable to proposals for the study of its crocodilians.

French Guiana

Caiman c. crocodilus is not in serious danger of extinction although the species is not protected by law. Specimens are shot for sale to tourists as stuffed curios, and to the local people for meat. Commercial hunting is non-existent at the present time. Melanosuchus occurs in small numbers in several river systems. It is protected by law, but enforcement is lacking. Poachers from Brazil shot out most specimens long ago. The species must be considered endangered even though small populations remain in some areas. Neither species of Paleosuchus is protected by law, but neither are they subject to hunting.

Trinidad and Tobago

Caiman c. crocodilus is protected by law in Trinidad but illegal hunting continues on a limited scale in some areas. The species is still abundant in the vicinity of the capital. A natural population occurs on Tobago, where it is not subject to any hide hunting. True crocodiles (genus Crocodylus) occasionally occur as waifs washed out of rivers on the mainland and cast up on the shores of Trinidad. These do not constitute a breeding population.

Ecuador

Six species and subspecies of crocodilians occur in Ecuador - Caiman c. crocodilus, C.c.chiapasius, Melanosuchus niger, Paleosuchus trigonatus, P. palpebrosus, and Crocodylus acutus. Of these, only Caiman c. chiapasius and Crocodylus acutus are seriously endangered. Eastern Ecuador is probably the only place in South America where the black caiman, Melanosuchus, is not on the verge of extinction. In 1972 the government put a total ban on the export of wildlife and its products. Ecuador is now the only South American country that protects all its animals, including fish.

Peru

Caiman c. crocodilus, Melanosuchus niger, and Crocodylus acutus are seriously threatened with extinction. A rapid decline in the numbers of hides exported each year documents the exhaustion of the Caiman c. crocodilus populations. Melanosuchus was formerly abundant throughout the entire region. Now it occurs in numbers only in the Rio Manu National Reservation. Hide statistics covering the last five years show a sharp decline in the black caiman populations. Crocodylus acutus still occurs in the Pacific coast drainages, but it must be considered endangered since the populations are small and all specimens are shot on sight as vermin. Paleosuchus trigonatus is rather abundant and not to be considered endangered. Paleosuchus palpebrosus is rare because of its ecological distribution, but it is not threatened with extinction. Total protection for the black caiman and American crocodile should be mandatory for a period of 15 to 20 years to give the populations a chance to recover. Sanctuaries need to be established for C. acutus as soon as possible. Wildlife laws are not rigorously enforced.

Crocodile Specialists,
Second Meeting,
Section A.3.

SOUTH AMERICAN REPORTS:
DISCUSSION

It was noted that Professor Medem had also carried out a survey in Colombia, but as yet no report was available. One of the biggest threats to crocodilians of the region was recognized to be the town of Leticia, which is completely exempt from many Colombian laws and regulations and unaffected by those of surrounding countries from which caimans, etc., are being smuggled. Dr. King stated that he had drawn the attention of the U.S. authorities to the fact that trade in baby caimans shipped from Colombia to the U.S.A. may be in violation of the U.S. Lacey Act. The export of caimans from Colombia had been reopened after a period of closure, although theoretically there is legislation banning the export of specimens less than 1.5 m. in length. The meeting recommended that efforts should continue to get more effective, properly enforced legislation enacted in Colombia, in particular prohibiting the export of baby caimans, and also to obtain fuller information on how the trade in crocodilians from Amazonian countries is actually being operated.

Crocodile Specialists,
Second Meeting
Paper A.4.1

CROCODILE STATUS REPORT FOR CERTAIN AFRICAN COUNTRIES
(1) PROVINCE OF NATAL, REPUBLIC OF SOUTH AFRICA

Anthony C. Pooley
Ndumu Game Reserve, P.O. Ndumu, Zululand, Natal, R.S.A.

Legal Status

Protected throughout the Province under the Reptiles Protection Ordinance no. 32 of 1968, commenced 24th April 1969, and now amended to include:

- 8a) No person shall import into the Province of Natal any crocodile or python, whether dead or alive, or the skin of any crocodile or python; without a written permit granted by the Board with the prior approval of the Administrator.
- 13c) Any officer may inspect and examine any weapon, trap, vehicle or other article or thing reasonably suspected of having been used or being used for any purpose in contravention of any provision of this Ordinance; and take possession of same.

Conservation Measures

Several important improvements have been made at the Experimental Crocodile Restocking Station. A new pumphouse was built to house an engine and pump capable of producing 6000 gallons per hour and an additional reservoir of 45000 gallons capacity was built. A network of two-inch diameter pipes was installed so that a constant trickle system operates to the thirty ponds and dams in use.

An office/display building is under construction at the farm entrance primarily for housing educational exhibits dealing with all aspects of crocodile biology, conservation and research, and to provide an interpretive service for the increasing number of visitors.

To date, 860 crocodiles have been released from the project all reared from artificially incubated eggs, most of which would have been flooded, anyway, if not collected.

Routine weekly counts are carried out to monitor populations in the Ndumu Game Reserve and aerial counts using both helicopters and fixed-wing aircraft have been undertaken over the past two years. Aerial photography has proved to be a useful method of census where crocodiles occur in concentrations.

An experimental breeding pen was established in June 1972, and although one nest was excavated, the eggs proved to be infertile.

Various methods of capturing crocodiles have been tested and eight problem adult crocodiles were caught and brought back to Ndumu during the past year.

There was a marked increase in the demand for crocodile eggs, embryo specimens, as well as both living and dead crocodiles, from schools, universities, medical institutions, museums and zoos -- for teaching, research or display purposes. Whereas in the past, crocodilian material was supplied free of charge, the increased demand has decided the Natal Parks Board to soon introduce a scale of charges for such material.

Publicity

Three film units have worked at the farm gathering material for educational films and television programmes. A small viewing hide has been constructed to allow close-up filming of adult crocodiles and has proved to be popular.

A conservation display was exhibited at the annual Zululand Agricultural Show in June 1972. A large aquarium containing juveniles and a selection of aquatic insects upon which they prey was particularly popular. The exhibit won a special award in the conservation section.

Habitat

Conditions at Lake St. Lucia have improved over the past two years although the Lake has not yet fully recovered from the effects of high salinization experienced in 1970.

STATUS REPORT (2) SENEGAL

Total protection for crocodiles was introduced on 23rd February 1973. Two species, C. niloticus and C. cataphractus occur (see Crocodiles, IUCN Suppl. Paper no. 33, January 1972, p. 45, 46).

STATUS REPORT (3) TOGO

ns. The sale of live animals continues and one dealer living 800 km north of Lomé sells both C. niloticus and C. cataphractus.

STATUS REPORT (4) SWAZILAND

Hunting still continues to take place freely and the local press showed photographs and reported an interview with a local hunter who had shot 141 crocodiles in the Usutu River, during the past few years.

STATUS REPORT (5) REPUBLIC OF MALI

(N.b. No report on this country was included in IUCN Supplementary Paper No. 33 of 1971)

(a) C. niloticus

Legal Status

Protected in the National Park and in Nature Reserves, and partially protected in classified Forestry Areas by the Hunting Code, contained in Ordinance no. 60/CMLN of November 11, 1969.

Established professional hunters may trap crocodiles throughout the country (except in classified areas). A permit enables each hunter to kill three animals a year and is issued, upon payment of a fee, by the Department of Forestry and Water Affairs.

Conservation Measures

Introduction of permits to reduce the rate of exploitation.

Reasons for Decline

Killed for belly skins, particularly by peoples of the Bozos and Somonos tribes; and because prior to introduction of a permit system in 1969, crocodiles were not protected in any way. Also there was a great market demand for hides which encouraged hunting.

It is considered that the number of crocodiles has decreased even in crocodile reserves, and without the partial protection now in force, the species would soon be exterminated.

Condition of Habitat

Suitable crocodile habitats have deteriorated due to cutting down of indigenous forest, mainly along the river banks and margins of swamp areas, for the purpose of establishing fields (mainly rice). Erosion too has been severe.

Remarks

No information is available on populations, breeding success, or animals held in captivity.

(b) Crocodylus cataphractus

According to Mr. Makono Sangare (1971), this species also occurs in the Republic of Mali, is subject to the same measures of protection, and is similarly threatened by hunting and habitat destruction, as C. niloticus.

REFERENCES

Mr. Makono Sangare (1971). In litt. Ministère de la Production, Service des Eaux et Forêts, République du Mali, ref. 0609 dated 12 April.

1
ted.
Crocodile Specialists,
Second Meeting,
Paper A.4.2

CROCODILE STATUS REPORT FOR RHODESIA

vere.
R.I.G. Attwell
Department of National Parks and Wildlife Management,
P.O. Box 8365, Causeway, Salisbury, Rhodesia.

The following in part revises and adds to the information contained in the first status report on Crocodiles in Rhodesia (IUCN Supplementary Paper no. 33, pages 42-44, 1972), and should be read in conjunction with the earlier report.

Attention is drawn to the Group's 1971 Proceedings in IUCN Supplementary Paper No. 32 (1971, pages 29-30, Annex - Recommendations): Rhodesia had already adopted Recommendation No. 6, before the 1971 Meeting, and will apply Recommendation No. 7 should the situation arise in Rhodesia. Of the remainder of the Recommendations, none have application to the present Rhodesian situation, but Nos. 3 and 4 will be borne in mind.

Legal Status

In addition to being scheduled under the Wild Life Conservation Act, Crocodylus niloticus, which is the only species that occurs in the country, receives complete protection in all National Parks under the National Parks Act of 1964, as well as in the Game Reserves. No hunting of the species is permitted in the Controlled Hunting Areas, but it is allowed on private lands and other areas on payment of fees, as stated in the earlier report.

Conservation Measures

The Department of National Parks and Wildlife Management has limited the number of commercial crocodile rearing stations to three. No more will be permitted until such time as the viability of such types of commercial enterprise can be demonstrated, and the biological effects of egg collection (not from National Parks or Game Reserves) on wild populations can be assessed.

At present, young equivalent to 5% (not 10% as previously required) of the eggs collected are handed over to the Department for release in suitable areas (not necessarily

areas from which eggs are collected) after a period of three years. In order to overcome transport problems which would arise if larger specimens were removed, only crocodiles approximately one metre in length, the expected length after three years, are accepted. Due to rapid growth some three-year olds have proved too large and two-year olds have been taken instead.

There is no evidence for the 'normal' survival rate of 2-5% in the wild quoted in the 1972 report. To date more than 300 have been released into the wild (St. Lucia Lake) out of the 860, in all, distributed to game reserves and private game ranches.

The Department is prepared to consider applications from appropriate departments in other African countries for young crocodiles for re-stocking purposes and conservation of the species.

Condition of Habitat

There are indications that whereas a reduction in the range of the species in the country overall is occurring, there has been some increase of its numbers in certain areas. Lake Kariba (5250 sq.km) has offered a vast shoreline, albeit much of it unsuitable for the crocodile, since the damming of the Zambezi River in December, 1958. The species, previously grossly over-hunted in the sector of the Zambezi now under the waters of the Lake, shows welcome signs of recovery along some shorelines and in some river systems feeding the lake.

The terrorist campaign against Rhodesia is undoubtedly having direct and indirect effects on the conservation of crocodiles on the northern Zambezi River and Lake Kariba boundary (see also paragraph 3 of section "Reasons for Decline" in the earlier report).

Generally, with the tremendous increase in human population, the hours of crocodile/human contact are increasing rapidly, with obvious consequences. In part, this problem is being met by translocation operations whereby problem animals are placed in suitable areas rather than destroyed.

Remarks

Two of the three permitted crocodile rearing stations are on Lake Kariba, the third on the Zambezi River near Victoria Falls (see above under Conservation Measures). There are no crocodile farms (in terms of the Group's definition) but as explained above, the commercial rearing stations serve at the same time the purpose of restocking stations. Disease problems have been almost completely overcome, and hatching

success is very high - over 90% in some cases. Egg collection is at present restricted to an overall figure of 7000 per annum, but in 1972 only 4321 were collected: this was due more to lack of space for additional numbers at the rearing stations rather than to inability to find the permitted number of eggs. Sanctions against the country have made overseas sales of skins difficult, and there was initially an embargo imposed on the export of untanned skins. Since the local tanning of crocodile skins has not been up to overseas standard, the embargo has been withdrawn. In 1972, a total of 589 animals was harvested by the three rearing stations.

In addition to research being carried out by the University of Rhodesia (reference (1) below), investigation into breeding behaviour and reproduction is being carried out at Kyle National Park on a captive group of animals. Population surveys are conducted on a regular basis in some of the better-stocked wild areas, but at this state of knowledge no purpose would be served by attempting to guess the possible overall population in the country.

Lectures to schools, radio and television talks, are given in an attempt to improve the species' image and to emphasise its importance in ecosystems.

REFERENCES

The following documents were handed out to Group members for their information:

- (1) Crocodile Research at the University of Rhodesia.
- (2) Techniques in the Immobilisation and Handling of the Nile Crocodile, Crocodylus niloticus, by J.P. Loveridge and D.K. Blake. Arnoldia 40(5), November 1972.
- (3) Conditions for keeping Crocodiles.
- (4) Specimen permit form with terms and conditions for egg collecting, etc.

Crocodile Specialists,
Second Meeting,
Section A.4.

AFRICAN REPORTS:
DISCUSSION

Among the problems of areas covered by Mr. Pooley's report, the threat to Lake Mkuzi in Natal, a main crocodile breeding ground, arising from the immigration of Bantu fishermen and consequential disturbance, received attention. It was recommended that every effort be made to get the lake set aside as a protected area, and that this possibility should be brought up at the next meeting of the Southern African Regional Commission for the Conservation and Utilisation of the Soil (SARCCUS), due to be held in Angola in September 1973, the Group meanwhile providing any information and assistance within their power for the purpose of securing better protection.

Concern was expressed at the continuing uncontrolled hunting in Swaziland referred to in the report and confirmed from other sources and it was agreed that this matter also might be brought up by Mr. Attwell in the appropriate committee of the SARCCUS meeting in 1973. It was noted that Swaziland was one of three countries in the region which had been urged by IUCN and others to introduce and enforce protective legislation and that assurances had been received from the Swaziland Ministry of Agriculture, but little improvement had been reported. It was agreed that further efforts, coordinated by IUCN, should be made by appropriate Group members to discuss the situation with the Swazi authorities.

The Group noted with appreciation the information that had been made available by Mali, but felt that the usual number of permits issued was still much too high in view of what was known about the precarious status of crocodiles in the country. It was recommended that the matter should be taken up by IUCN with the Mali Government.

Finally, there was considerable discussion of Zambian problems, which had not been covered by the Reports. These arose in connection with a request received through Mr. Pooley, for the advice of the Group in the establishment of crocodile farming in Zambia. It seemed clear that this was specifically for commercial purposes and not with a view to restocking or conservation, about which the Zambian Government had indicated that it had no worries, though in fact too little is known of the status of crocodiles in the country. Varying views were expressed on the issue, but it was finally agreed that provided advice can somehow be effectively tied to long term conservation of Zambian crocodile resources (the authorities there did not yet seem to be fully aware of, or appreciate, the significance of the fact that some sections of the Luangwa River support one of the best crocodile populations in Africa), it should be given. Recommendations were made accordingly.

Crocodile Specialists,
Second Meeting,
Paper A.5.1.

CONSERVATION REVIEW - AUSTRALIA

H. Robert Bustard
Australian National University, P.O. Box 475, Canberra City,
A.C.T. 2601, Australia.

NATIONAL SITUATION

(1) General

There are two species of crocodilians in Australia - freshwater crocodiles (Crocodylus johnsoni) and saltwater crocodiles (Crocodylus porosus). There appears to have been little change in the status of either species over the last two years.

(2) Exploitation

Exploitation is only legal in Queensland, where both species may be taken at any time. No seasonal or size limit restrictions apply. The Federal Government prohibited the export of crocodile skins or any products made from crocodiles in December, 1972, the only exception being for skins from licensed crocodile farms.

(3) Conservation

Both species are totally protected in Western Australia at all times (freshwater since November, 1962 and saltwater since January 1, 1970). The Northern Territory now also protects both species (freshwater from January 1, 1963 and saltwater from 1972).

Recent discussions with the relevant authorities in Queensland do not hold out much hope of crocodile conservation being implemented in the State in the foreseeable future. This is most unfortunate as Queensland is providing a loophole whereby skins poached from Western Australia and the Northern Territory can be smuggled across the lightly populated North and legally sold in Queensland. However, the Federal action has largely stopped this and the last remaining Australian

skin buyers (located in Cairns, North Queensland) have gone out of business. The only action at present, which is not currently considered serious, is the taking of baby crocodiles for the curio market. The crocodiles taken are almost all Crocodylus johnsoni as Crocodylus porosus is no longer numerous enough to collect juveniles in any numbers.

(4) Research

Research is now being carried out on a substantial scale by our own Group and by Professor Messel's Telemetry Group of the Physics Foundation at the University of Sydney. Professor Messel is working in Northern Territory and we are working in northern Queensland.

NATIONAL REQUIREMENTS

(1) Research

The above programmes should, in time, provide a sound basis for a thorough understanding of crocodile biology.

(2) Conservation

(a) National Parks

Australia's first National Park specifically for a crocodile species has just been declared in Western Australia (May, 1973). The National Park (the term 'Fauna Sanctuary' is used in Western Australia) comprises 59,000 acres situated on the Ord River near Wyndham. This is an important area for the saltwater crocodile and is the area which I recommended be reserved during my 1969 survey. The Government of Western Australia continues to treat crocodile conservation as a serious matter.

(b) Poaching

The recent Federal legislation banning the export of skins has had a marked effect. It would appear that poaching has now virtually ceased. The stuffed curio market is a rather difficult one to stamp out, although the number of freshwater crocodiles currently being used is probably not significant from the conservation viewpoint. Protection for the crocodile, as happened in the Northern Territory, merely doubles the price of the artefact. Queensland is the current major outlet but the juvenile freshwater crocodiles are coming from as far away as Western Australia. While there would be no conservation reason against curios being made from farmed crocodiles

(eggs laid by a captive breeding herd), I am totally opposed to the taking of any wild crocodiles for this purpose and I believe this is a matter in which IUCN should intervene by making appropriate representations to the Queensland Government with a view to stopping the practice.

One of our research projects consists of the production of a pamphlet for H.M. Customs to indicate from which state the crocodiles come, so that the illegal majority can be confiscated. Geographical variation in Crocodylus johnsoni is such that it is possible to do this with at least 90% accuracy. Clearly, there are fringe areas on the State borders where one cannot give a definite opinion. The Crocodile Group should recommend that a cordial letter be sent to Australia's Attorney-General, Senator Lionel Murphy, applauding his actions on behalf of the Federal Government and expressing the hope that it will be maintained against any opposition which may arise from former crocodile skin traders.

THE FUTURE

The lack of commercial exploitation of wild crocodilians will greatly help the hard-pressed saltwater populations today. However, in the mid-term, failure to commercialise these crocodiles - as through farming - will result, in Australia, in an irretrievable loss of habitat. Crocodilian wetlands in northern Australia are threatened. Large viable crocodile reserves will not be implemented and maintained against outside interests in a region where there are no large viewable game animals. In Australia, the best arguments for crocodile reserves are their market value. It is for this reason that we have pioneered crocodile farming, but it is still at a research level and not expected to be commercial for many years. If it is ultimately found practical to farm on a substantial scale, it could ensure that large areas of habitat are taken up for free-range farming in which crocodiles will be living in completely natural conditions and huge populations will be guaranteed for all time. Given this, crocodile populations will be "cropped", in accordance with IUCN philosophy, and not "mined".

Crocodile Specialists,
Second Meeting,
Paper A.5.2

RECENT DEVELOPMENTS IN PAPUA NEW GUINEA

M.C. Downes
Department of Agriculture, Stock and Fisheries, P.O. Box 2417,
Konedobu, Papua New Guinea.

A previous paper outlined the status and distribution of the two crocodiles, Crocodylus porosus and C. novaeguineae, found in Papua New Guinea - Downes (1971a).

This summary should be read in conjunction also with Paper No. B.3, page 67 of these Proceedings.

The main developments since the last meeting in 1971 are:-

- (a) Continued high flood conditions over the hunting grounds during 1971 and early 1972, with consequent low harvest of skins.
- (b) A severe drought from April to December, 1972, with a greatly increased skin harvest.
- (c) A gradual increase of price paid for skins from the severe slump in late 1970, until current prices (March 1973) are the same or slightly higher than the previous high in 1970.
- (d) Re-entry of expatriate traders into the business of skin buying when the prices are good and skins plentiful. When skins are not plentiful the buying service provided to hunters is very poor or non-existent.
- (e) Considerable dissatisfaction among the hunters, who are entirely indigenous, at the prices for skins in the hunting areas, compared with export prices received by traders at the coast.
- (f) There was no change in the legislative background nor the regulations controlling the skin harvest and outlined in the previous paper, Downes (1971b).

REFERENCES

- Downes, M.C. (1971a) - "Regional Situation Report - Papua New Guinea". IUCN Publ. (N.S.) Suppl. Paper 32: 41-43.
- Downes, M.C. (1971b) - "Management of the Crocodile Industry in Papua New Guinea". IUCN Publ. (N.S.) Suppl. Paper 32: 131-136.

Crocodile Specialists,
Second Meeting.
Section A.5

AUSTRALASIAN AND OCEANIA REPORTS:
DISCUSSION

17, Dr. Bustard emphasized that although there had been little change in the status of the crocodiles of this region, since the previous meeting of the Group in 1971, the legal situation had undergone a major change, following the banning in December 1972 by the Federal Government of the export from Australia of crocodilian skins and other products. Crocodile skin tanning facilities have closed down and skins have consequently become unsaleable. However, there is still a curio market for small stuffed crocodiles, which, as a result of the scarcity of C. porosus, relies almost entirely on specimens of C. johnsoni. In view of the low figures reported of the breeding population of the latter species (e.g. only 5 nests found along one suitable 50-mile stretch of river), representations to the Queensland authorities about imposing stricter control were recommended.

Some figures supplied by Professor H. Messel in discussions with Dr. King at Washington D.C. were put on record. Five out of six of the skins exported from Queensland were said to have originated outside that State; total Australian exports had dropped from about 41,000 skins in 1969 to 5,895 in 1972; the total surviving population of the saltwater or estuarine crocodile C. porosus was estimated at not more than 5,000. However, the view was expressed that a 'guestimate', such as the last figure, which it would be very difficult to check, had very little value.

Crocodile Specialists,
Second Meeting,
Paper A.6.1

REGIONAL SITUATION REPORT: ASIA

René E. Honegger
Curator of Herpetology, Zürich Zoo, Zürichbergstrasse 221,
8044, Zürich, Switzerland.

During January 1973 the Madras Snake Park and Conservation Centre, Madras, India mailed out about 200 crocodile investigation cards to zoologists and government officers. Only 12 answers on the status of the Indian crocodilian species were received. They merely went to show that all three species, Crocodylus palustris, Crocodylus porosus and Gavialis gangeticus, are endangered. It was also clear that there is so far little local interest in their biology or about their status. The following is an extract of a letter by Romulus Whittaker, Hon. Director of Madras Snake Park and Conservation Centre, Madras:

"There has been a rapid decline in the populations of the three Indian crocodilians throughout their respective ranges in the last ten years.

"Gavialis gangeticus has never been described as 'common' within its Indian range. Crocodylus porosus formerly had a wide distribution (mostly on India's eastern coast) but has not been reported as 'common' in the last fifty years. Crocodylus palustris was common in some localities as little as 25 years ago but it is now to be considered rare throughout its range in India.

"Indian crocodiles are killed by commercial hunters, tribals, fishermen, 'sporting' hunters and in general anyone who finds one and has the necessary facilities. Crocodilian skins are tanned locally. Since there is no widely effective law controlling local sale of the skin and articles made from it, even government tanneries are known to process the skins. The tanning centres are: Agra, Kanpur and Calcutta in North India, and Madras and Mysore in the South.

"The export of crocodile skins has been banned by Central Government Law since 1967 and by various states earlier than that. However, there is no local ban on sale of skins and articles and this loophole has kept the poacher-agent-tourist relationship flourishing. The situation is similar to that in Thailand: in a country where the per capita

income is less than \$100 (US) per year there is very little chance of curbing killing of crocodiles for their very high-priced hides, except by stopping the demand. Though the killing and export of crocodiles has been banned since 1967, killing and utilisation has continued (on a much smaller but still critical scale) because of the profits involved. There is a lack of sufficient protection (or even interest) by state authorities; and the crocodile is an unpopular animal, with a bad (though mostly unjustified) reputation. This points to the need for a bit of pro-crocodilian propaganda. Where previously religious sentiment had given crocodilians a measure of protection, this is no longer so.

"On September 11, 1972, the wild Animals Protection Bill was passed by Parliament in New Delhi. Enforcement of this new bill is one of the answers to the problem of the continued sale and use of protected animal skins, provided every state in India ratifies it.

Suitable areas for crocodile reserves

"The biotopic requirements of C. palustris are simple; crocodiles may not seem aesthetically beautiful nor active, yet they are popular 'big game' animals for the tourist. Almost all the existing game sanctuaries in India have perennial water and probably suitable habitat for C. palustris, the 'mugger'.

"Some reservoirs where C. palustris still occur are:

- (a) Krishnarajasagar Dam, Mysore
- (b) Tulsi, Vihar and Pawai lakes, Bombay
- (c) Chidambaram Waterworks, Tamilnadu
- (d) Mettur Dam, Salem District, Tamilnadu
- (e) Sirsi Reservoir, Uttar Pradesh
- (f) Serathi Reservoir, Uttar Pradesh
- (g) Veeranam Lake, Tamilnadu
- (h) Srisaillam Project, Andhra Pradesh
- (i) Pechiperai Dam, Tamilnadu
- (j) Ajwa Tank, Baroda, Gujerat
- (k) Nagarjunasagar, Andhra Pradesh
- (l) Nizamsagar Lake, Andhra Pradesh
- (m) Chambal Kotā Barrage Reservoir, Kota, Rajasthan.

"Crocodylus porosus still definitely occurs in three localities in India; Bhitarkanika Islands in Orissa, the Sunderbans in West Bengal and the Andaman Islands.

"Gavialis gangeticus is mainly a river-dwelling species and it is next to impossible to restrict their movements. River systems that run through sanctuaries that could, or already do support gharials are:

Ramganga River, Corbett National Park, Uttar Pradesh
Brahmaputra River, Kaziranga, Assam. "

An emergency project has been proposed for Gavialis gangeticus by Romulus Whittaker, of Madras Snake Park, and J.C. Daniel, of Bombay Natural History Museum. First a general survey is planned, to be immediately followed by population and ecological studies to establish specific reserves. It is to be hoped that World Wildlife Fund (India) will fund this first Indian crocodile project to the extent of Rs. 3000. Another project under consideration is for the collection of eggs of all three Indian species from the remaining wild nesting sites for hatching and rearing and restocking, and later for establishing breeding groups and restocking. The Gavial is the only Indian crocodile which has never been bred in captivity; its reproductive biology is almost unknown. World Wildlife Fund (India) has also made a grant to Mr. J. Daniel, of Bombay Natural History Society, for a feasibility study of a sanctuary project for Crocodylus porosus on the Vitarkhanika (Bhitarkanika) Island, off the Orissa coast (1). The Madras Snake Park and Conservation Centre, Madras has recently started a campaign to save the Indian crocodiles, appealing especially to tanneries, taxidermists and dealers in reptile skins, not to deal in crocodile skins until adequate surveys have been made (1). The FAO Crocodile Farming Project in India is now off the ground. The head of the Wildlife Division of FAO has contacted IUCN about obtaining expert advice (2).

PORTUGUESE TIMOR:

"Although crocodiles (Crocodylus porosus) (called 'Jacare' or 'Crocodilo' locally) do not seem to have ever been abundant in Portuguese Timor, it would appear from all indications that they are much less common than formerly.

"Investigation revealed that nowadays they are only occasional visitors to the whole North coast of the Portuguese section of the island, including the island of Atauro. In any case, they could never have been common on the North coast because there are few areas suitable to their needs. This is particularly true of virtually the whole coastline between Baucau and Liquiça. I was not able to visit the Northern coastal areas east of Baucau, but I heard from several sources that crocodiles are still sometimes seen along the coast at a place about 40 miles east of Baucau, in the vicinity of Laivai.

"The situation seems somewhat brighter on the south coast. The habitat here is more favourable to the Saurians as the climate is wetter, thus giving rise to more permanent water-courses and allowing, according to the dictates of the terrain, the formation of permanent swamps or small lakes on the coastal plain.

"As noted previously, crocodiles have been seen in the coastal sections of both the Tilomar and Lore Reserves, but it is doubtful if they breed there with any frequency.

"However, they do still breed on the south-east coast between the Lore Reserve and Jaco Island (sometimes going considerable distances up river) and also on the central south coast at a place called Fatu Berliu, south of Betano. The two areas seem to be the last strongholds of estuarine crocodiles in Portuguese Timor and steps should be taken to ensure that they survive in the province." (3)

WEST MALAYSIA:

"By continued hunting pressure the numbers of estuarine crocodiles (Crocodylus porosus) and the false gharial (Tomistoma schlegelii) have been reduced to the point where it is feared that the wild populations stand little chance of recovery because those of breeding size are being exterminated. Exports of undressed crocodile skins in West Malaysia fell from 312,865 lbs. in 1953 to 1,386 lbs. in 1968! These figures undoubtedly include the re-export of some skins imported from neighbouring countries, but imports therefrom also show a decline from 272,467 lbs. in 1953 to 44 lbs. in 1969, indicating a similar reduction in numbers in surrounding territories. With local supplies of crocodiles virtually non-existent, crocodile farms in Malaysia and Singapore now acquire their supplies of small crocodiles from as far away as West Irian.

"It would seem expedient to establish as quickly as possible captive breeding units within the country. Whilst the estuarine crocodile has been successfully bred in captivity by Yangprapakorn in Bangkok - and it should be a relatively simple process to duplicate this -, the false gharial has yet to be bred in captivity. West Malaysia is the centre of this species' range and the initiation of a captive breeding programme both for this and the estuarine crocodile could well lead to an eventual restocking of protected areas. The National Zoo in Kuala Lumpur would be the obvious choice for the location of such a project." (4)

West Malaysia: Tasek Bera:

"A national monument is proposed that would include an area of 63 square miles, mostly wetland. ... The water

harbours the (false) gharial crocodile Tomistoma schlegelii and many amphibians." (5)

REFERENCES:

- (1) Whittaker, R. In litt. 4 March 1973.
- (2) Crocodile Group Newsletter, No. 2, 1971.
- (3) Waterhouse, D. 1973. Status and Protection of Wildlife in Portuguese Timor. Manuscript.
- (4) Scriven, K. 1972. Conservation in West Malaysia, in World Wildlife, Yearbook 1971-72: 275-281.
- (5) Weber, B. 1972. A National Parks System for West Malaysia. Oryx XI, 6: 463.

Crocodile Specialists,
Second Meeting,
paper A.6.2

EXTERNAL TRADE STATISTICS FOR UNDRESSED CROCODILE SKINS
FROM MALAYSIA-SINGAPORE - A CORRECTION

F. Wayne King
Curator of Herpetology, New York Zoological Society, Bronx,
N.Y. 10460, U.S.A.

While gathering data on the international trade in crocodile hides, I inadvertently discovered that West Malaysia trade statistics published earlier (P. Wycherley, 1971, External trade statistics of West Malaysia for undressed crocodile skins. In Crocodiles. IUCN Publ. New Ser., Suppl. Pap. No. 32, pp. 51-53) were confused with data from Singapore.

Mr. Bullock, President of the Malayan Nature Society, has indicated (in litt.) that Wycherley's report "..... was apparently derived from the ... trade figures for W. Malaysia only from 1960 onwards, while the figures for 1953-59 were for Singapore and [Malaysia] ... After 1965, consolidated trade figures ceased to be published."

Corrected combined figures are shown in Table 1. Although there is no drastic decline in the number of hides traded during the years indicated, this does not mean the crocodiles remained as abundant as ever. There is no indication of where hides were being imported from. It is entirely possible that imports were coming from ever more remote areas as one population after another was over-exploited. This is suggested when the combined statistics for Singapore-Malaysia are compared with the figures for Malaysia alone after 1960 (Table 2). Exports from Malaysia have declined as the imports into that country have dwindled to nearly zero.

Mr. Bullock states that " ... the continued high production of skins does not indicate abundance of Crocodylus porosus in Malaysia. In W. Malaysia, C. porosus is definitely uncommon and the species appears to be declining. Regarding Tomistoma schlegelii, this species was never very abundant in W. Malaysia although it could be readily seen on the Tasek Bera a few years ago. I understand that its numbers have dwindled there, and it is never seen now."

The weight of the hides exported is greater than the weight of imports because many young crocodiles are imported

and reared to commercial size before being skinned. A number of these rearing stations are in operation in Singapore and Malaysia.

TABLE 1. Combined Singapore-Malaysia trade statistics for undressed crocodile hides. Combined figures were no longer issued after 1965.

<u>Year</u>	<u>Exports</u>		<u>Imports</u>	
	<u>lb.</u>	<u>£(Malayan)</u>	<u>lb.</u>	<u>£(Malayan)</u>
1953	312,865	2,130,580	272,467	1,114,339
1954	305,020	2,022,344	232,554	1,045,767
1955	350,276	2,451,564	280,611	1,413,919
1956	354,225	2,288,953	243,821	1,176,424
1957	366,155	2,617,423	327,811	1,577,322
1958	425,697	2,479,079	332,165	1,773,513
1959	308,840	1,982,182	184,275	985,202
1960	373,039	2,860,940	434,239	2,387,429
1961	522,935	4,980,394	531,079	4,106,277
1962	550,032	4,419,560	569,731	4,461,798
1963	432,710	4,263,701	489,075	1,182,292
1964	352,646	4,840,319	440,648	6,689,235
1965	280,420	3,341,477	317,924	4,198,253

TABLE 2. Malaysia trade statistics for undressed crocodile hides

<u>Year</u>	<u>Exports</u>		<u>Imports</u>	
	<u>lb.</u>	<u>£(Malayan)</u>	<u>lb.</u>	<u>£(Malayan)</u>
1960	4,998	20,359	1,052	3,121
1961	7,157	26,453	8,933	14,191
1962	3,004	15,987	4,892	12,535
1963	3,276	12,939	8,298	10,210
1964	4,074	12,326	3,571	5,228
1965	3,821	21,029	0	0
1966	1,321	7,730	168	1,060
1967	2,037	12,240	802	2,058
1968	1,323	6,795	25	100
1969	1,386	7,580	44	500

Crocodile Specialists,
Second Meeting,
Section A.6.

ASIAN REPORTS:
DISCUSSION

The high priority to be attached to the protection of Gavialis gangeticus and to the establishment of a sanctuary for Crocodylus porosus was emphasized, although further action must await the proposed survey to be funded by the Indian National Appeal of WWF (which did not yet appear to have been submitted for approval as a joint IUCN/WWF project). The case of G. gangeticus was considered to be especially urgent and Dr. King said that blocked funds, derived from U.S.A./Indian trade arrangements and to be used only for a joint Indian/U.S.A. project, were already available in an Indian bank.

Mr. Pooley confirmed that he was in close touch with Mr. Whittaker about the project for a crocodile rearing and restocking station, which the latter was keen to model on Ndumu. An approach had also recently been made to the Group about a proposal by Mr. Ken Sims, a Trustee of the Nature Protection Society, Kuala Lumpur, for the establishment of a crocodile farm at Prang Bazar in West Malaysia, though this was apparently intended mainly as a tourist attraction.

Crocodile Specialists,
Second Meeting,
Paper B.1

STOCKS AND CAPTIVE BREEDING, 1969-1972

René E. Honegger
Curator of Herpetology, Zürich Zoo, Zürichbergstrasse 221,
8044, Zürich, Switzerland.

t). The list on which I based my compilation in 1971 (1) mainly relied on the census carried out for the International Zoo Yearbook (IZYB) in 1969 (2). In the present paper the data quoted from the same source are only fragmentary, since, except for four species, crocodiles have been omitted from subsequent IZYB statistics (2, 3). However, one can still say that the general position is that all species of crocodilians are certainly rare in the wild, but relatively common in captivity.

	Males	Females	Indef.	Total	Number of Zoos
<u>Alligator sinensis</u>					
1969	12	11	50	73	38
1970	11	14	42	67	37
1971	22	8	35	65	39
<u>Crocodylus moreletii</u>					
1969	3	0	28	31	16
1970	6	2	36	44	19
1971	8	8	24	40	15
<u>Crocodylus rhombifer</u>					
1969	2	2	14	18	15
1970	5	1	15	21	14
1971	2	2	15	19	12 /
<u>Gavialis gangeticus</u>					
1969	6	9	37	52	23
1970	7	15	24	46	24
1971	7	16	31	54	26

FOOTNOTE: / No figures received from Havana or Sofia zoos.

A census of all crocodiles in zoos controlled by the members of the American Association of Zoological Parks and Aquariums (AAZPA) in the U.S.A. has also now been made by F. Wayne King, Bronx Zoo, and Steve Dobbs, Atlanta Zoo, the results of which are to be published elsewhere (King, pers. comm.). The editor of the IZYG, Nicole Duplaix-Hall, and myself are presently engaged in a similar compilation for all IZYG-participating zoos, the results to be published in a forthcoming issue of the Yearbook.

At their annual meeting held in Salt Lake City, 19-23 September 1971, the members of the AAZPA passed a resolution to:

- 1) exhibit or maintain only the number of species or subspecies of crocodilians whose behavioral, ecological and nutritional requirements can be properly satisfied in the zoo facility or space available;
- 2) exercise equal restraint in maintaining or exhibiting only the numbers of individuals of any crocodilian species that can be properly housed and bred in the facility or space available;
- 3) make every effort to initiate, improve and sustain a breeding programme for the crocodilians in their collections;
- 4) co-operate with other AAZPA members and other animal propagation and conservation organisations, in establishing breeding programmes for crocodilians through exchange of non-breeding or unmated specimens, and through the free exchange of information and records on captive crocodilians and their husbandry; and
- 5) discourage commercial dealers and collectors from regularly holding in stock excessive numbers of crocodilians. (4)

In the two censuses referred to above, the originators have also asked for details of the exhibits and the breeding facilities. As soon as all this information has been gathered, the proposed programme for the exchange of specimens, especially of endangered species, can proceed further.

Crocodile breeding records by Zoological Gardens 1969-1971 (1972)

(N.b. Figures in brackets in the 'Number' column indicate how many of the specimens failed to survive)

<u>Alligator mississippiensis</u>	<u>Number</u>	<u>Reference</u>
Murrels Inlet, USA 1969	10	(2)
Houston, Texas, USA 1970	4	(3)
Phoenix, Arizona, USA 1970	3	(3)
Monroe, La., USA 1972	22	(5)
(Zürich, Switzerland 1970-72	fertile eggs laid, but no hatching)	

Caiman crocodilus

Number Reference

Caracas El Pinar, Venez.	1970	5	(3)
Tuxtla, Mexico	1970	29 (4)	(3)
Amsterdam, Netherlands	1971 +	8	(6)

* The female started digging a nest on August 6; on August 7, 22 eggs were laid; 9 eggs hatched between November 7 & 16, 1971. Incubation temperature in the sand was 30 - 33° Celsius; the nest was sprinkled daily. Factors in successful breeding: improved heating and light conditions (direct sunshine), improved diet: freshwater fish, meat, whole rats. Both parents were received in 1966 as one year old specimens.

Caiman crocodilus fuscus

Number Reference

Atlanta, Georgia, USA	1970	2	(2)
" " "	1971	58	(7)

Crocodylus moreletii

Atlanta, Georgia, USA	1970 +	(1)	(3)
" " "	1971	(?)	(8)
" " "	1972	25	(9)
Tuxtla, Mexico	1972	15	(10)

N.b. see also WWF Project 615 (11)

* In 1969 and 1970 the females, of an average length of 2.25 m (received in 1965 as 60 cm juveniles), laid eggs, which produced only dead embryos. The cause of this was apparently a deficiency of Vitamin E in the 90% fish diet. In 1971 the diet was changed to 25% fish, 25% chicken and 50% rats, but still only a proportion (not specified) of the eggs hatched healthy specimens. As a result of this experience, in 1972 the diet was again changed, to 100% whole chicken with Vitamin E supplement, with the more satisfactory results indicated above.

Crocodylus niloticus

Number Reference

Paris Aquarium, France	1969	(2)	(2)
Tel Aviv University, Israel	1969	8	(2)
" " " " "	1970	7	(3)

Cr. niloticus x Cr. acutus

Hamburg, Germany	1970	1	(3)
------------------	------	---	-----

Crocodylus palustris

Ahmedabad, India	1969	23	(2, 12)
" " "	1970	31	(3)

<u>Osteolaemus tetraspis</u>		<u>Number</u>	<u>Reference</u>
Victoria, Cameroon	1969	(6)	(2)
Kumasi, Ghana	1970	5	(3)
Chester, U.K.	1972 Eggs laid, none hatched		(13)

REFERENCES

- (1) Honegger, R.E. 1971. Zoo Breeding and Crocodile Bank. In Crocodiles, Proc. 1st Working Meeting Crocodile Specialists, IUCN Publ. (N.S.) Suppl. 32.
- (2) Lucas, J. (ed.) 1969-1971. International Zoo Yearbook, Vols. 9-11, London.
- (3) Lucas, J. and Duplaix-Hall, N. (eds.) 1972. International Zoo Yearbook, Vol. 12, London.
- (4) Crocodile Group, Newsletter, 3 January 1972.
- (5) Stuart, M.D. 1972. In AAZPA-Newsletter, 12:8.
- (6) de Graaf, F. 1972. Brilkaimannen zorgden voor nageslacht. Artis 18/2, Amsterdam.
- (7) Crocodile Group, Newsletter, 4 April 1972.
- (8) Hunt, R.H. (in press). Breeding of Morelet's Crocodile, IZYG, Vol. 13.
- (9) Hunt, R.H. 1972. Int. Zoo News, 108, 19/5: 174, Leiden.
- (10) WWF International, Press Release 41/10.10. 1972.
- (11) Jackson, P. 1972 (Editor). World Wildlife Yearbook 1971-72: 167. Morges, Switzerland.
- (12) Reuben, D. 1970. Breeding the Mugger Crocodile and Water Monitor, Crocodylus palustris and Varanus salvator at Ahmadabad Zoo. Int. Zoo Yearbook, Vol. 10: 116.
- (13) Chester Zoo News, August 1972.

Crocodile Specialists,
Second Meeting,
Paper B.2

CURRENT TRENDS IN ALLIGATOR FARMING IN THE SOUTH-EASTERN UNITED STATES

Robert H. Chabreck
School of Forestry and Wildlife Management, Louisiana State
University, Baton Rouge, Louisiana 70803, U.S.A.

All states within the range of the American alligator
(Alligator mississippiensis) have laws regulating alligators
held in captivity. In general, captive alligators can be
grouped into three categories:

1. Alligator farm - an area having captive alligators
with adults held primarily for the purpose of
producing young;
2. Rearing station - an area set up for rearing young
which were produced by either captive or wild adults;
3. Alligator displays - including both roadside tourist
attractions and zoos: a number of animals are
usually confined within a small area, and breeding is
not a major objective.

Distribution of Alligator Farms

Alligator farms are now operating in various locations in
the south-eastern U.S. Largest operations are centred in
Louisiana and Florida; however, most states have farms in
some stage of development.

One of the Louisiana farms has achieved excellent success
and now produces over 2,000 young annually. This farm gets
approximately 75 nests per year and has over 12,000 alligators
of various size classes on hand. At the present rate of
development, the farm has the capability of increasing
production to 100,000 annually within a decade.

Louisiana has several other alligator farms, but all are
operating on a small basis with less than 10 breeding females.

A farm was set up in central Florida within the past few
years and has planned a large-scale operation. The farm had
7 adults which nested in 1972, laying a total of 215 eggs.

Many young are on hand, and rapid expansion of the breeding population is anticipated (Harrison, 1973).

In addition to the farm in central Florida, several smaller ones are in operation at various other locations in the state. Much of their work is of an experimental nature, but expansion is likely as technology is improved.

Research

Much of the work on alligator farms is still of an experimental nature, but technology is advancing at a rapid rate and each year the techniques are becoming more refined.

Research stations have been set up by the Louisiana Wild Life and Fisheries Commission and the University of Florida to investigate procedures for alligator farming. Experiments are designed to increase the efficiency of farming operations and reduce the costs and risks which confront private operators.

The present studies by the Commission are centred at the Rockefeller wildlife Refuge under the guidance of Ted Joanen and Larry McNease. Preliminary investigations by Chabreck (1967) and Joanen and McNease (1971) have revealed areas where additional knowledge is needed. The aspects of alligator farming currently being investigated are: pen design, stocking rates, sex ratio in breeding pens, use of hand-reared versus wild caught breeding stock, artificial insemination, foods and feeding method, breeding behaviour, artificial incubation of eggs, rearing of the young and marketing of farm reared animals.

The findings of the experimentation in Louisiana and Florida, plus that contributed by other state agencies and private individuals, will remove the "guess work" from alligator farming and place it on a scientific basis.

Major Problems

Inadequate technology has been a major problem faced by the alligator farmer. So long as wild populations were able to meet the demand for hides, little interest was shown in producing animals from captive stock. However, as wild populations declined, hide values increased and the idea that animals might be profitably produced from captive stock was considered. Many persons entered into the venture on a trial and error basis, and it was then that the lack of expertise in this area became apparent. The knowledge gained in the past decade has exceeded all gained prior to then, and if the trend continues, the future will be very bright.

A major obstacle, which has plagued the alligator farming industry in recent years, has been the lack of legal security. A strong, well-planned programme against the use of alligator skins has placed the future of alligator farming in jeopardy. Although the programme was aimed primarily at the use of skins from wild alligators, the threat that it could eventually influence the marketing of farm-reared animals, has made many farmers reluctant to put large capital investments into the operation. Recent developments, however, have taken a more positive approach and should provide investors with the needed incentive.

REFERENCES

- Chabreck, R.H. 1967. Alligator farming hints. Louisiana Wild Life and Fisheries Comm. Grand Chenier, La. 21 p. mimeo.
- Harrison, H. 1973. Ever seen an alligator farm? National Wildlife. Jan. 1973. p.20-24.
- Joanen, T. and McNease, L. 1971. Propagation of the American alligator in captivity. Proc. Annu. Conf. Southeastern Assoc. of Game and Fish Comm. 25: 1-23.

Crocodile Specialists;
Second Meeting,
Section B (1 & 2).

CONTROLLED BREEDING OF CROCODILES :
DISCUSSION

With reference to the concern expressed in Dr. Chabreck's paper, lest better protection and strict control of exploitation of crocodilians in the wild might jeopardize the future of crocodile farming, it was pointed out that the Convention on International Trade in Endangered Species of Wild Fauna and Flora (see paper C.2 of these Proceedings, p. 76), does in fact include specific provisions (Article VII) for exempting captive-bred animals and their products.

The Group considered that the growth of interest in the various categories of crocodile farming is generally encouraging and worthy of support, although several questions would need to be considered and resolved, such as the possibility of production exceeding demand; inferior processing of skins (instances have already occurred where the export of raw skins has been prohibited in some South American countries in the interests of the local tanning industry, and it has been necessary for the skins to be re-tanned after export to improve the quality); and the danger that if crocodile farms can supply all the skins required, the incentive to maintain wild populations might disappear. However, it was considered very unlikely that controlled breeding would produce enough skins to sustain a viable crocodile leather industry in the immediate future.

Several additional enterprises and projects were mentioned, including examples in the U.S.A. (Georgia, Alabama), in El Salvador, and, for the breeding of C. rhombifer, in Jersey Zoo. It was recommended, in connection with the last-mentioned project, that before proceeding, urgent steps should be taken to ascertain that the stock held did in fact consist of C. rhombifer and did not include rhombifer-acutus hybrids; that in the event of failure, due, for example, to the difficulty and expense of ensuring a suitable environment, agreement should if possible be reached on finding an alternative site for the project to which the rhombifer specimens might be transferred; and that, meanwhile, approaches should also be made to other zoos holding stocks (Havana, East Berlin, Winnipeg) with a view, if necessary, to strengthening or duplicating rhombifer breeding units.

Crocodile Specialists,
Second Meeting,
Paper B.3

MANAGEMENT OF THE PAPUA NEW GUINEA CROCODILE INDUSTRY

M.C. Downes
Department of Agriculture, Stock and Fisheries, P.O. Box 2417,
Konedobu, Papua New Guinea.

Previous papers outlined the basic situation which led to Government regulation of the crocodile skin industry and preparations for placing the harvest on a sustained yield basis. Downes (1971a) and (1971b).

The conservation and management of crocodiles are in a much more favourable situation in Papua New Guinea than in many other countries, for allowing continued controlled harvests, because of several factors peculiar to the country:-

- (a) The immense and as yet unaltered habitat for crocodiles, sparsely inhabited, with land ownership retained by native communities, and with access physically and socially difficult for outside hunters.
- (b) Uniform legislative controls enforceable at a few export ports; for example, inspection of all skin exports.
- (c) A system of licensing skin buyers and exporters under practical easily policed regulations, which has for instance enabled the total harvest of skins to be effectively reduced by prohibiting the export of skins over 20 inches in belly width. By requiring detailed export permits, every skin must be accounted for and the annual kill can be monitored.
- (d) Control of over-kill of crocodiles is achieved through economic embargo on the sale of skins, in contrast to theoretical game laws protecting individual crocodiles in the wild. Sophisticated hunting laws in the difficult jungle swamps of Papua New Guinea have little or no practical value.
- (e) The living conditions of the people in the crocodile areas of Papua New Guinea are being changed from subsistence hunting or gardening, toward a cash economy and participation in the national economic development.

- (f) Unless the people's natural interest in wildlife and, in particular, crocodile management, is encouraged and developed by practical conservation projects, introduced at the village or 'grass-roots' level, the development referred to under (e) will destroy the major part of the wildlife. If this happens crocodiles will be retained in Papua New Guinea only in small numbers as a scientific curiosity in relic patches of habitat.
- (g) A significant income from crocodiles would be possible in certain under-developed areas of Papua New Guinea having no other cash crop at present, without threatening the basic stocks of wild crocodiles still left in the untouched habitat.
- (h) There is a strong traditional interest among native lake dwellers who depend on the hunting of crocodiles. Such an interest could be channelled toward practical management projects in the skin industry. For example, the wastage of small crocodiles now being killed in large numbers before they reach a commercially profitable size, could be avoided by developing rearing pens as a village or 'cottage' industry.

REFERENCES

- Downes, M.C. (1971a). "Regional Situation Report - Papua and New Guinea" IUCN Publ. (N.S.) Suppl. Paper 32: 41-43.
- Downes, M.C. (1971b). "Management of the Crocodile Industry in Papua and New Guinea" IUCN Publ. (N.S.) Suppl. Paper 32: 131-136.

Crocodile Specialists,
Second Meeting,
Section B(3).

PAPUA NEW GUINEA CROCODILE INDUSTRY
DISCUSSION

In answer to questions, Mr. Downes, author of Paper B.3, said that, although restocking may well become vital in Papua New Guinea, he did not feel that the establishment of government hatcheries was a practical conservation measure at present. Existing regulations seemed to be still sufficient to ensure the essential increment of young and, for example, took into account the fact that, in the light of a breeding life of at least 25 years, excessive culling of older animals could endanger the maintenance of stocks. It was noted that for Crocodylus porosus and C. niloticus it had been shown (by Bustard and Cott respectively) that clutch sizes increase with age and older females become more experienced in defending their nests.

Mr. Downes also took the opportunity of reporting the progress being made with the preparation of a comprehensive crocodilian Bibliography containing over 6000 titles and due to be published before the end of 1973 by the Department of Agriculture, Stock and Fisheries of Papua New Guinea. He presented a self-contained section (reproduced as the Appendix to these Proceedings) which covers the literature, published up to early 1972, of Crocodile Husbandry. The Group expressed its warmest appreciation of this work and strongly supported its continuation. Mr. Downes stated that the next instalment would concern breeding behaviour and case histories of captive breeding.

Crocodile Specialists,
Second Meeting,
Paper C.1

SOME ASPECTS OF CROCODILE CONSERVATION - EDUCATION

A.C. Pooley
Ndumu Game Reserve, P.O. Ndumu, Zululand, Natal, R.S.A.

Introduction

It is a lamentable fact that in far too many zoological garden and park reptile dens, and crocodile and alligator farms, one finds crocodilian species exhibited under primitive and unimaginative conditions. Yet these establishments could, at small expense, provide interesting, educationally valuable displays, which would also surely lead to an increase in visitors and thus more revenue.

In many zoos, one typically finds a bare concrete pool, artificially lit, normally far too small, holding adults and juveniles of several species, different in habit and temperament.

Because of these conditions a previous recommendation of the IUCN/SSC Crocodile Specialists' Group (IUCN Suppl. Paper No. 32 of 1971) was ... that zoos should aim at maintaining one species group in a unit suitable for breeding, rather than individuals of several species ...

Although it is appreciated that zoos have limited space, it should be a matter for concern that for millions of people a visit to a zoo is their only link with nature. Yet very often the only information supplied to them is a plaque on the wall listing the names of the crocodilians housed; but in most if not all zoos I have visited there was more space available for educational display material.

The Zoo keeper should be the person to impart knowledge, but I noted in one large and prosperous zoo that whenever a group of people gathered to look at the crocodilians, the keeper obliged by prodding the nearest reptile with a long-handled broom. This had the desired effect of causing a growl, an audible snapping of jaws or a tail slap from the victim, calculated to impress the viewers, particularly children, with the vicious behaviour of the scaly monster.

Some crocodile farms, too, spend vast sums of money on exotic bird houses, aquaria, tropical gardens containing marble statues, fountains and wishing wells. Meanwhile the

crocodilians may be housed in a pool, green with algae and barely deep enough to allow the animals to submerge and escape the hazards of coin and peanut throwers. Further examples of man's disregard for crocodilians are the display farms that publish brochures and put on live shows of churning baby alligators through washing machines or arrange elaborate chutes, ladders and other obstacles that have to be negotiated at feeding times. Man versus alligator wrestling matches are yet another type of gimmick offered.

The impression gained by the average person must surely be that crocodilians are about the lowest form of life. They also observe curio shops selling baby caimans, crocodiles and alligators, mounted with jaws agape, often in contorted positions, painted or varnished and with glass bead eyes staring from shrunken heads. Thousands of hatchlings are sold alive across counters of reptile exchanges or pet shops. They are even mailed to backyard fanciers, who generally kill them once they outgrow the limited space available to house them. In Africa, much of the literature of hunters' and travellers' tales and wildlife in general contains exaggerated accounts of crocodile attacks on humans and animals, accentuating the ferocity of the dreadful crocodile. Children learn these tales at an early age and have no reason to doubt them.

Conversations with thousands of people who have passed through the Ndumu Crocodile Farm, since it was established, show that the average person has grown up regarding crocodiles as mean, nasty, sinister, repulsive, vicious, evil in appearance and habits. Few indeed will concede that the reptile serves a useful role as predator or scavenger, and many are astonished to learn of the rearing and restocking programme in operation, when surely the beasts should be exterminated. So, at this moment in time, when fourteen of the twenty-one crocodilian species are on the danger list, the need for educational programmes is really urgent; and it is for this reason we are concentrating on this aspect of conservation at Ndumu.

The following are some of the ideas we are developing:-

I. INSIDE DISPLAYS

- (a) Text describing historical background, dating back to the ancient Egyptians and their religious worship and superstitions.
- (b) Display boards describing: Order; Family; Species; present status; maximum recorded length; average length and adult weights; age and size at maturity; local breeding season; average nest depth; nest temperatures; clutch sizes; size of hatchlings; estimated percentage survival; estimated life span.

- (c) Illustrated diagram depicting and identifying predators and prey relationships, from hatchling through to adult stage, and food chains in general.
- (d) Full-colour wall map depicting lakes and river systems in Southern Africa, showing former recorded distribution and present distribution of crocodiles and explaining some of the factors responsible for reduction in populations, e.g. commercial hunting; consumption of eggs and flesh by some tribes; trapping for medicinal purposes; destruction of nesting habitats; drainage of swamps and marshlands; commercial fishing enterprises; pollution of waterways; damming of rivers; building of harbours, etc.
- (e) Diorama depicting a typical nesting site with nest opened to show eggs; or (1) photographs of colonial nesting grounds with adults on guard and close-up view of partly opened nest; or (2) demonstration at the appropriate season of the actual hatching of young. The texts supporting such exhibits could describe breeding biology fully, covering courtship, copulation, territorial defence of nesting grounds, parental care of the young and requirements at nesting grounds, viz. soil conditions, shade, distance from water, etc....
- (f) Embryo development: microscope photographs showing progress from the fresh egg through to hatching; oxygen requirements of the embryo; tolerances to flooding and high or low temperatures.
- (g) Skeletal exhibit: complete mounted skeleton with the different bones named; a comparative display of the skulls of the Nile crocodile, an alligator, caiman, etc., to show structural differences; explanatory exhibit of tooth replacement in crocodilians.
- (h) Enlarged photographs, black-and-white and colour, with captions to show interesting and specialised anatomical features, i.e. eyes, ears, throat-valve, nostrils and nasal turret, egg-tooth, tongue
- (i) Enlarged photographs of the digestive and respiratory systems, with the various organs named.
- (j) Examples of snares, traps, hooks, harpoons used by tribal peoples for killing crocodiles.
- (k) Photographic display of modern capture and transport techniques.
- (l) An exhibit to explain the aims and methods of a restocking programme; elimination of predators of eggs and young and of the numbers to be released, where and when.

2. OUTDOOR DISPLAYS

- (a) Aquarium containing a few juveniles, in company with aquatic insects, tadpoles, fish fry, molluscs, etc., and so situated as to benefit from optimum lighting conditions for photographers. The various life forms would be identified on an illustrated chart beneath the viewing window.
- (b) Display board alongside a natural pool containing juveniles and the burrows excavated. This will explain the purpose of the burrows, how they are dug and their importance during cold weather and as retreats in times of danger; and illustrate and identify the aquatic plants, submerged and floating, the frogs commonly seen and some of the insects in the pools.
- (c) Display board alongside a pool of adult crocodiles, identifying water terrapins, monitor lizards, crabs, etc. that may nest in the enclosure; and describing the barbel or catfish (Clarias sp.) introduced into the pool to clean up uneaten food particles; as well as the important role performed by crocodiles as predators of these fish.
- (d) Feeding of different sized crocodiles staggered to permit visitors opportunity of observing and photographing them all, if they should wish to. The provision of photographic hides is important for use by film units, TV crews and journalists.

At the First Meeting of the IUCN/SSC Crocodile Specialists' Group Bustard (1971) remarked that every effort should be made to provide factual information on Australian crocodiles and their right to continue to exist, by means of newspaper releases, semi-popular articles in magazines, radio, TV and films. Chabreck (1971) also mentioned that in the U.S.A., during the previous five years, the status of the alligator had been given wide publicity by various news media, and as a result the public's attitude toward the species had been greatly influenced. The public was now looking upon the alligator with concern and not with horror, as in the past.

The main objectives of our programme at Ndumu are, therefore:

- 1) to improve the image of crocodilians in Southern Africa; and
- 2) to provide an interpretive service that will interest and capture the attention of people from all walks of life and introduce them to avenues of natural history, science and conservation. The Ndumu Crocodile Rearing Station will be the experimental centre for this and the most popular exhibits will ultimately be incorporated in the proposed Crocodile Conservation Park to be built near Durban.

ACKNOWLEDGEMENTS:

I am most grateful to the Director of the Natal Parks Board, Mr. John Geddes Page, and to numerous colleagues for support of the Crocodile project; in particular to Col. J. Vincent, M.B.E., for his continual encouragement, interest and advice in all aspects of crocodile conservation.

Mr. D.E. Mitchell M.P. and Dr. H.B. Anthony, founder members of the Natal Parks Board, are thanked for supporting this project with enthusiasm.

Finally, my wife Elsa is thanked for typing this manuscript.

REFERENCES

Bustard, H.R. 1971. Crocodiles in Australia. In Crocodiles, IUCN Suppl. Paper No. 32, pp. 34-39.

Chabreck, R.H. 1971. Management of the American Alligator. In Crocodiles, IUCN Suppl. Paper No. 32, pp. 137-144.

Crocodile Specialists,
Second Meeting,
Section C.1.

CONSERVATION - EDUCATION:
DISCUSSION

The combination of indoor and outdoor display techniques for educating the public was endorsed. It was reported, however, that an evaluation of responses which was currently being undertaken by the New York Zoological Society showed that pictorial presentations have more impact than texts, the latter seldom holding the attention of the average visitor for more than a few seconds. A point receiving some emphasis was that unless the owners and staff of zoos and crocodile farms, etc., themselves make more effort to study and learn about their animals, they cannot teach others. But it was also recognized that the message to be put across must be comprehensive and, in addition to scientific data, cover aesthetic, moral and commercial utilization aspects.

Finally, it was thought that there was still a long way to go in improving the standards of housing and treatment of crocodiles in captivity, without which the public attitudes in turn could scarcely be expected to improve; advice on this should be obtained from such sources as the AAZPA and widely disseminated.

Crocodile Specialists,
Second Meeting,
Paper C.2

THE CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF FAUNA AND FLORA IN RELATION TO CROCODILE CONSERVATION

F. Wayne King
New York Zoological Society, Bronx, N.Y. 10460, U.S.A.

The single most significant development in crocodilian protection since the last meeting of the Group has been the negotiation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora in plenipotentiary conference in Washington, D.C., 12 February to 2 March 1973. Delegates from 80 nations participated in the negotiations and an additional eight nations sent observers.

The Convention is the first worldwide agreement designed to control international trade which could threaten the continued existence of species of wild plants and animals. It evolved from IUCN's continuous efforts over the last ten years to achieve such an agreement and is concerned only with threats caused by international trade. Threats to species resulting from habitat modification, pollution and internal trade are not covered.

The Convention provides for the control of trade in species, subspecies or geographically separate populations of wild animals and plants, including live specimens of certain crocodilians, and their readily recognizable parts and derivatives. Under these provisions species can be listed in three lists - Appendix I, Appendix II, and Appendix III:-

Appendix I includes all species threatened with extinction which are, or may be, affected by trade. Trade in these endangered or potentially endangered species is subject to very strict regulation and can only take place in exceptional circumstances.

Appendix II is for species which while not necessarily now threatened with extinction may become endangered if trade is not strictly limited to avoid over-exploitation. Also included are species which must be regulated in order to protect other species in Appendix II with which they might be confused.

Appendix III includes any species a member state identifies as being subject to regulation within its jurisdiction and as needing international co-operation in order to control trade in it.

The basic provisions governing trade in species in the three Appendices can be outlined as follows:

Before an Appendix I species can be exported, an export permit is required. This will only be issued after a government-designated scientific authority in the exporting country has advised that the export will not be detrimental to the survival of the species. An import permit is also required before importation is permitted into the receiving country. Like the export permit, issuance is dependent on assurances from a government-designated scientific authority in the importing country that the trade will not be detrimental to the survival of the species, and if a living specimen is involved that the recipient can properly house and care for the specimen. In addition, the export permit will not be granted until after the import permit has been issued.

Appendix II specimens can be exported only after issuance of an export permit following the advice of the scientific authority that the export will not be detrimental to the survival of the species. The import of Appendix II specimens requires the presentation of the above legal export permit. The scientific authority must also monitor the number of permits issued in order to advise when their issuance should be limited so as to maintain the species at a level consistent with its role in the ecosystem and above a level where it would become a candidate for Appendix I. This makes the exporting country responsible for preventing a species from becoming endangered through excessive trade.

Trade in Appendix III species requires only a legal export permit.

Each state that is a party to the convention must send its import and export records to the continuing convention secretariat for circulation to the other member states. These records include number and type of permits issued, states in which trade occurred, number, quantity and types of specimens, and names of species as included in the three Appendices. The records will permit the monitoring of the movements of endangered species in international commerce.

Appendices I and II of the Convention, as drafted and approved by the delegates, encompassed every species of crocodilian (see annex to this paper). At first glance the long list of species included in Appendix I might seem unrealistic. However, the Convention permits trade in specimens of Appendix I species which are the result of captive propagation, although crocodilians raised in captivity from eggs collected in the wild would not qualify for this exemption from the usual regulations. On the other hand, specimens hatched from captive-produced eggs would qualify. Such captive bred Appendix I specimens will be treated as though they were species included in Appendix II. This

provision permits limited trade in Appendix I crocodilians by promoting farming efforts while at the same time protecting wild populations.

A few additional provisions are worthy of mention in this summary review. The Convention permits trade between a state that is party to it and a non-party state only if comparable documentation and assurances are provided by the latter. The Convention does not limit the right of states to adopt stricter domestic laws governing trade in species listed in the Appendices. Methods are provided for amending the Appendices by member states.

The Convention will come into force 90 days after the tenth state has ratified it. Following ratification, each state will have to pass the legislation needed to implement the Convention within their jurisdiction. Because of the delay caused by the ratification and legislative procedures, the Convention probably will not actually be in full force before the end of 1973.

ANNEX

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES

Crocodilians regulated by the new Convention on International Trade in Endangered Species of Wild Fauna and Flora

The following crocodiles are listed in Appendix I of the Convention:

Alligatoridae	Alligator mississippiensis
	Alligator sinensis
	Melanosuchus niger
	Caiman crocodilus apaporiensis
	Caiman latirostris
Crocodilidae	Tomistoma schlegelii
	Osteolaemus tetraspis tetraspis
	Osteolaemus tetraspis osborni
	Crocodylus cataphractus
	Crocodylus siamensis
	Crocodylus palustris palustris
	Crocodylus palustris kimbula
	Crocodylus novaeguineae mindorensis
	Crocodylus intermedius
	Crocodylus rhombifer
Gavialidae	Crocodylus moreletii
	Crocodylus niloticus
	Gavialis gangeticus

This means that there would be virtually no trade in these species, except for authenticated captive-bred specimens. They could only be exported and imported when appropriate scientific authorities in both exporting and importing countries have certified that the export/import will not be detrimental to the survival of the species.

The following crocodiles are listed in Appendix II:

Alligatoridae

Caiman crocodilus crocodilus
Caiman crocodilus yacare
Caiman crocodilus fuscus (chiapasius)
Paleosuchus palpebrosus
Paleosuchus trigonatus

Crocodylidae

Crocodylus johnsoni
Crocodylus novaeguineae novaeguineae
Crocodylus porosus
Crocodylus acutus

This means that a licence would be required for the export of any of the listed species or subspecies and that the exports will be monitored by a scientific authority in the country of export. If it appears that wild populations of a species are dropping below the level at which it is able to maintain its role in the ecosystem, then exports are to be limited. In practice, this implies (a) export control and (b) some surveillance of exports, hopefully with the idea of reducing the latter if it is shown to be desirable for conservation reasons.

Crocodile Specialists,
Second Meeting,
Paper C.2

TRADE IN ENDANGERED SPECIES CONVENTION:
DISCUSSION

The wide-ranging discussion, which followed Dr. King's presentation of his report, stemmed mainly from the inclusion in Appendix I of the Convention of Alligator mississippiensis and the difficulty of reconciling this with the view unanimously adopted by the Group at its First Meeting in 1971 (IUCN Suppl. Paper No. 32, p.27) that the species should be transferred from the 'endangered' to the 'recovered' category. Although it was recognized that the policy followed during the negotiation of the Convention was in general to accept the nomination by a national delegation of a species for inclusion in one of the Appendices unless the grounds for its inclusion were successfully challenged by another delegation, and also that, as noted in previous discussion (Section B (1 & 2) above), the Convention made provision for captive-bred specimens of Appendix I species to be treated as Appendix II species, there was a considerable difference of opinion as to the justification and possible effects of the inclusion of A. mississippiensis in Appendix I.

It was felt, on the one hand, that the species was not 'endangered' and doubtfully ever had been, though it had been in decline before 1960 due to lack of protective legislation; that this legislation and the fairly simple problem of supervising the tanneries had been effective in stopping poaching, or most of it; that classification of the species could jeopardize the marketing of legal skins; and that if there is no future for economic exploitation of the alligator there would be no incentive for maintaining populations and they will eventually decline. Most suitable habitat is privately owned and will be turned to other uses if alligator utilization is unprofitable. On the other hand, it was argued that this can happen anyway and that wetland drainage has long been the major threat to the survival of crocodilians; that poaching has not in fact been eliminated, even inside national parks; and that a marketing moratorium was the only chance of making the future of the alligator secure.

It was finally agreed, with one dissenting voice, that the previous assessment of A. mississippiensis as no longer an endangered species still stood, but that it was essential to work out procedures whereby skins from sound management programmes could be marketed without again opening the market to illegal trafficking in skins. The Convention itself was endorsed as a positive step in the control of such illegal traffic. The Group nevertheless attached a high priority to continued monitoring of the status of crocodilian species, with a view to recommending the Appendix of the Convention, if any, in which each species could most suitably be placed. Such recommendations should be referred to the appropriate authorities as the basis for considering any changes when the machinery provided under the Convention comes into operation.

Crocodile Specialists,
Second Meeting,
Paper C.3

NOTES ON THE ECOLOGY OF THE LAKE ST. LUCIA CROCODILE
POPULATION

A.C. Pooley
Ndumu Game Reserve, P.O. Ndumu, Zululand, Natal, R.S.A.

Introduction

Lake St. Lucia, located in east central Zululand, covers an area approximately 122,090 acres, extending northwards from the St. Lucia estuary, parallel to the sea, for a distance of 45 miles and varying in width from one to nearly 5 miles. The surface area, including numerous small islands, comprises some 91,090 acres, while the surrounding half-mile strip of land totals about 31,000 acres.

The conservation history of the Lake began in 1897, when a portion was proclaimed as a sanctuary by the Natal Parliament. In 1939, the entire surface area was proclaimed as a reserve and then in 1944 the strip of land surrounding the Lake was included to form the present Lake St. Lucia Game Reserve and Park.

The Lake and its environs has always been noted for its wealth of wildlife and numerous hunters and traders made a living from shooting elephant, hippo, crocodile and many species of game mammals and wildfowl.

There is no doubt that in earlier times the Lake and the rivers flowing into it harboured an impressive crocodile population. Steedman (1835) describes how "the ford of the Black Umfolozi where our travellers crossed on 7th March 1828 was infested with alligators". Baldwin (1852) describes crocodiles as being numerous in the Umfolozi river and St. Lucia Bay. Dunn (1860), Durnford (1872) and Ashe (1880) all describe the Umfolozi river as swarming with crocodiles. Findlay (1903) found the Hluhluwe river and the Lake to be infested with crocodiles and Braadveldt (1921) observed numerous crocodiles in the Mkuzi river.

Apart from sport hunting, the early hunters shot crocodiles for their valuable belly hides and for the fat, which was much prized. Baldwin recounts on 19th September 1855 "shot a couple of crocodiles, took from one a lot of beautiful fat which burns brilliantly."

Man's interference with the ecology of the Lake began at the turn of the century when sugar farmers commenced planting on the rich alluvial deposits of the Umfolozi river floodplain. Canals and weirs were constructed to channel water away from the dense beds of papyrus and phragmites, a natural silt trap at the estuary. In 1948 the Umfolozi river, the major source of freshwater flowing into the Lake, was diverted to flow straight out to sea. This enabled sugar farmers to reclaim a vast area of alluvial silt for planting purposes.

The effect of this action was to deprive the Lake of its main source of fresh water and the reduced inflow, plus the removal of the natural silt trap and a combination of marine currents and tidal action caused the mouth of the estuary to close.

Dredgers were put into action to maintain a permanent channel open to the sea, but it was not until 1960 that this was achieved. Meanwhile the Lake underwent changes both in salinity and water levels.

Over the past twenty years, the inflow of fresh water into the Lake has been further reduced by extensive irrigation schemes. The Mkuzi river, now the major source of fresh water, has been heavily taxed for irrigating farms west of the Lebombo mountain range. The Hluhluwe river was dammed in 1966 and weirs and pumping systems installed along the Mzeneni, Nyalazi and Mpate rivers.

Denudation of the Mkuzi river catchment area and destruction of riverine forest resulted in log jams in the lower reaches of this river's course; and in recent years extensive clearing was necessary to divert water back into the Lake. An extensive afforestation programme around much of the Lake has caused drainage of wetlands and sponge areas.

The evaporation rate over such a large surface area is estimated to vary between 45-60 inches per annum, whereas the overall annual rainfall is in the region of 40 inches. Thus in years of poor rainfall, lowered lake levels and increased salinity are experienced. For an account of the ecology of Lake St. Lucia see Day (1954).

Reduction in Crocodile Populations

Over the past twenty years the territory and population of crocodiles have been reduced due to several factors. Numbers were destroyed in the vicinity of the estuary because of the likelihood of attacks on dredging crews operating there; and to safeguard the ever-increasing numbers of fishermen and bathers at this popular resort. The development of rest camps at Charters Creek, Fannies Island and False Bay, as well as other frequently used boat launching, fishing and picnic sites along the Lake shore, necessitated the shooting of crocodiles

in the near vicinity. In fact, following the death of a child from a crocodile attack at False Bay in 1957, there was immense public pressure to exterminate all the crocodiles in Lake St. Lucia.

Prior to the introduction of the Reptiles Protection Ordinance no. 32 of 1968, crocodiles were classed as vermin in Natal. European hunters operated in the Mkuzi swamps and along the rivers flowing into the Lake. A small number of reptiles were trapped as well by Bantu tribal peoples who greatly valued the supposed medicinal properties of crocodiles. Others were destroyed along the rivers as agricultural development became more intensive, because of the danger to livestock and humans.

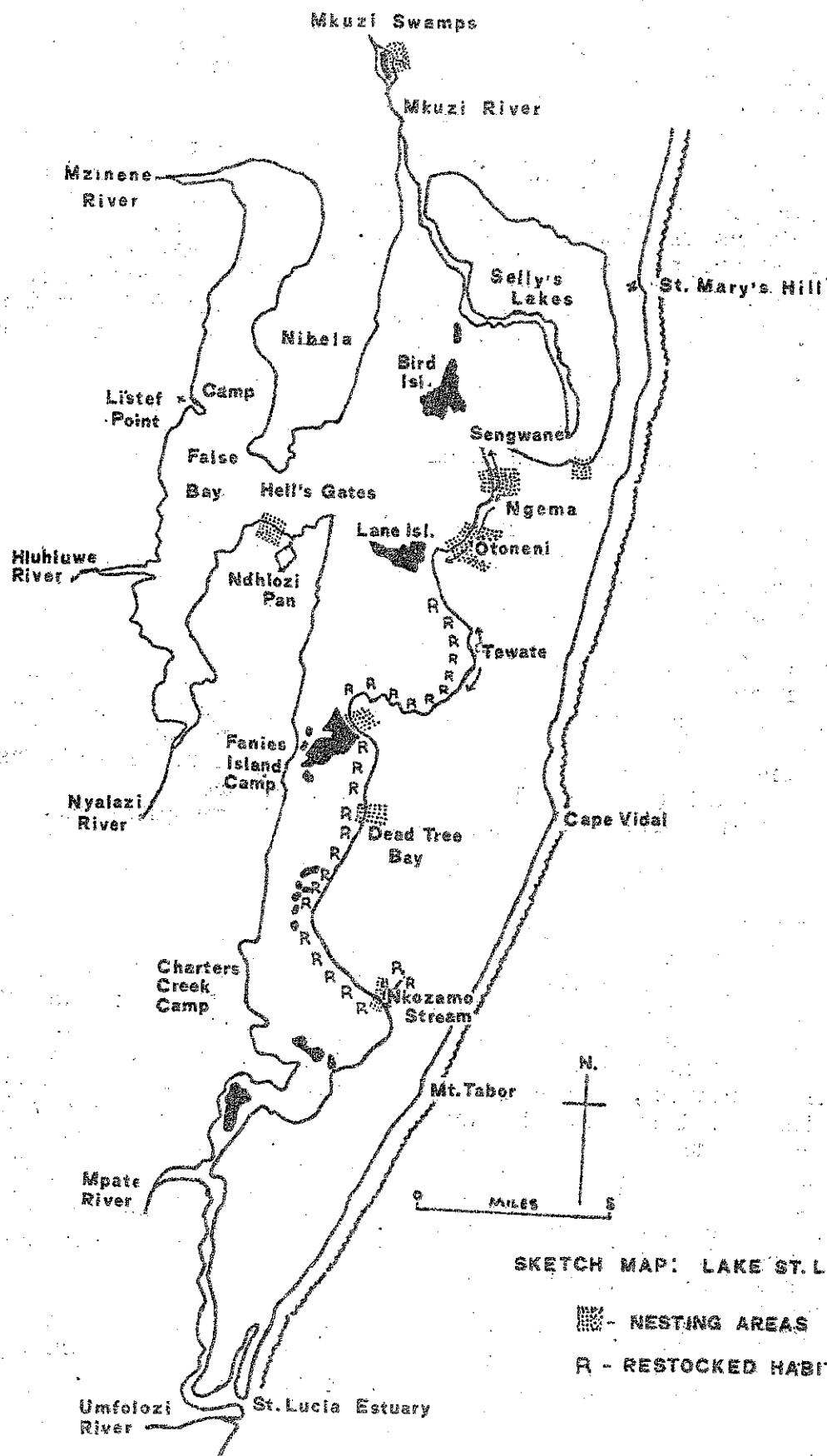
Distribution and Seasonal Movement

The main concentration of crocodiles in the Lake now occurs in the wilderness area; that is northwards of Hell's Gates, across Lane Island to Otoneni on the east and along the eastern shores (see sketch-map).

Modha (1967) and Pooley (1969) have recorded seasonal movement of crocodiles, and observations by Lake staff over many years and more recently aerial counts indicate a winter movement to suitable basking areas and a summer dispersal to the known breeding grounds and to nest sites along the rivers such as the Mkuzi (Pooley, 1962). However, present knowledge of crocodile ecology at the Lake is fragmentary.

Nesting Areas

Ludlow (1880) describes the discovery of a nesting colony at Goose Point which we think was probably at the entrance to False Bay. Nests have been found in the 1950's up to 12 miles inland along the banks of the Umfolozi, Mpate, Nyalazi and Hluhluwe rivers, according to old residents of the Lake; but farming development, disturbance and lowered water levels largely caused these sites to be abandoned. Game guards who have resided at the Lake for many years and who know the area intimately also confirm observations that crocodiles will nest year after year at the same grounds. Yearly observations on the main breeding grounds at Otoneni and Ngema show fluctuations in nesting populations related to disturbance by hippopotamus, lowered lake levels, lack of fresh water and high salinity levels. The breeding grounds known to have been used over the past twelve years and those found during recent surveys, 1972/1973, are shown in the sketch map.



SKETCH MAP: LAKE ST. LUCIA

▣ - NESTING AREAS

R - RESTOCKED HABITATS

Nesting Requirements

The known breeding grounds with the exception of the Mkuzi river colony are all in undisturbed areas. The depth of water offshore is sufficient for adults to submerge should disturbance on land necessitate retreat. Nesting sites are above normal flood levels, the shoreline is well vegetated or screened by reedbeds and the degree of slope is gentle. Suitable soil, shade and freshwater as well as a sunny aspect are requirements that these areas all have in common (see Pooley, 1969).

Effects of Salinization and Low Water Levels on Nesting

During the period 1959 to 1968 an average number of 64 crocodiles were recorded as nesting at the two colonies situated at Ngema and Otoneni. However, during November 1968/February 1969 only 35 nests were found. At this time salinity levels were 64.1 parts per thousand at Hell's Gates, 68.0 at Lister Point and 70.0 at the Mkuzi river mouth (Forrest, 1969). Offshore of the nesting colony, the water was so shallow that the crocodiles could not submerge. Depths varied between 0.9 and 1.0 feet. It was not possible to approach by boat closer than about 70 yards to the shore. We found that numbers of hippopotami, normally in large herds close to Lane Island, were spending much of the daylight hours on land in close vicinity of the nesting crocodiles. A large area of vegetation and some nests had been trampled.

For the first time that we know of, crocodiles nested on an island in the Mkuzi river. This was a totally unsuitable nesting area, subject to disturbance by Bantu fishermen and unshaded; the majority of eggs laid were either lying in water or else exposed to the sun because the island was only just above water level. Nevertheless, a total of twenty nests was found, and nesting has continued at this site up to the present 1972/73 season.

By the end of August 1970, Lake conditions had deteriorated further. No shell fish could be found north of Fannies Island and mullet Mugil sp. shoals were not noted north of Lane Island. Areas of papyrus and phragmites in the Mkuzi river swamps had died back, beds of zosteria grass had disappeared, and mounds of empty shells were washed up on mud banks. The northern section of the Lake was almost devoid of bird life. Salinity readings in the northern Lake now reached 92.8 at Sengwane, 96.8 at Lister Point and 104.0 in the Mkuzi Swamps. The Lake depth was down to 0.75 ft. In early October fish of different species were found to be dying in False Bay. Most of the freshwater streams had dried up.

Crocodile Mortality

Forty adult crocodiles died during July/September 1970. The first recorded death was on 31st July, 1970, when a bloated carcass was found at the Mkuzi river mouth. On August 7th, a further seven carcasses were found up the Mkuzi river and fifteen were counted from a helicopter on September 4th, in the upper reaches of the swamps. Three of the forty captured and translocated are known to have died and finally fourteen skeletons were noted in the upper Mkuzi channels and inlets. A large section of river and many channels and inlets in the swamp proper were too shallow to negotiate by boat or else impenetrable due to papyrus. It is very possible, therefore, that more crocodiles died than were actually located. All of the carcasses and skeletons were of adult animals.

Capture Translocation

This operation, organised by Mr. I.C. Player, Chief Nature Conservator, commenced on 4th September and by 30th September, forty were moved down to the Nkazama stream by helicopter, boat and vehicle. Thirty-seven survived, two of them sub-adult animals. The operation was then abandoned because the remaining crocodiles were very wary and took refuge in dense papyrus stands. We captured crocodiles by using nets to trap them in the narrow canals in the swamps, but the majority were noosed from a boat both at night using a spotlight and in daylight.

Observations on Captured Crocodiles

During capture operations we noted that the crocodiles were unable to completely submerge when pursued. The anterior third of the tail would protrude above the surface when a crocodile dived and would remain above surface as it swam along underwater. When the animal ceased to swim, even more of the tail became buoyant and exposed. This alteration in specific gravity would probably interfere in capture of fish and affect the mechanics of feeding. Starvation due to lack of food and possibly the difficulty in dealing with prey accounted for their poor condition.

Captured crocodiles examined had no evident sores or lesions in the mouth and the tongue and throat, eyes, ears and nostrils seemed normal. The majority, however, had lesions, some of these severe, behind the forelimbs and hindlimbs. Possibly in some cases roping of the animal during capture and the consequent struggle to subdue the crocodile had aggravated these lesions.

Most specimens had severe peeling and splitting of the dorsal tail scutes and in appearance the tissue had dried out, particularly towards the tail tip. It is likely that capture methods aggravated this condition but judging by the appearance of the scutes and underlying tissue, continual exposure and sunburn of the salt-coated tail surface was responsible for this condition.

The crocodiles were transported to the Nkazamo stream, at that stage the only reliable source of freshwater entering the Lake; they were induced to stay there by regular provision of game meat brought in from Umfolozi Game Reserve. Observation by local staff indicated that the food was eaten and that crocodiles remained in the area for some weeks after translocation. Fortunately an inflow of freshwater into the Lake improved conditions considerably by the end of October.

Nesting was observed on a reduced scale at the Otoneni/Ngema colonies, during December 1970. A total of 11 nests were discovered, two of which had been robbed.

Nesting Mortality

Observations at the main breeding grounds indicate that egg predation is high at Lake St. Lucia. A typical season's results, three weeks after laying, are as follows:-

TABLE I: Degree of Nest Predation

Date of Visit	Breeding Ground	Intact Nests	Robbed Nests	Spoiled Nests	Total No. of Nests	
23/11/1969	Otoneni	1	-	-	1	
1/12/1969	Otoneni	11	25	-	36	
14/12/1969	Otoneni	17	31	-	48	
14/12/1969	Ngema	5	1	-	6	
14/12/1969	Mkuzi	9	4	4	17	
14/12/1969	Dead Tree Bay	4	2	-	6	
Results over a period of 22 days		TOTALS:	35	38	4	77

The Water Monitor Lizard Varanus niloticus is certainly the main predator and numbers are seen at each visit to the nesting grounds. The Water Mongoose Atilax paludinosus is considered to be the other important egg predator (Pooley, 1969).

Restocking Programme

This was commenced in 1967, as an experimental measure to increase the Lake population. Eggs were collected for artificial incubation studies and to eliminate predation and flood hazards. Reared young were spread out over as wide an area as possible to minimise predation. To date a total of 463 young, from three to nine months in age, have been introduced into the following localities:-

TABLE 2: Lake St. Lucia Restocking Programme

Date	No.	Locality	Age at Release
12/7/1967	67	Dead Tree Bay/E. Shores	5 months
9/8/1967	40	E. Shores to Nkazamo	6 months
15/11/1967	49	Nkazamo stream	9 months
8/5/1968	25	Nkazamo Shore/Dead Tree Bay	3 months
28/4/1969	150	Ngema/Fanies Islands	4 months
17/10/1971	60	Tewati	8 months
23/5/1972	36	Nkazamo	3 months
23/5/1972	36	Dead Tree Bay	3 months
<hr/>			
TOTAL:	463	As at 15/3/1973	

The habitats selected for restocking were chosen to provide adequate cover in the form of reedbeds (Phragmites sp.) at the Lake edge, and small streams in particular were favoured for fresh water and food supply. The breeding grounds were avoided to allow young to radiate out as conditions of water and salinity levels and food supply dictated; also to avoid cannibalism.

Future Management

The future status of crocodiles in the Lake system depends mainly on solving the engineering and hydrological problems, i.e. the provision of an adequate water supply, and at the same time allowing for a free exchange of saline and fresh water and aquatic organisms between the sea and the Lake. The St. Lucia Scientific Advisory Council was established in 1968, to tackle these problems, and has commissioned a computer study of the Lake.

Aerial population counts of crocodiles have commenced and will be regularly undertaken, to gather data on seasonal movement. Monitoring of nesting grounds will be continued routinely. The restocking programme will be further pursued subject to suitable ecological conditions.

ACKNOWLEDGEMENTS:

I am most grateful to the Natal Parks Board for support in the Crocodile Restocking Project at Lake St. Lucia and to numerous colleagues at the Lake, past and present, for assistance in carrying out surveys and for time given to discussion and searching old records, over a number of years.

Particular thanks are extended to Senior Ranger Gordon Forrest and his wife for kind hospitality and to Lake Warden Nick van Niekerk for his advice and co-operation in all aspects of this work. Mr. R.S. Crass, Principal Scientific Officer and Mr. I.C. Player, Chief Nature Conservator, are thanked for their interest and enthusiasm for this project. My wife Elsa is thanked for typing this report.

REFERENCES:

- Ashe, Major and Wyall Edgell, E.V. 1880. The Zulu Campaign. Sampson, Low, Marston, Searle & Rivington: London.
- Baldwin, W.C. 1894. African Hunting and Adventure from Natal to the Zambezi. Richard Bentley & Son: London.
- Braadvedt, H.P. 1949. Roaming Zululand with a Native Commissioner. Shuter & Shooter: Pietermaritzburg, Natal.
- Day, U., Patterson M. and Broekhuysen, G.J. 1954. The Ecology of South African Estuaries. Part IV: the St. Lucia System. Trans. Roy. Soc. S.A. 34(1).
- Dunn, J. 1886. Cetywayo and the Three Generals (D.C.F. Moodie ed.). Natal Printing and Publishing Co., Pietermaritzburg, Natal.

Durnford, Col. A.W. 1882. A soldier's life and work in South Africa. Sampson, Low, Marston, Searle & Rivington: London.

Findlay, F.R.N. 1903. Big Game Shooting and Travel in South East Africa. T. Fisher Unwin: London.

Forrest, G.W. 1969. Some Bird Notes from St. Lucia. Lammergeyer, Journ. Natal Pks. Bd., 10.

Ludlow, Capt. W.R. 1882. Zululand and Cetewayo. Simpkin, Marshall & Co. London.

Modha, M.L. 1967. The Ecology of the Nile Crocodile (Crocodylus niloticus Laurenti) on Central Island, Lake Rudolf. East African Wildlife Journ. 5.

Pooley, A.C. 1962. The Nile Crocodile. Lammergeyer, Journ. Natal Pks. Bd., 2(1).

Pooley, A.C. 1969. Preliminary Studies on the Breeding of the Nile Crocodile (Crocodylus niloticus) in Zululand. Lammergeyer, Journ. Natal Pks. Bd., 10.

Steedman, A. 1835. Wanderings and Adventures in the Interior of Southern Africa. 2 vols. Reprinted 1966: C. Struik. Cape Town.

Crocodile Specialists,
Second Meeting,
Section C.3.

SUPPLEMENTARY PAPERS:
DISCUSSION

As a background for Mr. Pooley's paper, Colonel J. Vincent reviewed the work of the Natal Parks, Game and Fish Preservation Board, which he emphasized was an autonomous body responsible to the Natal Provincial Council. Set up in 1947, it had so far established 39 reserves and by 1973 its budget had reached a figure equivalent to £1.75 million. The Lake St. Lucia reserve was one of the three oldest in the Province, dating from 1897. One suggestion under consideration for dealing with the decreased supply of fresh water and salinity problem referred to in the paper was to reduce the size of the Lake itself and thereby cut down evaporation losses.

Mr. Pooley added in explanation of his reference to 'a computer study of the Lake' that this was aimed at deciding how much fresh water input was required to maintain the ecological balance. Until this was determined and guaranteed there was no point in continuing the restocking programme, and at present the emphasis was on mapping distribution and movements and limiting crocodile ranges to reduce the risk of incidents involving humans.

The Paper led to a general discussion of the importance of habitat, which Dr. Chabreck and Dr. King illustrated, respectively, by details of the vegetation, water and soil characteristics and the wildlife productivity of the Louisiana coastal region, and of destruction of alligator habitat in Florida (based on a report presented by Mr. James L. Schortemeyer to the American Alligator Council meeting at Lake Charles in May 1972). The alligator population had responded well to the management methods adopted in Louisiana, which aimed at avoiding the situation that had developed in southern Florida, where 35% of the alligator habitat had been lost through drainage.

Some of the relevant points which had emerged from research on the American alligator were summarised, it being explained that these were based on preliminary results:

- (a) Young alligators are subject to reduced growth rates if kept in too saline an environment for long periods: food is available but its intake reduced.

- (b) When artificial incubation is used, inverting the eggs during the first month after laying may affect the hatching success: but the latter did not seem to be affected by multiple layer or mixed clutch incubation procedures.
- (c) The best hatching rate was achieved at a temperature of 90°F and 70% moisture (the latter figure was, however, challenged on the grounds that eggs held in damp Sphagnum would in fact be in a saturated environment). Of eight types of nest material tested grass hay had produced the best results.

Finally, Dr. H.R. Bustard reviewed the crocodile conservation programme at Edward River, North Queensland, which was intended to form the basis for the future farming of C. porosus. About half the natural nests in the region were destroyed annually by flooding, and half of those that survived were predated by monitors and wild pigs, leaving a hatching success of about 25%, as compared with a rate of 70-80% for artificially incubated clutches. The river had recently been restocked with 350 specimens and the crocodile population, much reduced by shooting and poaching in the past, was gradually building up. The answer to the question whether female crocodiles are adversely affected by constant removal of their eggs was generally considered to be still very uncertain, although some members of the Group quoted instances in which egg collection had been maintained without apparent disturbance of a female and the latter had returned year after year to lay in the same site.

A P P E N D I X.

THE LITERATURE OF CROCODILE HUSBANDRY

M.C. Downes,
Wildlife Section, Department of Agriculture, Stock and
Fisheries, P.O. Box 2417, Konedobu, Papua New Guinea.

These titles are concerned with the keeping of crocodiles in captivity and particularly the conditions required.

The list has been selected from a comprehensive manuscript in preparation, called "The Literature of the Living Crocodilians" containing more than 6,000 items.

The form of the reference in the manuscript has been retained in this selected list.

Those papers which have not been examined in the original form are marked / and the words (not seen) included before the comments. In these items the details such as page numbers and wording could be quite inaccurate.

Where an author has more than one paper in any one year only those papers dealing with captivity are included but the same lettering as in the master list referred to above is retained.

- ALLEN, E.R. (1937). "Alligators and their care." All - Pets Magazine July (reprint only). 2pp.
- ALLEN, E.R. (1938b). "Instructions for care and feeding alligators, crocodiles etc." (Florida Reptile Inst., Silver Springs, Fla., U.S.A.)
- ALLEN, E.R. (1940). "About Florida's alligators." Florida Game and Fish 1(6): 7-9, 14+ (Reprint). (Growth; habits, etc.)
- ALLEN, E.R. (1963). "Caimans." Bull. No. 31 Ross Allen's Reptile Institute, Florida. 1 pp.
- ALLEN, E.R. (1964). "Alligator farming." Bulletin No. 44 Ross Allen's Reptile Institute. 2 pp.
- ALLEN, ER. (1966). "Keep them Alive - how to care for and feed your pets, snakes, lizards, turtles." 4th Edit. enlarged and revised. St. Petersburg, Florida. 100 pp. + figs. (:41-53 alligators; :55-57 crocodiles; :59-61 caimans, etc. 1 photo, 3 drawings.)
- ALLEN, E.R. (1968). "Caimans - their care and feeding." Pet Shop Management 22(12): (reprint). (Reprinted by International Crocodilian Society.)
- ALLEN, E.R. (1971a). "Artificial incubation of alligator eggs." International Crocodilian Society, Silver Springs, Florida. 1 pp.
- ALLEN, E.R. (1971b)] "Pinni-Poi as crocodilian food." see ANON (1971e).
- ALLEN, E.R. & NEILL, W.T. (1950b). "Keep them alive! How to keep snakes, lizards, turtles, alligators and crocodiles in captivity." Silver Springs, Florida. 24 pp. (:13-15 alligators and crocodiles; 2nd edit. 1954 revised and enlarged, Ross Allen's Reptile Inst. Spec. Publ. No.1; 3rd edit. (1959b)).
- ALLEN, E.R. & NEILL, W.T. (1959b). "Keep them alive! How to keep snakes, lizards, turtles, alligators, caimans and crocodiles in captivity. Third edition." Special Publication No. 1 Third Edition, Ross Allen's Reptile Institute, Silver Springs, Florida. 28 pp. (:17-19 alligators and crocodiles, caimans.)
- ALVAREZ DEL TORO, M. (1969). "Breeding the Spectacled Caiman (Caiman crocodylus) at Tuxtla Gutierrez Zoo." Intern. Zoo Yearbook 9:35-36.
- ✓ ALVAREZ DEL TORO, M. (1971). "Centro de Repoblacion del Cocodrilo de Pantano Crocodylus moreletii." :15-17 icach (20-21) July 1970 - June 1971. (Instituto de Ciencias if Arter de Chiapas (not seen): quoted by Pooley.)

- ANDRES, A. (1910). "Krokodile im Zoologischen Garten in Gizeh bei Cairo." Blatter Aquarien Terrarien Kunde 21 (25): 398-399. 1 photo. (Crocodylus niloticus, Alligator mississippiensis measurements.)
- ASTLEY-MABERLY, C.T.A. (1949). "'Soda' was lazy until it rained. Observations on a pet crocodile." African Wildlife 3(2): 104-111. 1 photo, 5 drawings. (C. niloticus in captivity 6 years.)
- AUSTIN, W.A. (1962). "Growth rates." Your Detroit Zoo 16 (2): 7. 1 photo. (Alligator 6 years 6 feet and another grew from 7 feet to 8 feet 11 inches in one year.)
- BADE, E. (1907). "Praxis der Terrarienkunde." Magdeburg. (:67, 116-123, Krokodile. 5 photos (Tafel 8. Abb. 78, 79, 80, 81).)
- BALL, D.J. (1968). "Handling reptiles." Journal Institute Animal Technicians 19(4): 143-166. 30, + 6 figs. (:146 Crocodilia: - caimans. Fig. 3, 5.)
- BALL, D.J. (1969). "Housing reptiles." Journal Institute Animal Technicians 20(4): 137-154. 16. + figs. (:139-141 Crocodilians. Keeping notes.)
- BARTRAM, G. (1973). "Charlie's a pet of a crocodile." Australian Women's Weekly (17 Jan.): 71. 3 photos. (A tame 4 feet long C. porosus handled by children.)
- BATEMAN, G.C. (n.d.) (1897). "The Vivarium; being a practical guide to the construction, arrangement and management of vivaria ... etc." London. (:58-66 Crocodiles and frontispiece.)
- BECHTLE, W. (1971). "Bunte Welt im Terrarium." Stuttgart. (:52 Caiman crocodilus + photo notes on keeping.)
- BENZIEN, J. (1956). "Vegetabilische Kost für Hecht-Alligatoren." Die Aquarien Terrarien Zeitschrift 9(3): 81-82.
- BERNDT, T. (1966). "Kleine Tarrarienkunde." Wiesbaden. (:90-92 Panzerechsen (Crocodilia) Crocodylus porosus, Caiman crocodilus, Alligator mississippiensis, notes on keeping.)
- BETANCOURT, L. (1970). "Cazador de cocodrilos un oficio difícil." Mar y Pesca 53: 34-39. 10 photos, cover.
- BIGALKE, R. (1929). "The longevity of wild animals in captivity." South African Journ. Nat. Hist. 9(4): 297-302. (:301 Nile crocodile.)
- BLAKE, D.K. (1970). "Crocodile farming in Rhodesia." Roneo ms. Dept. Nat. Parks and Wildlife Management, Rhodesia (not seen).

- BOYCE, G.F. (1957). "Hints on rearing Crocodilia in captivity." British Journ. Herpetology 2(4): 78. (Aquarium, food, etc.)
- BRANDT, L. (1948). "Attack by pet alligator." Herpetologica 4(6): 218.
- ✓ BRAZAITIS, P. (1967b). "Crocodilian Pets." New York Zool. Soc. Reptile Dept. mimeo report 5pp. (not seen).
- BRAZAITIS, P.J. (1968a). "The determination of sex in living crocodilians." British Journ. Herpetology 4(3): 54-58. 2 figs. (Manual probing of cloaca, 200 specimens in 8 genera.)
- BRAZAITIS, P. (1968b). "T'o." Animal Kingdom 71(5): 24-27. 3 photos, 3 drawings. (Alligator sinensis breeding pens.)
- BRAZAITIS, P. (1969). "The occurrence and ingestion of gastroliths in two captive crocodilians." Herpetologica 25(1): 63-64. (Crocodylus acutus and C. rhombifer.)
- BREEN, J.F. (1949). "Reptiles - their Habits and Care". (Boston). 115 pp. (:13-22 Alligators and crocodiles. 3 photos.)
- BREYDEL, A. (1906). "Un élevage d'alligators." Cosmos 55 (1134): 432-434. 3 figs. (alligator farm).
- BROCK, J. (1960). "Panzerrechen im Zimmer." Aquarien-und Terrarien Zeitschr. 13(1): 18-23. 2 figs.
- | | | | |
|------|--|-----------------|---------|
| II | ibid <u>Caiman crocodilus</u> | 13(2): 50-53. | 2 figs. |
| III | ibid <u>Alligator mississippiensis</u> | 13(3): 83-88. | 2 figs. |
| IV | ibid <u>Crocodylus acutus</u> | 13(4): 118-121. | 1 fig. |
| V | ibid <u>C. niloticus</u> | 13(5): 152-155. | 1 fig. |
| VI | ibid <u>Osteolaemus tetraspis</u> | 13(6): 180-183. | 1 fig. |
| VII | ibid General notes | 13(7): 212-216. | 2 figs. |
| VIII | ibid Behaviour | 13(8): 245-247. | 1 fig. |
| IX | ibid General notes | 13(9): 276-278. | 1 fig. |
- BROCK, J. (1965). "Krokodile." Stuttgart. 48 pp. 17 Abbildungen (Kleine DATZ-Bücher Nr. 22.) (17 species, details of size, keeping notes, etc.)
- BROCK, J. (1966). "Beobachtungen an Krokodilen." Die Aquarien Terrarien Zeitschrift 19(9): 277-280. 4 photos. (In captivity Crocodylus siamensis photo and notes; C. johnsoni photo, notes, Paleosuchus trigonatus.)
- ✓ BROCK, J. (1970). "Baby krokodile: Wie pflegen die Panzerrechen?" Aquar. Mag. 4(11): 476-482. (not seen.)
- BUSACK, D. (1959). "Caimans." Rephibia 2(9): 17. (N.Y. Met. Herp. Soc.). (Brief note on conditions for captivity.)

- BUSTARD, H.R. (1969a). "Tail abnormalities in reptiles resulting from high temperature egg incubation." Brit. Journ. Herpetology. 4(5): 121-123. 2 photos. (Crocodylus novaeguineae.)
- BUSTARD, H.R. (1971d). "Temperature and water tolerances of incubating crocodile eggs." Brit. Journ. Herpetology. 4(8): 198-200. (Crocodylus novaeguineae.)
- BYERS, C.A. (1912). "Alligator farming an interesting occupation with little competition." Scientific American 106(19): 422, 427. 4 photos.
- ✓ CARR, I.S. (1965). "Pet alligator." Naturalist 25(3): 12-14 (not seen). (Food notes.)
- CHABRECK, R.H. (1965). "Methods of capturing, marking and sexing alligators." Proc. Ann. Conf. S.E. Assoc. Game Fish Comm. for 1963 17: 47-50.
- CHABRECK, R.H. (1967b). "Alligator farming hints." Grand Chenier, Louisiana. 21 pp. roneo.
- ✓ CHABRECK, R.H. (1971a). "Artificial incubation of alligator eggs." (not seen). (Progress Report 2 Feb. 1971.)
- ✓ CHABRECK, R.H. (1971d). "Artificial incubation of alligator eggs. Laboratory investigation of moisture and temperature levels." (not seen). (Roneo Ms. Progress Report Louisiana Co-op Wildlife Research Unit 24 Feb. 1971.)
- ✓ CHABRECK, R.H. (1971f). "Artificial incubation of alligator eggs. Field investigation of nest moisture and temperature levels." (not seen). (Roneo Ms. Progress Report Louisiana Co-op Wildlife Research Unit 4 Mar. 1971.)
- CHAFFEE, P.W. (1969). "Artificial incubation of alligator eggs (Alligator mississippiensis) at Fresno Zoo." Intern. Zoo Yearbook 9: 34.
- ✓ CHIRIVI GALLEG0, H. (1971). "Notas sobre la problematica del manejo de los Crocodylia en Colombia con especial referencia a la babilla (Caiman crocodilus), y la fatibilidad de su cria en cautividad." Bogota, Colombia. (not seen). (Roneo Ms. Report Inderena Bogota, Colombia.)
- COATES, C.W. (1941). "The care of turtles and small alligators." Bull. N.Y. Zool. Soc. 44(4): 107-113. (:112-113 the care of small alligators. 2 photos.)
- ✓ COULSON, R. (A) (1970). "Effects of various environmental parameters on growth rates in captive crocodiles - Metabolism in the Crocodile." (Papers read at 50th Ann. Meeting Amer. Soc. Ichth. Herp. 26-30 Mar. 1970, New Orleans, Louisiana No. 35 & 36. Titles only.)

- DACY, G.H. (). "The world's largest alligator ranch." Nature Magazine 2(1): 8-10. 4 photos. (J. Campbell alligator farm, Jacksonville, Florida.)
- DAHNE, R.A. (n.d.). "How to keep alligators in captivity." Reprint from Florida Wildlife Magazine (undated)..
- DAVID, R. (1970). "Breeding the Mugger crocodile and Water monitor at Ahmedabad Zoo." Internat. Zoo Yearbook 10: 116-117. (Crocodylus palustris breeding dates, food, sizes.)
- DAVIDSON, R.S. (1966a). "Laboratory maintenance and learning of Alligator mississippiensis." Psychological Reports 19(2): 595-601. 5 figs.
- DESCARPENTRIES, A. (1954). "Vivarium." Science et Natur 2: 21-26. 10 photos. (:21-22 Caiman sclerops. Photo.)
- DOWLING, H.G. & BRAZAÏTIS, P. (1966). "Size and growth in captive crocodilians." Internat. Zoo Yearbook 6: 265-270. 5 figs. (Alligator sinensis, Melanosuchus niger, Crocodylus niloticus, etc.)
- D(URIGEN, B) (1890). "Lebensdauer der Reptilien." Blätter Aquarien Terrarien Freunde 1(1-2): 16. (Alligator in Berlin Aquarium 21 years.)
- ECKELMANN, G. (1968). "Wie schnell wächst ein Hechtalligator." Aquarien u. Terrarien 15: 173. (Alligator mississippiensis 63 cm to 105 cm in 2½ years, growth and food.)
- ✓ EVANS, H.E. (1968). "Keeping reptiles as pets." (not seen). (:422-435 in Kirk, R.W. (1968) "Current Vet. Ther. Small Animal Practice.")
- FARRIS, E.J. (1950a). "The Care and Breeding of Laboratory Animals." New York. 515 pp. (:325-327 care of crocodilians in captivity.)
- ✓ FIELDING, B. (1962). "Getting crocodilians started." (not seen). Bull. Philad. Herp. Soc. 10(4): 5-6..
- FISCHER, J.V. (1884b). "Das Terrarium, seine Bepflanzung und Bevolkerung". Frankfurt a M. (:200-206 Loricata. Krokodile oder Panzerechsen. Alligator lucius; A.sclerops; Crocodylus niloticus; C. acutus; C. rhombifer.)
- FISCHER, J. von (1879). "Zur Haltung des Kaimans (Champsä lucius)." Isis. Berlin 4(1): 4.
- FLOERICKE, K. (1927). "Der Terrarien-Freund." Stuttgart. (:147 Panzerechsen.)
- FREYTAG, G.E. (1954). "Vom Temperaturhaushalt der Reptilien." Aquar. -u. Terrar. - Z 1(1): 22-25 (reprint). (Discussion of Vorzugs - Kolpertemperatur of Alligator.)

- FRIEDERICI, G. (1947). "Amerikanistisches Wörterbuch." Hamburg. (not seen). (:152-154 Cayman, etc.)
- GESSLER, R. (1915). "Zur fruheren Verbreitung des Nilkrokodils." Zoologischer Beobachter (= Zool. Garten) 56(10): 257-263.
- GEYER, H. (1925). "Katechismus der Terrarienkunde." Magdeburg. (:134-135 Alligator mississippiensis + abb. 46.)
- GEYER, H. (1949). "Praktische Futterkunde für den Aquarien- und Terrarienfreund." Stuttgart. 106 pp. (:20 Panzerechsen. list of food, culture of aquarium food. 1957 edition: 30.)
- GREGOR, G. (1969). "Farming crocodiles in Kabwe." Horizon 11(7): 4-9. 10 + figs. (Rutledge crocodile farm in Zambia.)
- HADLEY, D. (1969). "Breeding of crocodile in Livingstone Game Park." Puku: Occas. Papers Dept. Wildlife, Fish. Nat. Parks Zambia (5): 226-228. photo. (Crocodylus niloticus female in captivity, dug eggs out of ground, carried 3-4 in mouth to water, then cracked them. 21 young hatched.)
- HAGMANN, G. (1901). "Der Zoologische Garten des Museu Goeldi in Pará (Brasilien), mit besonderer Berücksichtigung der Tierbeschaffung." Frankfurt a M. 55 pp. (:51 Caiman sclerops, C. niger listed; :21 von Marajo :38 etc. keeping notes.)
- HARMAN, I. (1950). "Reptiles as Pets." London. 115 pp. (: 32-33 Alligator mississippiensis.)
- HEDIGER, H. (1950). "Wild Animals in Captivity - an outline of the biology of zoological gardens." London. 207 pp. (Crocodiles: 10, 82, 165, etc.).
- HEDIGER, H. (1955). "Studies of the Psychology and Behaviour of Captive Animals in Zoos and Circuses." London. 166 pp. (:4 crocodile made by Sepik people to hide in ceremony. :149 behaviour in zoo, brief.)
- HEDIGER, H. (1961). "Beobachtungen zur Tierpsychologie im Zoo und im Zirkus." Basel. (: 374-375 Gähnen der krokodile.)
- HEDIGER, H. (1965). "Mensch und Tier im Zoo: Tiergarten - Biologie." Stuttgart. 332 pp. (:20, 97, 172-173. Fig. 101, 102.)
- HEILER, M. (1938). "Freilandbeobachtungen an meinen Hechtalligatoren." Wschr. Aquar. -u. Terrarienk. 35(30): 483, 497-499 (reprint).
- HEINROTH, O. (1924). "Krokodilen des Aquariums." Blätter Aquarien Terrarienkunde 35(8): 218.
- HEINROTH, O. (1941). "Wie brüllt der Alligator?" Der Zoologische Garten (N.F.) 13(3-4): 284-288. 6 photos. (Alligator mississippiensis and other species.)

- HEINROTH, O. (1942). "Wie brüllt der Alligator?" Der Zoologische Bericht 54(6)8: 238. (Abstract of Heinroth, O. (1941).)
- HELLER, R. (1952). "Zur Pflege kleiner Panzerechsen." Die Aquarien -u. Terrarien Zeitschrift 5(2): 55.
- HERALD, E.S., DEMPSTER, R.P. & ENSRUD, P.J. (1967). "Impact of Homo sapiens upon an alligator wishing well." Parks and Recreation 2(9): 30, 57-59.
- HERVEY, G.F. & HEMS, J. (1967). "The Vivarium." London. (:84-86 appendix "Crocodilians." notes on keeping, mentions crocodiles in New York sewers.)
- HIRSCHFELD, K. (1966a). "Paarung und Eiablage der Brillenkaimane im Vivarium Kehl." Die Aquarien Terrar. Zeit. 19(5): 151-154. 5 figs.
- HIRSCHFELD, K. (1966b). "Zucht von krokodilkaiman (Caiman crocodilus) im Vivarium Kehl." Die Aquarien Terrar. Zeit. 19(10): 308-310. 7 photos.
- HIRSCHFELD, K. (1967). "Der Kaiman-Nachwuchs im Vivarium Kehl." Die Aquarien Terrarien Zeitschrift 20(7): 217-219. 7 figs.
- HOCH, R. (1936). "Panzerechsen." Blätter u. Aquarien v. Terrarien kunde 47(7): 166-167.
- HODGE, A.E. (1923). "Vivarium and Aquarium keeping for amateurs. A practical guide to the hobby." London. 127 pp. (:27 keeping hints, :45, 49 alligator-case.)
- HOEFT, E. (1955). "In Hamburg trafen ein" Die Aquarien Terrarien Zeit. 8(2): 54. 1 photo. (Caiman crocodilus.)
- HONEGGER, R.E. (1969a). "Alligatoren - Farmen existieren nicht!" Aquaria 16(7): 104-106. 1 photo.
- HONEGGER, R.E. (1971b). "Zoo breeding and crocodile bank." IUCN Publications (N.S.) Supplementary Paper 32: 86-97. (Survey includes most species.)
- HOOPES, I. (1936). "Reptiles in the home zoo." New England Mus. Nat. Hist. Spec. Publ. 1: 1-64. photos. (:61-64 alligators, care in captivity.)
- HUME, A.N. (1955). "My Family of Reptiles." London. 94 pp. (:63-68 caiman. 2 photos :48.)
- HUNT, R.H. (1969). "Breeding of spectacled caiman (Caiman C. crocodylus) at Atlanta zoo." Intern. Zoo Yearbook 9: 36-37.

- HUNT, R.H. (1971). "Breeding of Morelet's crocodile (Crocodylus moreletii) in Atlanta Zoological Park, Atlanta, Georgia." IUCN Crocodile Specialists Group Newsletter 4: 4-5. (Also Caiman crocodilus crocodilus, treatment of Vitamin E deficiency and low hatching rates.)
- HUNT, R.H. (1972). "Breeding of Morelet's crocodile Crocodylus moreletii." IUCN Crocodile Specialists Group Newsletter 4: 4-5. (Hatching failures due to diet.)
- ✗ HUNT, R.H. (). "Regulated crocodilian growth." (not seen). (Mimeo report G.V. Grass Zool. Park, Atlanta, Georgia, U.S.A.)
- JAHN, J. (1970). "Kleine Terrarienkunde." Minden. 142 pp. (:117-119 Alligator mississippiensis. photo 49; Caiman crocodilus, C. sclerops, brief keeping notes.)
- JENNINSON, G. (1937). "Animals for show and pleasure in Ancient Rome." Manchester. 209 pp. (:41, Oxyrhynchus Papyri I (33): 127 crocodiles to be hungry on arrival of Roman Senator, 112 B.C.; :50, 41, crocodiles used in shows of Scaurus 58 B.C.; :64, 2 B.C. Games of Circus Flaminius, 36 crocodiles in pool; :84 Roman noble Symmachus exhibited crocodiles (3-4 Century A.D.). :90 Elagabalus (A.D. 218-222) kept crocodiles; :97 Symmachus 398 A.D. keeping crocodiles.)
- JARVIS, C. (1965). "Crocodilia bred in captivity in 1963." Intern. Zoo Yearbook 5: 364. (Crocodylus niloticus, crocodile unspecified.)
- JARVIS, C. (1967a). "Crocodilia bred in captivity in 1965." Intern. Zoo Yearbook 7: 348. (Crocodylus niloticus, C. palustris, C. rhombifer, Alligator mississippiensis.)
- JARVIS, C. (1967b). "Census of rare crocodilia in captivity in 1965." Intern. Zoo Yearbook 7: 383. (Crocodylus rhombifer, C. moreletii.)
- JARVIS, C. (1968a). "Crocodilia bred in captivity in 1966." Intern. Zoo Yearbook 8: 338. (Crocodylus niloticus, C. palustris, Alligator mississippiensis, Caiman sclerops, C. latirostris.)
- JARVIS, C. (1968b). "Census of rare Crocodilia." Intern. Zoo Yearbook 8: 379. (Crocodylus rhombifer, Alligator sinensis, A. mississippiensis.)
- JARVIS, C. & BIEGLER, R. (1966a).
- JARVIS, C. & BIEGLER, R. (1966b).
- JARVIS, C. & MORRIS, D. (1961). "Crocodilia bred in captivity in 1960." Intern. Zoo Yearbook 2: 278. (Alligator mississippiensis, crocodile, alligator unspecified.)

- JARVIS, C. & MORRIS, D. (1962). "Crocodilia bred in captivity in 1961." Intern. Zoo Yearbook 3: 285. (Alligator mississippiensis, Caiman crocodilus.)
- JARVIS, C. & MORRIS, D. (1963). "Crocodilia bred in captivity in 1962." Intern. Zoo Yearbook 4: 254. (Crocodylus palustris.)
- JESS, H. (1955). "Beobachtungen an jungen Caiman C. crocodilus (L.) und Paleosuchus trigonatus (Schn.)." Die Aquarien Terrarien Zeit. 8(6): 161-162. 2 photos. (measurements, growth.)
- JOANEN, T. & McNEASE, L. (1971). "Propagation of the American alligator in captivity." Proc. Ann. Conf. S.E. Assoc. Game Fish Comm. 25: 1-23 (reprint).
- KAMMERER, P. (1912). "Das Terrarium und Insektarium." Leipzig. 209 pp. (:105-112 Die krokodile fig. 41-43.)
- * KAUFFELD, C.F. (1939). "Pet alligators." (not seen) Animaland 6(2).
- KAUFFELD, C.F. (1955a). "The care of pet alligators." In Animaland (Staten Island Zool. Soc. 23(3): 3 pp.) (2 photos, 1 drawing, condensation of Kauffeld C.F. (1955b).)
- KAUFFELD, C.F. (1955b). "Pet alligators." Fond du Lac, Wisconsin. 24 pp. (All-Pets Books, Inc.) (Keeping notes: 7 distinguishing sex in alligators by vent scalation.)
- KEMNA, A. (1955) "Haltung und Aufzucht von Kaimanen und Wasserschildkroten." Mitteilungsblatt Europäischen Vivarianer Volk 3(4): 44-47. 1 photo. (Caiman latirostris, C. sclerops, keeping notes.)
- KENNEDY, K. (1951). "Mt. St. John Sanctuary." North Queens-land Naturalist (Cairns) 19(96): 2-3. 1 photo. (Crocodylus porosus. photo.)
- KIMURA, W. (1968a). "Crocodiles of Palau Islands." Attagawa Tropical Garden and Alligator Farm Res. Report 1: 1-40. 15 maps, 4 photos. (In Japanese with English resumé. "New Guinean crocodiles, salt water crocodiles, Philippine crocodiles," imported crocodiles from the Philippines, American alligators from Tokyo.)
- KIMURA, W. (1968b). "On the hatching of crocodile eggs of Palau." Attagawa Tropical Garden and Alligator Farm Res. Report 2: 1-32. 3 maps, 29 photos. (Details of artificial incubation and hatching of 'saltwater species'. In Japanese with English resumé.)
- KIMURA, W. (1969a). "Crocodiles in Cambodia." Research Report 3, Attagawa Tropical Garden, Alligator Farm. 23 pp. in Japanese, English summary. (Crocodylus siamensis, C. porosus, distribution etc., breeding in farms.)

- * KIMURA, W. (1969b). "Wani no Jinko Fuka o kokoromite - Hachurui ni toritsukare te 16 nen." (Trials of artificial incubation of crocodile eggs.) (not seen) Kagaku Asahi 29(5): 85-87. (From National Diet Library, Tokyo.)
- KIMURA, W. (1971). "On the hatching of crocodile eggs of Palau." Acta Herpetologica Japonica 4(1-4): 24-25. (Artificially incubated at 32° and 35°C., possibly salt water crocodile.)
- KIMURA, W. (1972a). "Report No. 2, Study on the artificial incubation of Crocodiles." Bulletin Attagawa Institute Tropical Garden and Alligator Farm (3): 2-9. 5 figs. (In Japanese. Crocodile eggs from Palau island in Micronesia.)
- KIMURA, W. (1972b). "On the protection of Crocodiles." Bulletin Attagawa Institute Tropical Garden and Alligator Farm (3): 27-29. (In Japanese. photo page 32.)
- KIMURA, W. & FUKADA, H. (1966). "Crocodiles of the World." ? Japan. 127 pp. (In Japanese, with scientific names, also common names and index in English. Keeping 20 species in the Attagawa Crocodile Vivarium, synopsis of species; growth, feeding, care, disease, etc. 5 coloured plates, 31 photos, 5 drawings.)
- KING, W.S. (1953). "Stumpy crocodile farm." Nigerian Field 18(4): 171-174. 2 figs. (Abua, Ahoada Division. 2 photos of crocodiles in pens.)
- KISSLINGER, H. (1964). "Haltung und Pflege des Hechtalligators (Alligator mississippiensis)." Die Aquarien Terrarien Zeitschrift 17(8): 224-246. 1 photo. (See POPP, B. (1965).)
- KLINGELHOFFER, W. (1909). "Der zweite Jahrgang des Städtischen Vivariums zu Offenburg-Baden." Blätter Aquarien Terrarienkunde 20 (43): 681-684. 2 photos. (:681 photo krokodilhaus.)
- * KLINGELHOFFER, W. (1911a). "Aus dem Leben der Krokodile." (not seen) Natur. Z. dtsh. naturwiss. Ges (Leipzig) 2: 177-180; 200-205. (From Mertens, R.)
- KLINGELHOFFER, W. (1911b). "Der dritte Jahrgang des Städtischen Vivariums zu Offenburg-Baden." Blätter Aquarien Terrarienkunde 12(4): 49-51. (Brief mention krokodile: Crocodylus cataphractus, C. palustris, Osteolaemus tetraspis.)
- KLINGELHOFFER, W. (1928). "Einrichtung von Zimmer - und Freiland - Aquarien und-Terrarien einschliesslich der Technik der Haltung und Zucht von Fischen, Reptilien und Amphibien." Berlin 465 pp. (:390-394 Die Pflege der Panzerechsen.)

- KLINGELHOFFER, W. (1931). "Terrarienkunde." Stuttgart.
(:329-343 Aquaterrarien für Panzerechsen. Abb. 312-319,
details of keeping, sizes, etc.)
- KLINGELHOFFER, W. (1952). "Vom Sehvermögen der Panzerechsen."
Die Aquarien - v. Terrarien Zeitschrift 5(1): 21-22.
1 photo. (Photo of Melanosuchus niger.)
- KLINGELHOFFER, W. (1955-1959). "Terrarienkunde." Stuttgart.
4 vols.
I Teil: "Allgemeines und Technik." 1955. 167 pp.
II Teil: "Lurche." 1956. 236 pp.
III Teil: "Echsen." 1957. 264 pp.
IV Teil: "Schildkroten, Panzerechsen, Schlangen,
Reptilienzucht und ausführliches Sachregister."
1959. 379 pp.
(I: 11, 43, 56, Fig. 25, in captivity; :159-160 Krank-
heiten Alligator. IV: 298-319 Panzerechsen. 14 fig.
discussion of conditions in captivity, feeding, etc.)
(Zweite ... Auflage von C. Scherpner.)
- KLINGELHOFFER, W. & FAHR, A. (1912). "Der vierte Jahrgang
des Städtischen Vivariums zu Offenburg-Baden, 2 Biologisches.
Die Panzerechsen." Blätter f. Aquarien u. Terrarienkunde
23(7): 103-106. 3 figs.
- KLINGELHOFFER, W. & SCHERPNER, C. (1959). see KLINGELHOFFER, W.
(1955-1959).
- KLUNZINGER, C.B. (1909). "Belehrender Begleiter für Aquarien
- und Terrarien freunde bei Ausflügen und Besichtigung von
Sammlungen, insbesondere vom Ausstellungen." Stuttgart.
82 pp. (:57-58 Krokodile, brief keeping notes.)
- KNIGHT, M. (1952). "Keeping Reptiles and Fishes." London.
(:54-55 crocodiles.)
- KOCH, C. (1924). "Die Abteilung 'Terrarium' Reptilien und
Amphibien." Blätter Aquarien Terrarienkunde 35(10):
259-260. photo. (Photo of junger alligator.)
- KOLLER, O. (1949). "Das Amerikanische Spitzkrokodil
(Crocodylus americanus Laur.) in Freiheit und Gefangenschaft."
Wochenschrift Aquarien - u. Terrarienkunde 43(7): 197-201.
1 drawing. (Also C. cataphractus.)
- KORFER, W. (1927). "Mein Alligator mississippiensis." Wschr.
Aquar. -u. Terrarienkunde 24: 40.
- KORNALIK, F. (1941). "Die Odematose bei Panzerechsen als
Heilbare B-Vitaminkarenz." Der Zoologische Garten (N.F.)
13(3-4): 300-304.
- KREFFT, P. (1905). "Krokodile im Zirkus." Blätter Aquarien
Terrarienkunde 16(4): 37-38. 1 photo. (Performer in with
animals (Mr. Pernlet).)

- KREFFT, P. (1907-08). "Das Terrarium." Berlin. "III Abschnitt. Das Leben d. Kriechtiere u. Lurche u. ihre Haltung im Vivarium." (:501-503 Die Panzerechsen. 2 figs.)
- KREFFT, P. (n.d. 1908). "Reptilien - und Amphibienpflege." Leipzig. 144 pp. (:5-6, Panzerechsen. 1 photo. :44-45.)
- ✓ KREFFT, P. (1910). (C. niloticus Madagascar.) (not seen)(:255.)
- KREFFT, (P.) (1912). "Krokodilpflege." Blätter f. Aquarien u. Terrarienkunde 23(49): 795. (Question and answer on keeping of crocodiles in aquaria.)
- KREFFT, P. (1926a). "Das Terrarium. III. Abschnitt. Besondere Hinweise für die Haltung, Pflege und Zucht usw." (:463-468 Die Panzerechsen. Fig. 186-188. keeping notes, sizes, temperature, etc.)
- KREFFT, P. (1926b). see WERNER, F. (1926).
- ✓ KUCHLING, G. (1971). "Summer vacation for terrarium animals." Aquarien Mag. 5(5): 210-212 (not seen). (Includes crocodiles.)
- LACHMANN, H. (1897). "Meine Kaimans." Blätter Aquarien Terrarienkunde 8(21): 250-252. 11 fig. (22): 260-263. (Alligator lucius, A. niger.)
- LACHMANN, H. (1900). "Panzerechsen im Terrarium." Nerthus 2: 60-62.
- LAMBRIS, A.J. (1965). "Some observations on certain reptiles and amphibians in captivity." Journ. Herp. Assoc. Rhodesia (23-24): 53-55. (Brief mention only that young Crocodylus niloticus like being tickled on belly.)
- LE BUFF, C.R. (1957a). "Observations on captive and wild North American crocodilians." Herpetologica 13(1): 25-28.
- LEDERER, G. (1927a). "Die Bedeutung des Lichtes in der Tierpflege. (Beobachtungen aus dem Zoologischen Garten der Stadt Frankfurt a. M.)." Blätter Aquarien Terrarienkunde: 38(2): 36-42. 1 fig. (3): 63-64. (:41 Crocodylus porosus, Alligator mississippiensis, Caiman sclerops.)
- LEDERER, G. (1927b). "Neue Wege in der Tierhaltung und -Zucht." Entom. Zeitsch 41: 161-167. (:164-165 crocodiles; effects of light in captivity.)
- LEDERER, G. (1933). "Rachitis bei Reptilien und Lurchen." Wochenschrift f. Aquarien u. Terrarienkunde 30(48): 765-767 (28 November). (Incl. Krokodilien.)
- ✓ LEDERER, G. (1934). "Krokodil im Zoo." (not seen) Frankfurter Zoo Zeitung 11(7): 14.
- ✓ LEDERER, G. (1940). "Der China Alligator." (not seen) Frankfurter Zoo Zeitung 17: 8.

- LEDERER, G. (1941). "Zur Haltung des China - Alligators (Alligator sinensis Fauvel)." Der Zoologische Garten (N.F.) 13(3-4): 255-263. 5 photos.
- LEGGE, R.E. (1966a). "Mating behaviour in the American alligators at Belle Vue Zoo Park, Manchester." The Aquarist 31: 138-139. 1 fig. (October.) (Photo head Alligator mississippiensis.)
- ✓ LEGGE, R.E. (1966b). "Mating behaviour of the American alligator." (not seen). Int. Zoo News 13(3): 91-93.
- LEGGE, R.E. (1967). "Mating behaviour of American alligators (Alligator mississippiensis) at Manchester Zoo." Intern. Zoo Yearbook 7: 179-180.
- LEGGE, R.E. (1969). "Further notes on the mating behaviour of American alligators (Alligator mississippiensis) at Belle Vue Zoo, Manchester." Intern. Zoo Yearbook 9: 35.
- LEHMANN, H.D. (1968). "Wegweiser durch die Ausstellung Lebender Amphibien und Reptilien." 'Terrarienaustellung 1968 im Kölner Rheinpark.' Köln. Dellbrück. 40 pp. (:16-18 krokodile. 1 photo Caiman crocodilus.)
- LEKAGUL BOONSONG (1969b). "Raising crocodiles and monitors encouraged in Thailand." Conservat. News, S.E. Asia 8: 38.
- LEUTSCHER, A. (1952). "Vivarium Life: A Manual on amphibians, reptiles and cold-water fish." London. 230 pp. (134-135 Alligator mississippiensis, brief notes.)
- LEUTSCHER, A. (1961). "Vivarium Life: A Manual on amphibians, reptiles and cold-water fish." Second edition - London. (:156-157 Mississippi alligator.)
- LEUTSCHER, A. (1963). "A Study of reptiles and amphibians including their care as pets." London. (:38-41. Fig. 32-35, general notes.)
- LUCAS, J. (1969a). "Crocodilia bred in captivity in 1967." Intern. Zoo Yearbook 9: 268. (Crocodylus niloticus, C. palustris, Alligator mississippiensis, Caiman crocodilus.)
- LUCAS, J. (1969b). "Census of rare Crocodilia." Intern. Zoo Yearbook 9: 304. (Crocodylus rhombifer, C. moreletii, Alligator sinensis.)
- LUCAS, J. & DUPLAIX-HALL, N. (1972a). "Crocodilia bred in captivity during 1970." Internat. Zoo Yearbook 12: 371. (Alligator mississippiensis, Caiman crocodilus, Crocodylus moreletii, C. niloticus × C. acutus, C. palustris, Osteolaemus tetraspis.)
- LUCAS, J. & DUPLAIX-HALL, N. (1972b). "Census of rare crocodilians in captivity February to June 1971." Intern. Zoo Yearbook 12: 405-406. (Alligator chinensis, Crocodylus moreletii, C. rhombifer, Gavialis gangeticus.)

- McNEELY, J. (1972). "In Thailand wurden 15,500 krokodile gezuchtet." Das Tier 12(5): 34-39. 10 photos. (Samutprakan farm, Bangkok, Thailand.)
- MATZ, G. (1965). "L'élevage d'amphibiens et de reptiles exotiques en captivité." Bull. l'Assoc. Philomat. d'Alsace et de Lorraine 12(1): 79-91. 4 figs. (:89 et Fig. 4 crocodiles. :89-90 maladie Caiman.)
- MEDLEY, C. (1970). "One way to halt poaching - gator farming." New York Times 18 Jan. 1970: 7. 3 photos.
- MITSCH, H. (1936). "Panzerechsen." Wschr. Aquar. -u. Terrarienkunde 33: 37-39. (Alligator mississippiensis.)
- MOLLISON, J. (1952). "Crocodiles 'at home'." Victorian Naturalist 69(7): 100. (Crocodilus porosus reported breeding in captivity Townsville, Australia.)
- ✓ MOOR, C.B. (1937). "The Book of Wild Pets." New York. (not seen) (:186 alligator.)
- MORITZ, E. (1951). "Max und Moritz, meine beiden Mohrenkaimane!" Die Aquarien Terrarien Zeitschrift 4(11): 304-305. (In captivity, longerwarteten Kaimane 30 cm. lange.)
- MULLER, E. (1933). "Heizung eines Alligatorenbehalters." Bl. Aquarien -u. Terrarienkunde 44: 331-332. 1 fig.
- MULLER, L. (1899). "Das Panzerkrokodil (Crocodylus cataphractus)." Natur. und Haus 7(16): 263-266. 1 drawing.
- MULLER, L. (1903). "Das Stumpfkrokodil (Osteolaemus tetraspis Cope)." Natur. und Haus 11: 4-9.
- MULLER, L. (1909). "Aquarium und Reptilienhaus des Zoologischen Gartens zu Frankfurt a. M." Blätter Aquarien Terrarienkunde 20(19): 289-291. 2 photos
(20): 308-313. 1 photo
(21): 324-329. 2 photos (Alligator sinensis in aquarium. Crocodylus palustris, Osteolaemus tetraspis: 325-329 particularly. Scattered references.)
- MULLER, L. (1928). "Das Halten und Züchten zoologischer Untersuchungsobjekte. I Süsswasser - Aquarien und Terrarien." Methodik Wissensch. Biol. 2: 149-231. 17 + fig. (:216 Krokodile.)
- MULLER, P. (1970). "Notes on reptile breeding at Leipzig Zoo." Internat. Zoo Yearbook 10: 104-105. (Alligator sinensis laid 6 eggs in water in captivity.)
- MUNTZNER, J. (1970). "Zoo to zoo alligator transport." Herp. New York Herp. Soc. Bull. 6(3/4): 32-34. 15 photos. (All picture story.)

- ✓ MUSSHOF, H. (1903). "Das Terrarium und seine Bewohner."
Berlin. (not seen) (:49. A. lucius, from Mertens, R.)
- MUSSHOF, H. (1908). "Die Panzerechsen (Crocodilia)."
:3-22 in "Bibliothek für Aquarien-und Terrarienkunde
10. Das Terrarium. I. Teil; Einheimische Reptilien und
ihre Pflege." (Keeping notes, size, temperature, several
species.)
- NIETZKE, G. (1972). "Die Terrarientiere. Bau, technische
Einrichtung und Bepflanzung der Terrarientiere in zwei
Banden Zweiter Band. Pflanzen im Terrarium, Zucht und
Aufzucht, Freilandaufenthalt und Überwinterung, Terrarien-
tiere 11: Krokodile, Echsen, Schlangen." Stuttgart. 299pp.
(:19 species and Futter. :22 Zwangsfütterung. :25-39 Abb.
2-7. general keeping notes, and species details: Alligator
mississippiensis, Caiman crocodilus, Crocodylus acutus,
C. cataphractus, C. niloticus, Osteolaemus tetraspis,
Paleosuchus palpebrosus, P. trigonatus, Tomistoma schlegelii.)
- ✓ O'CONNELL, J.H. (1905). "Young crocodilians in captivity."
(not seen) Trans. Liverpool Biol. Soc. 19: 165-179.
- ✓ O'CONNELL, J.H. (1912). (not seen) Trans. Liverpool Biol.
Soc. 24: 1-12.
- PAWLEY, R. (L) (1963). "Propagating reptiles." Intern. Zoo
Yearbook 4: 95-97. (Hints for captive crocodilians, etc.)
- PAWLEY, R.L. (1967). "Mixing it up in Brookfield's Reptile
House." Animal Kingdom 70(3): 90-95. 7 photos. (Photo
Chinese alligator, notes on Morelet's crocodile in captivity.)
- PEAKER, M. (1967). "Rearing young caymans." Aquarist and
Pondkeeper 32(2): 46-47, photo.
- PEAKER, M. (1969a). "Some aspects of the thermal requirements
of reptiles in captivity." Intern. Zoo Yearbook 9: 3-8.
(Includes crocodilians.)
- PEAKER, M. (1969b). "Active acquisition of stomach stones in
a specimen of Alligator mississippiensis Daudin." British
Journ. Herpetology 4(4): 103-104.
- POOLEY, A.C. (1966). "Crocodiles and crocodile farming."
African Wildlife 20(3): 210-216. 5 photos. (Preliminary
account.)
- POOLEY, A.C. (1969a). "Rearing crocodiles in Zululand."
African Wildlife 23(4): 314-320. 4 photos.
- POOLEY, A.C. (1969c). "Some observations on the rearing of
crocodiles." Lammergeyer 3(10): 45-57.
- POOLEY, A.C. (1969e). "Addendum to crocodile rearing paper."
Lammergeyer 3(10): 58-59.

- POOLEY, (A.C.) T. (1970). "Crocodile rearing in Zululand." Animals (London) 13(2):76-79. 5 photos. (Crocodylus niloticus in artificial hatcheries.)
- POOLEY, A.C. (1971a). "Conservation of the Nile Crocodile (Crocodylus niloticus).". Roneo report Natal Parks, Game and Fish Preservation Board - Pietermaritzburg. 29 pp.
- POOLEY, A.C. (1971b). "Crocodile rearing and restocking." IUCN Publications (N.S.) Supplementary Paper 32: 104-130. 4 figs. (Crocodylus niloticus, reprint of Pooley (1971a) with minor corrections.)
- ✓ POPP, B. (1933). "Panzerechsen." (not seen) Deutsch Almanach Aquar. Terrarienkunde :133+ (From Mertens, R.)
- POPP, B. (1963). "Meine Tiere. Beobachtungen an Reptilien und Amphibien im Heim und in der freien Natur." Dessau. 244 pp. (:36-42 Die Panzerechsen. 5 photos. Keeping notes, temperatures, sizes etc., several species.)
- POPP, B. (1965). "Zum Artikel: Haltung und Pflege des Hechtalligators." Die Aquarien Terrarien Zeitschrift 18(3): 94. (Concerns Kisslinger, H. (1964).)
- PRAKASH, M. (1971). "Crocodile (Crocodylus palustris) breeding at the Jaipur Zoo." Journ. Bombay Nat. Hist. Soc. 68(3): 835-837.
- PUFFETT, D.F. (1972a). "Raising crocodiles in village pens." D.A.S.F. Wildlife Leaflet 72/2. (Roneo 12 pp. + diagram. Papua New Guinea.)
- PULKOWSKI, H. (1930a). "Von Alligatoren, Krokodilen und Schildkroten." Wochenschrift f. Aquarien - u. Terrarienkunde: 27(14): 226-227 (8 April)
(16): 264-265 (22 April)
(19): 310-311 (13 Mai)
(24): 360-361 (17 June)
(27): 444-445 (8 Juli) (History of alligators in captivity.)
- ✓ PULKOWSKI, H. (1930b). (not seen) Wochen.Aquar.Terr. 27:395-396.
- RATCLIFFE, H.L. (1966). "Diets for Zoological Gardens: aids to conservation and disease control." (not seen) Intern. Zoo. Yearbook 6: 4-23.
- REESE, A.M. (1901a). "Artificial incubation of alligator eggs." Amer. Naturalist 35(411): 193-195.
- REESE, A.M. (1947b). "Reactions of the alligator in an artificial environment." Anat. Record 99(4): 646 (abstract).
- REESE, A.M. (1948). "Hibernation of the alligator in an artificial environment." Herpetologica 4(4): 127-128.

- ROBERTS, M.F. (1958). "Alligators and Crocodiles as Pets. A guide to their selection and care." Jersey City, N.J. 26 pp. 21 photos. (A T.F.H. Publication.)
- ROTTER, J. (1955). "Meine Beobachtungen an Krokodilen." Aquarien und Terrarien (Leipzig & Jena) 2: 87-91 (reprint). (Gavialis gangeticus, Alligator sinensis, Osteolaemus tetraspis, Caiman crocodilus, C. latirostris.)
- RUST, H.T. (1937a). "Panzerechsen in Taschenkalender für Aquarien-und Terrarienkunde 1937." :153-191. (Detailed discussion of 27 species.)
- RUST, H.T. (1937b). "Panzerechsen in Liebhaberhänden." Wochenschrift f. Aquarien-und Terrarienkunde: 34(20/21): 296-297 (22): 317-319. 2 photos. (Several species of crocodilians.)
- RUST, H.T. (1938). "Über eine selten in der Gefangenschaft gehaltene Panzerechse." Blatt. Aquar. Terrar. 7: 98-99. (Caiman crocodilus fuscus, Kolumbien.)
- RUST, H.T. (1941). "Beitrag zur Haltung des Chinesischen Alligators." Der Zoologische Garten (N.F.) 13(3-4): 263-265. 1 photo.
- RUTLEDGE, J. (1969). "Crocodile farm." Parts 1 and 2. Black Lechwe 7(4): 23-25. 2 photos. (5): 4-7. 1 photo. (Crocodylus niloticus, location: Kabwe, eggs from wild, hatched on digging up. Survey of Luangwa area.)
- SACHS, W.B. (1925). "Herbst - Import." Blätter Aquarien Terrarienkunde 36(15): 404-405. (Includes Alligatoren.)
- SACHS, W.B. (1930). "Zur Haltung von Krokodilen." Blätter f. Aquarien-und Terrarienkunde 41(5): 78-80. 3 plates. (8 photos.)
- SACHS, W.B. (1948). "Giftzahn und Schleuderzunge." Stuttgart. 80 pp. (:27, 74-77. General notes on status & conservation.)
- SACHS, W.B. (1956). "Een en ander over mijn dieren-tehuis." Lacerta 14(9-10): 65-67. 2 photos. (Includes Alligator mississippiensis, Caiman sclerops, Crocodylus americanus, photo of Caiman latirostris.)
- ✓ SACHS, W.B. (1959). "Krokodile in der wohnung." (not seen) Kosmos (Stuttgart) 55(12): 543-544.
- SACHS, W.B. (1964). "Unfälle mit Amphibien und Reptilien." Münchener Medizinische Wochenschrift 106(20): 952-958. 8 photos (reprint 20 pp.) (:6-7 krokodile. 2 photos.)

- SACHS, W.B. (1969). "Schocken-wirkung auf einen Brillenkaiman, Caiman crocodilus?" Die Aquarien Terrarien Zeitschrift 22(4): 126-127. (Also Crocodylus acutus, Tomistoma schlegelii.)
- SACHS, W.B. & OESER, R. (1953). "Terrarienpflege leicht gemacht." Stuttgart. 76 pp. (:19, 51-53, keeping notes, written temperatures.)
- SAPORITI, E.J. (1957). "Observaciones Sobre Reproducción de Reptiles en el Jardin Zoologico de la Ciudad de Buenos Aires." Rev. Diana (208/209/210): 15 pp. (reprint unpagged) photos. (9. 'Yacare du hocico corto' (Caiman latirostris), 3 photos. :12-14.)
- SCHERER, J. (1902a). "Caiman latirostris." Blätter Aquarien Terrarienkunde 13(4): 42-44, 1 fig. (5): 51-52. (Notes and drawing.)
- SCHERER, J. (1904). "Das Leistenkrokodil (Crocodylus porosus Schneid)." Blätter Aquarien Terrarienkunde 15(9): 129-131. 1 fig.
- SCHERER, J. (1905). "Das amerikanische krokodil (Crocodylus americanus Laur.) in Freiheit und Gefangenschaft." Nerthus 7(8): 125-128. + 1 plate. (Keeping notes.)
- SCHNEE, P. (1905). "Einiges über Krokodile, was ich von ihnen sachen und horte." Blätter Aquarien Terrarienkunde: 16(1): 1-4 (2): 14-16 (3): 21-22 (6 photos: Caiman sclerops, Osteolaemus tetraspis, Crocodylus niloticus, C. cataphractus, C. porosus, Alligator mississippiensis.)
- SCHNEIDER, E. (n.d.) "Enjoy your Alligator." New York. 31 pp. (21 photos alligators as pets.)
- ✓ SCHNEIDER, K.M. (1938). "Das Farbfoto - Buch vom Zoo." Leipzig. 88 pp. (not seen). ('crocs:88' from Mertens, R.)
- SCHNEIDER, K.M. (1941a). "Unsere Tiergarten im Winter 1939/40 - Leipzig." Der Zoologische Garten (N.F.) 13(1-2): 36-38. photos. (:45 list of species.)
- SCHNEIDER, K.M. (1941b). "Einige Gefangenschaftsbeobachtungen über die Fortpflanzung des Hechtalligators (Alligator mississippiensis Daudin)." Der Zoologische Garten (N.F.) 13(3-4): 275-284. 4 figs. (1 photo, 3 drawings, notes on mating.)
- SCHNEIDER, K.M. (1942a). "Zur Tauchdauer der Hechtalligators." Zool. Garten (N.F.) 14(3): 156-157.
- SCHNEIDER, K.M. (1942b). "Fettlager im krokodilschwanz." Zool. Garten (N.F.) 14(5/6): 263-267. 4 figs. (Alligator mississippiensis, Osteolaemus tetraspis.)

- ✓ SCHNEIDER, K.M. (1942c). "Ein Hechtalligator mit Kunstlichen Kiefern." (not seen). Zahnärztl. Mitt. 34: 120-121. (From Dathe (1960): 292.)
- SCHNEIDER, K.M. (1943a). "Von den Entleerungen einiger Panzerechsen." Zool. Anz. 142(5/6): 95-101. 2 photos.
- ✓ SCHNEIDER, K.M. (1943b). "Ein Hechtalligator mit kunstlichen Kiefern." (not seen). Zahnärztliche Mitt. 13(14): 1-2. (See (1942c).)
- SCHNEIDER, K.M. (1948). "Haben Sie das schon einmal beobachtet? Wie krokodile fressen." Mitteil. Zool. Garten Leipzig (N.F.) 8: 14-20, 13. 4 photos. (Notes on keeping, several species.)
- SCHNEIDER, K.M. (1953). "Vom Leipziger Zoo aus der Entwicklung einer Volksbildungsstrategie." Leipzig. 228 pp. (Incidental references listed index: 226, 225.)
- SCHNEIDER, K.M. (1957). "Tiere haben das Wort." Leipzig etc. 392 pp. (:142-144 Vor krokodilen im Zoo.)
- SCHNEIDER, K.M. (1960). "Tiere im Zoo." Wittenberg. 125 pp. (:122-125 krokodile. 1 photo Caiman sclerops.)
- SCHOENHER, R.J. (1967). "How we controlled roaches in the Aquarium of Niagara Falls, N.Y., amidst rare fish and alligators!" Pest Control 35(10): 22-24. 5 + figs. (Phosphorus paste.)
- SCHWEIZER, R. (1909). "Mein Nilkrokodil." Wschr. Aquar.-u. Terrarienkunde 6: 23-24.
- SCHWEIZER, R. (1910). "Panzerechsen." Wschr. Aquar.-u. Terrarienkunde 7(25): 97-99.
- ✓ SCHWEIZER, R. (1911). Woch. Aqu. Terrarienkunde 8: 66-67. (not seen). ('Crocodylus niloticus', from E. Schirner, mss.)
- SCHWEIZER, R. (1913a). "Etwas vom Stumpfkrokodil." Blätter Aquarien u. Terrarienkunde 24(9): 633-636. 2 photos. (Osteolaemus tetraspis.)
- SCHWEIZER, R. (1913b). "Allerlei vom Alligator." Wochen-schrift Aquar. Terrarienkunde 10(20): 343-345. 2 photos.
- SEIDL, F. (1963). "Beobachtungen an einem Caiman crocodilus." Die Aquarien Terrarien Zeitschrift 16(3): 88-89. 1 photo. (Notes in captivity.)
- "SHAW, C.E. (1957). "'Wuhu' the Chinese alligator." Zoonooz (San Diego) 30(10): 10-11. 2 photos.
- SHAW, C.E. (1960). "Ways and wiles of alligators." Zoonooz 33(10): 10-13. 4 figs. (Crocodilians in captivity, photos.)

- ✓ SOSSNOWSKY, J. (1961). "Terrarium in Moskowskij Zoo Park." Moskva. (not seen). (: 65-69.)
- ST(EHLI), G. (1913). "Aus einer Alligatoren farm." Kosmos 10(9): 341-344. 2 photos. (Alligator mississippiensis, Los Angeles, California, U.S.A.)
- STONEMAN, J. (1969a). "Notes on growth and feeding of Crocodylus niloticus." Occas. Paper Ministry Animal Industry, Game & Fisheries, Fisheries Dept. Republic of Uganda (2): 11-14, 3 pl.
- ✓ TAKASHIMA, H. (1950). (Haruo Takashima) "Atami no Wani En." (Crocodile Gardens at Atami) Saishu to Shiiku 12(1): 17. (not seen). (From National Diet Library, Tokyo.)
- TOFOHR, O. (1901). "Er und sie. Alligator lucius und Aromochelys odoratum." Blatter Aquarien Terrarienkunde 12(8): 101-103, 115-116. 2 photos.
- TOFOHR, O. (1913). "Das Terrarium. IV. Teil. Die Ordnung: Crocodilia, Rhiptoglossa, Rhynchocephalia, ihre Haltung und Pflege." Bibliothek für Aquarien-und Terrarienkunde 33: 1-39. 9+ figs. (:3-22 Die Panzerechsen (Crocodilia).)
- TOFOHR, O. (1916). "Eine krokodilfütterung." Lacerta (1): 3-4, (2): 11-12. (Crocodylus porosus; C. americanus, C. cataphractus, C. palustris, C. intermedius, Caiman sclerops, C. niger, C. palpebrosus, Osteolaemus tetraspis.)
- TOFOHR (O). (1917). "Krokodilfutter" & "Ein Schwamm fresser." Lacerta (4): 30-31. (Crocodylus cataphractus.)
- TOWERS, H.C. (1956). "Crocodiles answer keeper's call." Zoo Life 11(1): 15. photo. (Abera village near Kotah in Rajasthan, India.)
- TOWNSEND, C.H. (1916). "Large Alligator." Bull. New York Zool. Soc. 19(2): 1345, 1342, 1 photo. (Nearly ten feet, in captivity 1903-1916.)
- ✓ TOWNSEND, H. (1972). "There are crocs at the bottom of our garden." (not seen). Afr. Wildlife 26(3). (Crocodylus niloticus in captivity for 19 years. From Pooley.)
- VILLIARD, P. (1969). "Reptiles as Pets." New York. 189 pp. (: 48, 60, 69-70, 84, 147-148 crocodilians.)
- VOGEL, Z. (1959a). "Seltene Terrarientiere aus dem Fernen Osten." Aquarien und Terrarien 6: 45-47. 3 photos. (Alligator sinensis in captivity.)
- VOGEL, Z. (1959b). "Über das postembryonale Wachstum einiger krokodile." Zoologische Garten (N.F.) 24(3/4): 222-227. 6 photos. (Growth of several species, photos of Caiman latirostris.)

- VOGEL, Z. (1963). "Wunderwelt Terrarium." Leipzig. 255 pp. (:126-133 krokodile. Plates 36-44 photos of Crocodylus cataphractus, Tomistoma schlegelii, Caiman crocodilus fuscus, Melanosuchus niger, Caiman niger, Alligator sinensis, A. mississippiensis.)
- VOGEL, Z. (1964). "Reptiles and Amphibians - their care and behaviour." London. (Orig. edit. Berlin 1963). (:44-46 catching; :211 tears; :117-123 crocodiles and alligators. Plates 33-34 colour photos, 36-44 photos.)
- VOGEL, Z. (1966c). "Terrarien-Taschenatlas. Terrarien in Zoo und Heim." Prague. 294 pp. (:142-147 Krokodile - die Ritter vergangener Zeiten. :194-195 text and colour figure Gavialis gangeticus.)
- VOGT, D. & WERMUTH, H. (1961). "Knaurs Aquarien -und Terrarienbuch. Das Haus -und Handbuch der Vivaristik." München. 280 pp. (:31, 104-105, 236-238.)
- VOGT, D. & WERMUTH, H. (1963). "The Complete Aquarium." (not seen). (:224-226, 228-229 English edition of Vogt, D. & Wermuth, H. (1961).)
- WALKER, E.P. (1942). "Care of captive animals." Smithsonian Report 1941: 305-366 (Publ. 3664). (:358 Crocodilians.)
- WALLIS, K. (1925). "Kon meinem Spitzkrokodil (Crocodylus americanus Laur)." wschr. Aquar. -u. Terrarienkunde 22: 388-389. (Also Alligator mississippiensis and Caiman latirostris in captivity.)
- WEHNER, W. (1966). "Kleine Terrarienkunde. Eine Anleitung zur pflege von Lurchen und Kriechtieren." Leipzig etc. 124 pp. (:103 Panzerechsen brief notes.)
- WELLS, M. (1964). "Pets not to keep." (not seen). (:89-93 in "You, me and the Animal World." Boston.)
- WERNER, F. (1898b). "Über Tropenreptilien im Terrarium." Natur & Haus 6: 132-135, 151-154. (:153 krokodile.)
- WERNER, F. (1899a). "Über Tropenreptilien im Terrarium." Natur & Haus 7: 413-418. (Bestimmungstabelle für krokodile.)
- WERNER, F. (1926). "II. Abschnitt. Bestimmen der Reptilien -und Amphibienarten." in P. Krefft, "Das Terrarium." (:282-285 Crocodilia (Panzerechsen). I. + fig. neck shields. Key to species, notes on distribution, etc.)
- WIJFFELS, L. (1955). "Ervaringen met zelf geïmporteerde terrariumdieren, De Groene Leguaan (Iguana iguana iguana Laurenti)." Lacerta 13(4): 25-27. 1 photo. (Includes note on Caiman sclerops.)
- WILD, O. (1928). "Gehör oder Witterung?" Blätter Aquarien Terrarienkunde 39(7): 140, 242. (Alligator.)

- WORRELL, E. (1945). "Freshwater crocodile in captivity." Proc. Roy. Zool. Soc. New South Wales 1944-45: 30-32. 2 photos. (Crocodylus johnsoni from Katherine River, Northern Territory, Australia; probably hatched November.)
- ✓ YADAV, R.N. (1968). "Birth of young crocodiles." (not seen). Int. Zoo Yearbook Zoo News 15(2): 43. (From Honegger, R.E.)
- YADAV, R.N. (1969). "Breeding the Mugger crocodile (Crocodylus palustris) at Jaipur Zoo." Intern. Zoo Yearbook 9: 33.
- YANGPRAPAKORN, U., MCNEELY, J.A. & CRONIN, E.W. (1971b). "Captive breeding of crocodiles in Thailand." IUCN Publications (N.S.) Supplementary Paper 32: 98-101. (Crocodylus porosus, C. siamensis.)
- ZAHL, P.A. (1954). "In the wilds of a city parlor." Nat. Geog. Mag. 106(5): 645-672. 33 photos. (:661 Caiman in aquaria. :663 young caimans, colour photo of heads.)
- ✓ ZEDWITZ, F.X. (1930). (Fr. Xavier Graf Zedwitz) "Alligatoren im Berliner Zoologischen Garten." (not seen) Das Aquarium (Berlin): 95-96.
- ZERNECKE, E. (1906). "Leitfaden für Aquarien -und Terrarien-freunde." Leipzig. 455 pp. (:365-366 keeper's notes.)
- ✓ ANON (1882). "The profession of alligator farming has been developed in California." Daily News 8 June 5/3. (not seen). (From Mertens, R.)
- ANON (1968a). "Crocodile farm in Natal." Oryx 9(5): 324. (Ndumu Game Reserve.)
- ✓ ANON (1968g). "Farming of crocodiles new project in Uganda." African Wildlife News 3(1): 9. (not seen).
- ✓ ANON (1970s). "Aquarium crocodiles." Vancouver Aquar. Newsletter 14(4): 4. photo. (not seen).
- ANON (1970t). "Crocodile Nursery." African Wildlife News May: 7. (Kabwe, Zambia, by J. Rutledge.)
- ANON (1971d). "Handbag farming can be a nightmare." Airways (Sept. 1971): 12-15. 5 photos. (Binga, Lake Kariba, northwest Rhodesia, farm of K. & A. van Jaarsveld.)
- ✓ ANON (1972d). "Reptilia: Crocodylia: conditions for keeping crocodiles." Herpetol. Rev. 4(1): 17-18. (not seen).

The International Union for Conservation of Nature and Natural Resources (IUCN) is an independent international body, formed in 1948, which has its headquarters in Morges, Switzerland. It is a Union of sovereign states, government agencies and non-governmental organizations concerned with the initiation and promotion of scientifically-based action that will ensure perpetuation of the living world - man's natural environment - and the natural resources on which all living things depend, not only for their intrinsic cultural or scientific values but also for the long-term economic and social welfare of mankind.

This objective can be achieved through active conservation programmes for the wise use of natural resources based on scientific principles. IUCN believes that its aims can be achieved most effectively by international effort in cooperation with other international agencies, such as Unesco and FAO.

The World Wildlife Fund (WWF) is an international charitable organization dedicated to saving the world's wildlife and wild places, carrying out the wide variety of programmes and actions that this entails. WWF was established in 1961 under Swiss law, with headquarters also in Morges.

Since 1961, IUCN has enjoyed a symbiotic relationship with its sister organization, the World Wildlife Fund, with which it works closely throughout the world on projects of mutual interest. IUCN and WWF now jointly operate the various projects originated by, or submitted to them.

The projects cover a very wide range from environmental policy and planning, environmental law, education, ecological studies and surveys, to the establishment and management of areas as national parks and reserves and emergency programmes for the safeguarding of animal and plant species threatened with extinction as well as support for certain key international conservation bodies.

WWF fund-raising and publicity activities are mainly carried out by National Appeals in a number of countries, and its international governing body is made up of prominent personalities in many fields.