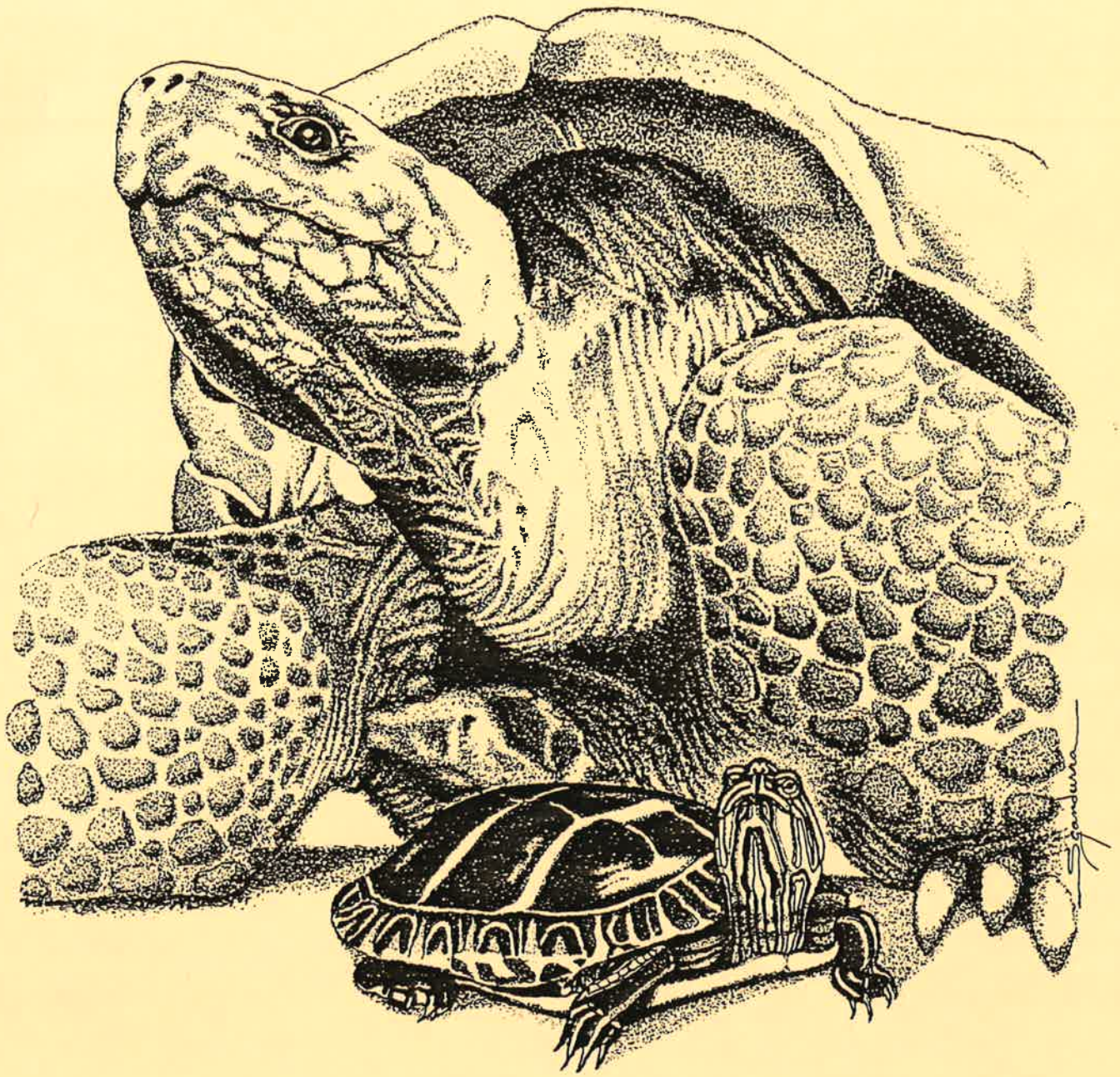

TORTOISES & TURTLES

No. 5, October 1990

IUCN Tortoise and Freshwater Turtle Specialist Group

TORTOISES & TURTLES

Newsletter of the IUCN Tortoise and Freshwater Turtle Specialist Group

No. 5 October 1990

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Editorial

This newsletter is late, but large. I hope the latter will compensate for the former.

For a group as vigorous as ours, there is an inevitable tendency for a newsletter to evolve into a journal. In a sense this is to be resisted; there are many journals that will accept valid scientific contributions to the conservation biology of turtles and tortoises, but we only have one newsletter in which to distribute less formal information, or to circulate opinions, to give notice of meetings, and to publicize similar ephemera.

But we will try and present both news and science, in the hope that this will not mean that neither will be done well. We will always be available as a medium for news-type information submitted by members of the Group, but we will also publish papers of definitive value if they are relevant and not too long. But we will not go so far as peer review. Your editor will correct obvious errors, alter grammar or organization of manuscripts that seem to need it, and sometimes shorten long but worthwhile papers as judiciously as possible. But beyond that, authors' errors may survive unchallenged. Be warned, but not intimidated!

Klemens to Spearhead Action Plan Implementation

Michael Klemens, specialist on *Clemmys*, staff member of the Herpetology Department at the American Museum of Natural History, and recent zoology graduate student under Ian Swingland at the University of Kent, has been appointed by the co-chairmen and by IUCN to direct the implementation of the Tortoise and Freshwater Turtle Action Plan. He will be based at the American Museum of Natural History during this three-year assignment. His functions will include updating the individual action plans included in the Comprehensive Plan distributed at the Canterbury Congress, coordinating the various recovery efforts, and working with the co-chairmen and with George Rabb's staff in Chicago to identify funding for the various plans. A message from Klemens calling for support and assistance in this undertaking appears elsewhere in this newsletter.

Comment on *The Conservation Biology of Tortoises*

Commentary upon the Conservation Biology of Tortoise volume, edited by Swingland and Klemens and distributed at the Canterbury Congress (and still available) has generally been extremely positive. However, both co-chairmen recently received a series of critical comments from David Germano about the Desert Tortoise entry in this volume. This species account was authored by Group Vice Chairman Kristin Berry, with whom I consulted in preparing these responses. Germano's comments are paraphrased somewhat for brevity.

Germano:

Many of Berry's points are not new but have been repeated so often that the IUCN does not doubt her conclusions. Several of the arguments for endangered status are particularly unsupported by data.

Response:

The basic reference document on the status of the desert tortoise is an 800 plus-page report entitled "The Status of the Desert Tortoise (*Gopherus agassizii*) in the United States," prepared by various authors (including Dr. Berry) for the USFWS. The review process, conducted by representatives of three major conservation groups, was extremely stringent, and the consensus was that the species should be listed as endangered or threatened under the ESA. Since 1984, the situation has worsened. A fatal upper respiratory disease has decimated some of the western populations, an unidentified shell necrosis disease has broken out in the Chuckwalla Bench population, habitat continues to be destroyed, and predation upon juveniles by ravens has become very serious. I suspect that the data available for the desert tortoise place it in the top first or second percentile of endangered species as regards abundance of data on population trends and survival and thoroughness of documentation.

Germano:

Figure 1 is a misleading attempt to portray the decline of desert tortoise populations. So-called "historic range" is shown by an area taken from a field guide range map, while current range is restricted to high density areas only in California and Nevada and mountain ranges in Arizona—the latter being the only known habitats, past or present, in Arizona as far as is known. The only honest part of this map is the question marks in Mexico.

Response:

Germano is correct. The map was not submitted nor captioned in this form when submitted by Berry. Her map showed only the darkened areas, which were identified as "breeding populations." The additional shading of "historic range" and the recaptioning of the dark areas as "present range" occurred during the editorial process.

Germano:

There has not been a large decline in desert tortoise populations except in the western Mojave and around the cities of Las Vegas, Tucson, and Phoenix.

Response:

Germano is not taking into account the substantial and documented deterioration, fragmentation, and loss of habitat due to development. Such areas as the Chuckwalla Bench have lost 50-70% of their population between 1982 and 1988, whilst declines in Ward Valley of eastern California and the Beaver Dam Slope of Utah led to federal listing ten years ago.

Germano:

The claimed historic densities of 1000 tortoises per km in California and Nevada are unfounded. These data are based upon interviews and anecdotes, which are a valid means of establishing presence but not actual abundance.

Response:

No formal population studies were conducted before the 1970s, so interview data are the only kind of information available for historical abundance. Interviews were conducted with some well-educated, respected, articulate, and prestigious members of the public, including historians, writers, and scientists. The chapter has been scrutinized by many reviewers. Dr. G. Zug, for example, commented that "the data may be anecdotal, but still reliably document the decline of tortoise populations."

Germano:

The more recent data on population decline are derived from censuses from permanent study plots established in the late 1970s. These were initially censused during high rainfall years, and then recensused in the mid to late 1980s in poor rainfall years. Tortoises are easy to find when rainfall is high but can be overlooked during dry conditions. Thus the decline may be more apparent than real.

Response:

The study plots were distributed throughout the geographic range of the species, although with an emphasis on California. The rainfall situation was much more complex than suggested by Germano, being variable from one plot to another even within a single year. Moreover, the surveys were not simple counts of tortoises; the Stratified Lincoln Index approach utilized will result in a wide confidence interval under circumstances where tortoises are difficult to find, but will not skew the estimate downwards.

Germano:

I object to the secretiveness of her work and the seemingly deceitful way she presents her case for listing the desert tortoise. The species may need further protection but using scientifically flawed data is not the means by which protection should be given. Those of us who conduct research on the desert tortoise are dismayed by the lack of objectivity concerning the desert tortoise.

Response:

These are largely personal remarks, and one wonders why Germano did not make contact with Dr. Berry directly and some time ago. Her work is not only widely respected, it could not conceivably be considered secretive. Dr. Berry works with a rather large team and is a full-time federal employee, not an isolated private researcher. This would hardly allow for secretiveness. She publishes in peer-reviewed journals and her reports are widely circulated for comment; these comments are generally reproduced in full in the final versions of these reports.

One is inevitably left wondering why Germano has taken issue with one of the best-documented USDI listed species in the entire world. What are his motives? What are his views on the long-term trends of tortoise populations in the western United States, and their ability, in the long run, to tolerate habitat destruction, raven predation, upper respiratory disease, shell necrosis, casual collection for pets, off-road vehicles, highways penetrating much of their habitat, and juvenile would-be marksmen practicing with their BBs (or bazookas) in the desert?

Bour in Réunion

The Réunion Island tortoise was described in several eighteenth-century reports, but material was lacking to establish a scientific name for the taxon until Roger Bour at the Muséum National d'Histoire Naturelle in Paris received an incomplete shell and a skull a few years ago, which he described as *Cylindraspis borbonica*. The species disappeared some time before 1780, and Réunion is now extensively developed and urbanized. However, Bour writes from Réunion that he has found over 1,000 bones of the extinct tortoise, including about 40 skulls. This find will be of extraordinary value in determining the morphology and variation of the Mascarene tortoises, an entire genus that, alas, disappeared before the TFTSG was created.

New Synopsis of the Turtles of the World

F. Wayne King and Russell L. Burke have produced an outstanding contribution to herpetological nomenclature. This volume, entitled *Crocodilian, Tuatara, and Turtle Species of the World: A taxonomic and geographic reference*, had a confused editorial history, but finally saw publication through the good offices of the Association of Systematics Collections (730 11th Street, 2nd Floor, Washington, DC 20001; price $29). The book opens with an 11-page tribute to Archie Carr and account of his life and work (including a comprehensive list of his publications). The species listed by CITES are illustrated with good line drawings, although this makes for erratic taxonomic coverage, since all the Testudinidae, for ex-

ample, are listed by CITES, but none of the Kinosternidae and only one species of the Chelidae.

Synoptic information is given for each species, under standardized headings. Details are given of the original name of each form, the location, provenance, and museum number of the type specimens, and the geographic distribution is presented both descriptively and in a coded list of countries of occurrence. Subspecies are ignored. Perhaps the most valuable information is given under "Comment," which summarizes information relevant to the resolution of nomenclatorial controversies, with detailed citations to allow the reader to trace the various arguments and determine whether his conclusion agrees with that of the editors.

Several New Tortoise Species Described

A new species of *Xerobates*, *X. lepidocephalus*, from a locality near La Paz, Baja California, has been described by Ottley and Velazques (1989, *Great Basin Naturalist* 49(4):496-502), and two new species from North Africa, named *Testudo flavominimaralis* and *Furculachelys nabeulensis*, have been proposed by Highfield and Martin, in a series of papers privately published in Great Britain, in the *Journal of Chelonian Biology* and elsewhere. The latter authors also include in *Furculachelys* the species *Testudo whitei* Bennett 1836.

Unquestionably, the first of these species is very closely related to *Xerobates agassizii*, and the various North African forms fall broadly within the concept of *Testudo graeca*. Yet none can be dismissed without further comment.

It is unfortunate that there are irregularities in the description of all of these forms. Peer review appears to have been escaped entirely, and *X. lepidocephalus* was based upon a single entire specimen and a partial shell (showing none of the diagnostic features). Moreover, although the entire specimen has a museum number (BYU 39706), it was still living when the description went to press. Indeed, the brief interval between the capture of the holotype (January 1989) and the appearance of the published description of the new form (October 1989) may constitute a record in the annals of herpetology. One only hopes that the holotype does not escape, grow, or sicken before its eventual demise and preservation. But to look on the bright side, the fact that the holotype is still vital may have advantages. Although only the single trivial name *agassizii* is available for any population of the desert tortoise, Kristin Berry and coworkers have demonstrated that at least three distinct forms are recognizable within this species-complex: the California type, the Beaver Dam type, and the Sonoran type. Mitochondrial DNA differences between these populations are comparable to those between any of the forms and the Texas tortoise, *X. berlandieri*, and there are correlated morphological differences. Thus, it seems obligatory to determine the mtDNA configuration of the type specimen of *lepidocephalus* to see if it is allocable to any of the three *agassizii* morphs. If the specimen could be attributed to any of the morphs other than the nominate form (from California), then the name could stand, at least as a subspecies.

Highfield and Martin have demonstrated some extraordinary variation in adult body size and color pattern in North African tortoises, and they define their new genus *Furculachelys* on the basis of the presence of two suprapygal bones, of which the upper embraces the lower between two posterolateral extensions. They describe this character of the carapace as "conclusively and absolutely separated from *Testudo*," although it is in fact the standard configuration in *T. horsfieldi* and may be expressed also in *T. marginata*. It is widespread amongst other testudinid genera and even occurs in cheloniids. The various accounts are somewhat confusing in their differentiation between *Testudo flavominimaralis* and *Furculachelys nabeulensis*. Both appear to be very small tortoises from Tunisia, and great emphasis is laid upon their laying tiny eggs, 13 mm by 15 mm, although the authors had never actually seen the eggs. Museum numbers were not given for the type material, and, confusingly, the holotype of *F. nabeulensis* was a damaged skeleton with the lower suprapygal missing, and the "topotype" was a specimen whose precise locality was unknown "due to the specimen having been subject to transportation."

Webb on *Carettochelys*

Grahame Webb of Darwin, Australia, described the major role that *Carettochelys* played in recent debates about whether or not to mine an area known as Coronation Hill. This mineral-rich area stands in the path of a proposed expansion of Kakadu National Park. Webb reported that the press gave quite a misleading impression of the rarity of *Carettochelys*, suggesting in some cases that the future of the species was dependent upon one water hole in which 20–30 specimens lived. Webb concluded that he could not imagine a program of devastation that could threaten the hold that *Carettochelys* has within the Alligator and Daly River basins.

On the other hand, having always been a rarity in the international pet trade, in the course of the last year rather large numbers of *Carettochelys* have been commercially imported into the United States. These have entered through both California and Miami, but it appears that rather few have survived even long enough to be sold at retail. The reported origin of the specimens is Irian Jaya. Many of the dead specimens were deposited in the Pathology Department of the San Diego Zoo, which is currently undertaking necropsies. Preliminary findings indicate heavy parasite loads (nematodes and trematodes).

Recovery Plans Available

The US Fish and Wildlife Service has issued a recovery plan for the flattened musk turtle, *Sternotherus depressus*. This form was determined to be a Threatened Species by the Service on 11 June 1987, and the Recovery Plan, prepared by John J. Pulliam, III and Robert G. Bowker, was issued on 26 February 1990. The Plan focuses upon improvement of habitat quality (the species has been severely impacted by siltation and mining operations), restoring genetic contact between populations isolated by habitat alteration, decreasing incidence of disease (both mixed gram-negative septicemia and a protozoan agent of turtle malaria have been found in wild specimens), control of collection for trade (prohibited by both federal and Alabama State law), and control of the circumstances leading to hybridization with *S. minor peltifer* in the area below Bankhead Dam.

The Service has also published a recovery plan for the Alabama red-bellied turtle, *Pseudemys alabamensis*. This species was listed as Endangered on 16 June 1987, and the Recovery Plan, drawn up by James Dobie and Fred M. Bagley, was published on 8 January 1990. The Plan recommends that studies continue on basic parameters of population biology and ecology; that disturbance and predation on the eggs, young, and adults be reduced; and that nesting, basking, and overwintering habitats be protected.

Both plans may be obtained from Fish and Wildlife Reference Service, 5430 Grosvenor Lane, Suite 110, Bethesda, Maryland 20814.

Alligator Snapper Status Review

The alligator snapping turtle, *Macroclemys temminckii*, was proposed as a Threatened Species by your editor in 1983. The petition was denied, or at least postponed, for various reasons (outlined in my recent book, *The Alligator Snapping Turtle: Biology and Conservation*, Milwaukee Public Museum). However, a minor recrudescence of federal activity on this question has occurred, and the USFWS Jackson, Mississippi, office contacted the various state wildlife agencies in May to see what further data had become available since 1983.

Several states had no new information or did not reply. However, Georgia reported low trapping success in the Flint River and an absence of large turtles. Illinois considered the turtle to be endangered in the state. Indiana considered it extinct. Only one specimen had been found in Kansas in recent years. Alligator snappers were still present in northern Louisiana. Missouri reported them rare and largely confined to the "bootheel," where habitat loss was a concern. The species still exists in the "Land Between the Lakes" region of Tennessee. In Texas it had been listed as "Threatened" on 1 March 1987.

The status survey will continue, with a polling of herpetologists and also commercial and recreational trappers.

Buskirk's Translations

Jim Buskirk (4131 Terrace Street, Oakland, California 94611) has translated a number of important turtle papers originally published in French, German, Russian, or Spanish during the last few decades. Parties interested in seeing a list of available titles should make direct contact with Buskirk.

River Turtles in Guyana

The two large river turtles *Podocnemis expansa* and *Podocnemis unifilis* are well known and extensively studied in the Amazon and Orinoco River systems. However, their presence in the Essequibo River system of Guyana is much more poorly documented, and indeed the best available reference is still the account of Schomburgk's travels in the region 150 years ago.

Your editor spent a week travelling with a team of Wapisiana Indians in remote rivers of the Upper Essequibo system in January 1990. He was able to visit a variety of Wapisiana and Macusi villages, documenting the numbers, species, and sizes of turtle carapaces either in use as utensils or discarded around the villages, and was able to travel up the Rewa River to two mass nesting sites of *Podocnemis expansa*. He also found numerous nests of *P. unifilis* in sandbanks throughout the region.

The *P. expansa* here are very large. The mean straight-line carapace length of a dozen adult female shells was 74.96 cm, with the largest 83.1 cm. This may be compared with an average length of about 65–66 cm in the Orinoco and about 70 cm in Brazil. The Wapisiana people call the species "matad," and they catch them on hooks baited with cassava. Ironically, the empty carapaces of the slaughtered animals are used as receptacles for dried cassava.

News from Madagascar — and New York

Quentin Bloxam of the Jersey Wildlife Preservation Trust departed for Madagascar on 28 January 1990, his mission being to carry out field work on the ecology of the very restricted tortoise species *Pyxis planicauda* in the area between Beroboka and Tsiribihana. Bloxam also reported that the two female *Testudo kleinmanni* at the Jersey Trust had each laid two eggs, and one female produced a second clutch 23 days later.

John Behler also travelled to Madagascar recently and had a wonderful time with field work on both species of *Pyxis* and also on *G. radiata* and *G. yniphora*. Behler also passed on the good news that the New York Department of Environmental Conservation had issued protective regulations for the diamondback terrapin, which establish size limits, prohibit sale during the closed season, and require a licence for those who propose to catch them. It is the first legal protection offered *Malaclemys terrapin* by New York State.

Bolson Tortoises Bound for Big Bend

The Bolson tortoise, *Gopherus flavomarginatus*, is today a rare species confined to the Chihuahuan Desert near the junction of the Mexican states of Chihuahua, Durango, and Coahuila. However, there is evidence that tortoises of this or a very similar species once occurred as far north as what is now the Big Bend National Park of Texas, where they are thought to have been exterminated by early man.

Agreements have now been established to reintroduce the Bolson tortoise to the Big Bend area. The 800,000 acres of protected ecosystems within the National Park could be a vital new habitat for the tortoise, and the plans are to import 200 to 250 tortoises from Mexico in the early spring.

The plan is an intriguing one, and we wish it well. Detailed methodologies for the proposed reintroduction have not yet been made clear, but such undertakings are not necessarily easy. The Florida Game and Fresh Water Fish Commission has been studying protocols for the relocation of the related *Gopherus polyphemus* in recent years, and it would be appropriate for the agencies to compare notes before the transfer of the tortoises from Mexico is consummated.

Softshells and Saddam

Peter Paul van Dijk has drawn our attention to the increasingly tenuous position of *Rafetus euphraticus*, a soft-shelled turtle limited to southern Turkey and adjacent parts of Iraq and Iran. The southern distribution of this species may already have been seriously affected by the Iran-Iraq war, while the northern distribution is now threatened by ambitious hydroelectric and irrigation schemes that may affect most of the waterways in the area. Old-fashioned irrigation ditches and canals provide excellent softshell habitat, but involve much evaporative water loss; on the other hand, tunnel or "qanat"-type systems conserve water but are uninhabitable by turtles.

Moreover, the $20 billion Ataturk Dam, completed in January 1990, reduced the flow of the Euphrates to Syria and Iraq by 75 percent, angering both of those nations, even though the stoppage was only for a month. If Turkey cuts off the water to Iraq again in retaliation for the Iraqi invasion of Kuwait, *Rafetus euphraticus* may be a barely-noticed victim of the conflict.

Course on Amazonian Freshwater Turtles

Richard Vogt taught a course on field biology and research techniques of South American turtles in November 1989 and plans to offer a similar course annually henceforth. The 1989 course was based out of Manaus and was limited to 14 participants. It involved both theoretical aspects and detailed field procedures, the participants having the opportunity to catch turtles using a wide variety of techniques. They were able to catch all four local species of *Podocnemis*, including *P. erythrocephala*, a surprise in the white-water Rio Tapajós.

The course is free, but participants must find their own way to Manaus. They must be South American nationals, but both Brazilian and Spanish-speaking individuals (from Peru, Colombia, and Venezuela) participated in the last course. Presumably Guyanese would be welcome too; Vogt speaks some English.

The course sounds like an excellent opportunity. Oh, to be young, female, and South American!

—PCHP

TFTSG Action Plan
Request for Information and Assistance

MICHAEL W. KLEMENS
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Projects

I would appreciate receiving communications as soon as possible from the contact persons (project leaders) listed on pages 44-45 of the TFTSG Action Plan including:

1. A brief synopsis of their projects.
2. Whether they anticipate requiring assistance to get their projects up and running, and if so, in what form.
3. Current *curriculum vitae* of project leaders.

Current Information

The Action Plan office is soliciting reprints, newspaper clippings, and other materials pertinent to turtle and tortoise conservation. Please put us on your mailing list as we need to keep up to date in order to be effective.

Fund Raising/Education

We are developing several slide presentations for education and fund raising purposes. If members have slides of turtles and tortoises, especially those listed in the Action Plan projects, copies of these would be appreciated. Our interest is in quality, not quantity. Slides of habitats, depredation and threats to species, as well as field work in progress would be very useful. These slides will be used *only* for the aforementioned purposes, with credit given to the contributors.

Gopherus Library Established

JOHN DOUGLASS
Archbold Biological Station, Lake Placid, Florida 33852, U.S.A.

A library has been established at Archbold Biological Station near Lake Placid, Florida, for the purpose of accumulating, indexing, and disseminating information on all aspects of the biology of tortoises of the genus *Gopherus*. It is hoped that, with the assistance of amateur and professional workers involved in this field, the new *Gopherus* Library can become a comprehensive repository and source for information on all four living species in this genus.

The nucleus of the literature collection consists of all references cited in an earlier bibliography and supplement on the genus (Douglass, 1975, 1977) totalling 644 entries. A detailed subject code is available for these references.

Mailings of reprints and of informal research reports are solicited and will be greatly appreciated. Photocopies of difficult-to-obtain articles will be made available at a nominal fee (i.e., at cost). Mailings should be directed to:

Gopherus Library
c/o Mr. Fred E. Lohrer, Librarian
Archbold Biological Station
Lake Placid, Florida 33852 U.S.A.

Should participation and interest be sufficient, preparation of a second bibliographic supplement may be considered at some time in the future. This would include a detailed subject index to the contents of material appearing since the 1975 and 1977 installments.

More on Tortoises in Greece

JAMES BUSKIRK
4131 Terrace St.
Oakland, California 94611, U.S.A.

In Newsletter No. 4 (September 1989) of the IUCN Tortoise and Freshwater Turtle Specialist Group, R.E. Willemsen presented a series of concerns on the status of the non-marine chelonians of Greece. Referring to Willemsen and Hailey (1989), in press at the time, Stubbs carefully reviews the geographic distribution of the marginated tortoise, *Testudo marginata*, and states that the only known concentration of the species is at Gytheion in the southern Peloponnesus (Stubbs, 1989). The following, excerpted from a series of letters, is offered as an update to these reports.

Since early 1988 naturalist and missionary Gary Rose and his family have been living in a remote area of coastal northeastern Attica. By November of that year he and his daughter had identified more than 40 adult *T. marginata* inhabiting the rocky slopes overlooking a bay in the Aegean. Although present in relatively flat areas as well, the tortoises seem to prefer ravines and other rocky areas, where human locomotion is not always easy, and through which the tortoises travel by well-worn, recognizable trails.

The carapace length of adult tortoises varies from 25 to 33 cm. Mating has been observed in the spring as well as in late October to early November. Dramatic male rivalry was seen and photographed on 1 November 1989, a dominant male up-ending a just-mounted rival and sending him rolling down a hillside, prompting a third male to leave the area. Two hatchling tortoises have been found, one in July 1988, the other a month later. A female was observed nesting on 5 May 1988, a few days after the discovery of a recently predated nest containing the remains of 15 eggs. Very few juvenile tortoises have been seen; either they are heavily predated, perhaps by foxes, or are very secretive. Additionally, the shells of six adult tortoises have been found. Some of the living tortoises bear scars of injuries apparently resulting from falls. In summer 1989 an adult female, wedged tightly but able to scratch audibly, was rescued from a crevice into which she had fallen. Most tortoises were infested with ticks.

The tortoises seem to restrict themselves to a home range about 50 m in diameter, but some much farther, and there is evidence of seasonal movement up and down the slope. During spring and early summer the tortoises are active before 10:00 hr and again after 18:00, by which time there is no longer direct sunlight on their north-facing slope. Although not active at midday, tortoises will sometimes position themselves in crevices or shallow caves in such a way as to expose themselves to direct solar radiation while remaining largely hidden. Between July and September tortoises are seldom active. In November 1989 tortoise sightings ceased entirely a few days before cold weather set in. A series of color transparencies taken between 9:00 and 10:00 on 7 April 1989 shows eight adult tortoises feeding on annual vegetation, basking in the open, resting in shaded or sunlit crevices, or foraging in brushy vegetation.

No *Testudo hermanni* have been found in the area, nor any freshwater chelonians, but on the nearby island of Euboea (Evviya), three adult *T. hermanni* were found in June 1989. In addition, for nearly a week in August 1988, a large *Dermochelys coriacea* was a regular and "friendly" visitor to the

Roses' cove before ultimately perishing in a fisherman's net. The estimated carapace length of the leatherback turtle was 1.5 m.

There is little adverse human impact on the marginated tortoise in this area due to its remoteness from human settlement and the rugged nature of the landscape. Gary promises a more detailed report in the future. Plans are under consideration to incubate tortoise eggs in an exclosure and head start the young before releasing them.

Literature Cited:

Hailey, A. and **R.E. Willemsen.** 1989. Status and conservation of tortoises in Greece. *Herpetological Journal* 1:315-330.

Stubbs, D. 1989. *Testudo marginata*: Marginated tortoise. In *The Conservation Biology of Tortoises*, I.R. Swingland and M. W. Klemens, eds., pp 41–42. Occasional Papers of the IUCN Species Survival Commission No. 5., Gland, Switzerland.

Reproductive Biology of *Kinosternon scorpioides* (Testudines: Kinosternidae) in Captivity

MARIO BORGES DA ROCHA and FLAVIO DE BARROS MOLINA
Reptile Section, Fundação Parque Zoológico de São Paulo

The scorpion mud turtle is a freshwater species distributed from southern Tamaulipas, Mexico, to Argentina and Brazil. Its meat, considered a delicacy, is frequently served in its own carapace in some restaurants in northern Brazil. This dish is regionally called "Casquinho de muçuã." Even so, the habits of the scorpion mud turtle are poorly known.

Since 1985 we have kept this species in the São Paulo Zoo, Brazil. Nesting has occurred from March to August, usually in autumn; one to six eggs are laid per clutch (mean: 3.4; n=14). The eggs are ellipsoid and weigh from 6.8 to 11.8 g (mean 9.2; n=46).

We assisted a hatchling from the egg after 266 days of artificial incubation (see Molina and Rocha, 1988). This female hatchling measured 2.85 cm in carapace length and weighed 5.3 g. It fed aggressively upon meat, fish, fruit, and mealworms, and after one year measured 6.49 cm in carapace length and weighed 44.1 g.

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Reproductive Biology of *Phrynops geoffroanus* (Testudines: Chelidae) in Captivity

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From 1985 to 1989 we studied the Geoffroy's sideneck turtle (*Phrynops geoffroanus*) in captivity in an attempt to analyze some aspects of its biology and behavior. The study was performed at the Fundação Parque Zoológico de São Paulo, São Paulo, Brazil.

Courtship occurred from the beginning of December to mid-April. Courtship phases included: first encounter of male with female, pursuit of female by male, courtship, and copulation. Nesting occurred from March to November, mainly in the afternoon, and included the phases of: walking to the nest site, nest excavation, egg-laying, nest closing, and departure.

The captive *Phrynops geoffroanus* laid between 7 and 26 eggs per clutch (mean 18.1; n=66). It appears that females lay at most once per year; not all of them nest every year. No correlation was found between clutch size and mean egg dimensions, but there was a positive relationship between the numbers in a clutch, the mean egg width, the mean weight, and the overall egg volume to the size of the female. The clutch weight ranged from 0.076 to 0.107 of female body weight (mean 0.086; n=9).

The mean incubation times for individual clutches varied from 149 to 331 days (n=21). We observed an inverse correlation between these values and the nesting dates of one and the same year. There was a positive correlation between egg width, weight, and volume to the size of the hatchling.

The mean dimensions of the hatchlings were: carapace length: 4.06 cm (n=130); weight: 10.05 g (n=134). Those kept in tanks after the first month and fed on fish and invertebrates grew rapidly. We estimate that maturity is attained in three to four years in males and six to eight years in females.

The general basking pattern is unimodal, but on very hot days it is sometime bimodal.

The species is carnivorous and rarely eats vegetables. Aggressive interactions occur only between adults and mainly during the courtship period. The pursued turtle uses its carapace as a shield, turning it frontally towards the aggressor.

Tortoises and Turtles in Egypt

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We have become increasingly concerned over the plight of reptiles in Egypt, in particular, the Egyptian tortoise, *Testudo kleinmanni*, and sea turtles, *Caretta caretta, Chelonia mydas, Eretmochelys imbricata, Dermochelys coriacea*, and *Lepidochelys olivacea*. Egyptian tortoises are increasingly threatened by habitat destruction and collection from the wild. Most Egyptian tortoises are found along the Mediterranean coast where there has been extensive development for agriculture and tourism. In addition, tortoises have been taken from the wild to be sold as pets. Today, due to the opening of the border between Libya and Egypt, thousands of Egyptian tortoises are imported into Egypt from Libya, which is not a party to CITES. Egyptian tortoises can be found in pet shops and markets throughout Cairo. Often they are badly treated; dozens can be found in cardboard boxes or at the bottoms of bird cages. Egyptian tortoises have declined in Egypt in the wild, but the extent of their decline is unknown as no formal survey has been carried out.

Sherif has kept and raised Egyptian tortoises in captivity for the past 18 years. From the initial three (two females and a male), he now has 18 tortoises. This is the only known successful breeding programs in Egypt. Sherif would like to return the tortoises to the wild, but it is impossible at this time due to the current situation. He would like to give his tortoises to a foreign zoo, such as the Jersey Zoo, for a captive breeding program.

Sea turtles are still being captured in Egypt for both food and to be sold as tourist souvenirs. They are captured by fishermen in Lake Bardawil in North Sinai and sold in fish markets in Al Arish. It has been reported that at least one green turtle, *Chelonia mydas*, is captured per month. In Hurghada, sea turtle has been offered on the menus of local restaurants, and shells and stuffed turtles have been sold in tourist shops. One woman reported seeing a pair of earrings and a necklace made from baby sea turtles. The Red Sea Governorate has announced that they would stop this trade, but it is unknown if the trade in sea turtles and other marine life has been discontinued.

Important breeding areas for sea turtles are likewise threatened. Oil pollution and the planned development of the islands are the major threats to sea turtles breeding in the Red Sea. Little is known about sea turtles breeding along Egypt's Mediterranean coast. There could be important nesting sites (perhaps for the green turtle, *Chelonia mydas*) in this area, particularly along the sand bar at Lake Bardawil, but a study is needed. This should be done as soon as possible, because Lake Bardawil and the rest of the Mediterranean coast are under threat from development.

At the present time Egyptian tortoises and sea turtles are not protected by law in Egypt, in spite of the fact that Egypt is a member of CITES and the Bonn Convention. We hope you can assist our efforts in Egypt to preserve these amazing creatures.

Possible Courses of Action:

- Launch an international letter-writing campaign to encourage the Egyptian authorities to declare the Egyptian tortoise and sea turtles protected species, to protect important breeding sites for tortoises and sea turtles, and to enforce the laws.
- Conduct surveys of Egyptian tortoises and sea turtles along Egypt's Mediterranean coast.
- Start a captive breeding program for Egyptian tortoises at a foreign zoo.

Organizations and Officials Responsible for Wildlife Conservation in Egypt:

Dr. Attif Abeid
Minister of the Cabinet
1 Maglis El Shaab
Cairo, Egypt

(Responsible for the environment and the Egyptian Environmental Affairs Agency)

Dr. Mohammedi Eid, Director
Egyptian Environmental Affairs Agency
11 Sharia Hassan Sabri
Zamalek
Cairo, Egypt

(Responsible for the Protected Areas and Governorate Environmental Offices)

Dr. Yousef Walli
Minister of Agriculture
Wazaret al Ziraa
Dokki
Cairo, Egypt

(Responsible for laws protecting wildlife and the Egyptian Wildlife Service)

Dr. Mohammed Amer
Under Secretary of Zoos and Wildlife
Egyptian Wildlife Service
Giza Zoo
Cairo, Egypt

(Responsible for wildlife conservation in Egypt)

Freshwater Turtle Rehabilitation in National Chambal Sanctuary, India

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The National Chambal Sanctuary has been declared over the Chambal River, a major tributary of the Ganges River System, to protect the gharial and other wildlife species. In order to devise appropriate conservation measures, I initiated studies on the status, distribution, and ecology of the freshwater turtles in the National Chambal Sanctuary in October 1983. A rehabilitation programme for turtles in the Sanctuary is under way; results are given below.

Turtle Species in the Chambal River

Shells and live specimens of four hard-shell species belonging to two genera and one family, and three species belonging to three genera and one family of softshell turtles were identified in the Chambal River. These species are: *Kachuga kachuga*, *K. dhongoka*, *K. tentoria*, *Hardella thurjii*, *Chitra indica*, *Lissemys punctata*, and *Trionyx gangeticus*. *Hardella thurjii* is the rarest turtle in the Chambal; one shell was collected on 13 April 1988, but no live animal has been found since 1983. The other hard-shell species occur all along the Chambal, utilizing rock outcrops, sandbars and hard soil for basking, and large sandbars and similar areas for nesting. Soft-shelled turtles occur throughout the sanctuary area, preferring flat-topped sandbanks with inclined shorelines bordering fast-moving water at least 50 cm deep for basking. *Trionyx gangeticus* and *Lissemys punctata* nest on mud banks, usually inside gullies. Details on the habitat requirements, basking, and nesting behavior of the turtles are reported elsewhere (Rao and Singh, 1985, 1987a, b, c).

Turtle Rehabilitation Programme

To counteract effects of poaching, habitat destruction, and predation on the turtles, conservation measures have been initiated. We recommend the same technique ("grow and release") as is being practiced for Indian crocodilians of several species on an experimental basis (Choudhury and Choudhury, 1986). I started captive rearing of freshwater turtles at the Deori Gharial Rearing Center (DGRC) of the National Chambal Sanctuary in collaboration with the Madhya Pradesh State Forest Department in 1984. Although the first year results were not encouraging, we achieved 60% hatching success for eggs of *Kachuga* species in 1985 (Rao, 1985). Since 1985 turtle eggs have been collected annually from the Chambal for the captive rearing programme. During 1987 the captive rearing programme was extended to *Trionyx gangeticus* by collecting eggs from natural nests for incubation at DGRC. Each species and age group is reared separately. All the Chambal turtle species (except the marginal *Hardella thurjii*) are now being reared at DGRC. Suitable areas in the sanctuary where disturbance is minimal have been identified for release of the captive-reared turtles.

Since 1986 eggs of *Trionyx gangeticus*, *Lissemys punctata*, and *Chitra indica* have been collected from the National Chambal Sanctuary for a project to expand local softshell populations for the biological control of partly cremated corpses that pollute the Ganges River. The Project includes the protected nesting, hatching, and rearing of the young turtles, and their eventual release into the Ganges (Basu, 1987). Under the Project, measures have been taken to stop poaching, and closed areas have been declared for rehabilitation of the captive-reared turtles. I was also involved in the surveys conducted from August to October during 1986 to 1988 in the Chambal River to collect turtle eggs.

Captive Breeding Programme

Since 1987 *Lissemys punctata* has bred regularly in captivity at DGRC. We also plan to acquire breeding groups of *Kachuga dhongoka*, *Kachuga tentoria*, *K. kachuga*, and *Trionyx gangeticus*.

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TABLE 1. Turtle captive rearing programme at Deori Gharial Rearing Centre.

Year	Species	Eggs Collected	Eggs Hatched	No. of Turtles in Captivity
1985	*Kachuga kachuga*	10+	3	6**
	Kachuga dhongoka	34	26	—
	Kachuga tentoria	23	11	—
1986	*Kachuga kachuga*	—	—	—
	Kachuga dhongoka	165	72	4
	Kachuga tentoria	92	62	0
1987	*Kachuga kachuga*	—	—	—
	Kachuga dhongoka	120	72	51
	Kachuga tentoria	15	10	—
1988	*Kachuga kachuga*	21	14	12
	Kachuga dhongoka	24	8	5
	Kachuga tentoria	11	9	7
	Trionyx gangeticus	72	34	9
	Lissemys punctata++	5	4	2
1989	*Kachuga kachuga*	60	33	33
	Kachuga dhongoka	—	—	—
	Kachuga tentoria	89	78	71
	Trionyx gangeticus	142	68	62
	Lissemys punctata++	6	4	3

* As of 30 August 1989
** Hatchlings were also collected from the field.
\+ Eggs laid by wild-caught female
++ Captive-bred animal

Flattened Musk Turtle Survey in Lost Creek, Alabama

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During the late summer of 1989, Dr. Robert Mount (Auburn University, Alabama) conducted a distributional survey in two sections of Lost Creek, Walker Co., Alabama. The study was funded to determine whether the flattened musk turtle (*Sternotherus depressus*), a species listed as threatened under U.S. federal law, was present in streams expected to be impacted by a proposed highway by-pass around the town of Carbon Hill. No flattened musk turtles were found above the Cedrum Impoundment, although a small population had inhabited this section of the stream near Mill Creek in 1985. However, several turtles were seen or caught within the impoundment, including a large juvenile.

In mid-summer 1989, Dr. Mount surveyed Slate Creek and downstream sections of Lost Creek in connection with a stream "relocation" project on Lost Creek. No flattened musk turtles were found in Slate Creek. On Lost Creek, 19 *S. depressus* were seen, of which 18 were basking. Three of six turtles caught had symptoms associated with a disease seen affecting flattened musk turtles elsewhere in the Warrior River Basin. No turtles were caught in ten traps.

While it is encouraging to note the presence of flattened musk turtles in downstream sections of Lost Creek, the appearance of disease symptoms in this population is cause for concern. The spatially fragmented nature of flattened musk turtle populations and the low numbers of older adults in a number of already isolated populations makes this species vulnerable to catastrophic events, whether from habitat degradation or disease. As yet no research has been conducted on the etiology of the flattened musk turtle disease syndrome. Except for Mount's brief surveys last summer, follow-up studies on populations affected by habitat alteration and disease have not been undertaken since this species was protected in 1986.

Exploitation and Management of the Central American River Turtle, *Dermatemys mawei*, in Belize

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Exploitation

There are four ways that Belizeans take *Dermatemys*: diving, nets, "striking with a peg," and hook and line. The largest local take presumably occurs during the peak of the dry season. During that time, the waters of the Belize River have receded, turbidity has decreased, and turtles congregating in the deeper pools become vulnerable to men diving with masks and fins. Many turtles are taken during this period. This is a product of both catchability of the turtles and of a good market—"Hicatee" (*Dermatemys*) is a traditional Easter season dinner in Belize. Many captured turtles are trucked to Belize City and sold either to McKesey's Meats or in an open-air market downtown. Belizeans consider Hicatee a delicacy and a large turtle can bring $25 to $35 Belize.

During the remainder of the year, nets and "pegs" are the most common methods of capture. The wall of the locally made Hicatee nets is light nylon twine. Mesh sizes range from four to six inches. The top line is light polypropylene. There is no sinker line. Nets designed for lagoons are 100 to 200 feet in length, 12 to 14 feet deep, and require corks. River nets are much shorter (8 to 10 foot wall) but equally deep and are set in short, calm stretches and baited with natural feed (i.e., fig leaves). Both types of net are very light and responsive and select for large juvenile and adult *Dermatemys*.

A "peg" is a long staff (10 to 12 feet) tipped with a detachable barbed metal point fashioned from an old triangular file. Heavy twine links the tip and the staff. *Dermatemys* are struck when rising to the surface to "blow" (obtain fresh air) or when surprised while feeding. Upon impact the peg tip penetrates the carapace and the turtle is brought into the boat (usually a dugout). Although hunters may go out specifically for *Dermatemys*, more frequently they are prepared for any fish or game that translates into food or cash. If turtles are encountered, they are taken. This includes *Trachemys scripta*, locally known as Bocatora. Although the number of hunters who "strike" may far surpass those who dive or use nets, striking rarely produces large numbers of animals and presumably causes less impact to *Dermatemys* populations than more intensive and efficient methods.

Hook and line captures with natural baits (figs, guava, or plantain peels) are difficult and presumably relatively rare and inconsequential.

High water reduces capture efficiency (for nets and pegs), and the quarter just completed may prove to have been the slowest in terms of "Hicatee trade."

Management

Life in a rural village and working with men who have at least partially supported themselves through hunting (i.e., ex-alligator hunters) has provided some insights on how wild game is exchanged in the villages and marketed in Belize City. While most exchange is local, market hunting is far from dead. For example, during a good night on the river with an 18-gauge shotgun, a dory, and a headlamp, a lucky man might take four gibnuts (*Agouti paca*). At $30 to $40 Belize per gibnut, minus $6 for bus fare, $10 for food during the trip to the market, and $20 to resupply, the profit from a night's work might be $104 Belize.

The two Belizean laws that apply to *Dermatemys* management are the Wildlife Protection Act of 1981 and the Wildlife Protection (Amendment) Act of 1988. In relevant sections, this legislation states that:

3. No person shall hunt any obviously immature wildlife, or any female accompanied by her young;

7. No person shall carry on the business of a dealer in wildlife, except pursuant to a valid dealer's license issued under section 13;

8-(1) There shall be a . . . moratorium on the sale, exchange, hire, or any other dealing for profit in any wildlife of any species or parts or products thereof. This shall not apply to sales of meat from species, the hunting of which is not prohibited and which is acquired by the consumer within fifteen miles of the place where the animal was killed or captured.

Dermatemys is not on the list of "prohibited species." The 15-mile distance restriction in section 8-(1) is intended to keep commercial exchange of wildlife on an exclusively local level.

Section 11 of Part III of the act contains four provisions which allow the advancement of more specific wildlife management regulations. In this section, the minister is empowered to make regulations that:

b) Prohibit hunting and possession of any specified wildlife species either for a period to be named in the regulations, or absolutely;

c) Prohibit or limit any method employed for hunting which appears to him to be unduly destructive, dangerous, or otherwise improper;

d) Prohibit hunting of wildlife specimens smaller or younger than a prescribed size or age;

g) Limit the number of any wildlife of any species that may be killed, captured, or possessed by any person.

Part IV of the act provides sufficient legal leverage, fines, and penalties to allow authorities to enforce the act.

It needs to be noted that the present-day wildlife management scenario in Belize may parallel the conditions found in the United States during the 19th century. Subsistence and market hunting far exceed recreational hunting in importance. In fact, a frontier mentality dominates much of rural Belize. Until recently wildlife has seemed inexhaustible. The bush environment itself frequently requires the taming touch of fire, axe, and machete in order to become inhabitable. Although an increasing number of Belizeans emigrate from rural areas in search of employment opportunities, those who remain frequently "live off the land." By way of contrast, wildlife management, in the form it takes in the United States, may have benefited indirectly from massive agricultural expansion and industrialization, which elevated the standard of living and reduced some of the consumptive pressures on wildlife.

In many respects, the Wildlife Protection Act and its amendment are adequate starting points for wildlife management. The legislation allows the input and flexibility required to manage wildlife on a species-by-species basis. The gaps that remain can be filled. However, in order for the legislation to be effective, it must be communicated to the public, then enforced, not ignored. While scientific research can provide the information needed to formulate more specific regulations, a massive increase in education and enforcement will be required for those regulations to become effective.

Conservation Status of the Bog Turtle in Massachusetts

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The bog turtle, *Clemmys muhlenbergii*, is a rare and localized species restricted to the eastern United States, ranging from southern Massachusetts to northern Georgia. Prior to 1984, bog turtles were reported from Massachusetts on the basis of a single specimen from central Berkshire County. Between 1984 and 1986, I discovered three populations in southern Berkshire County. These populations appear viable, as adults of varying ages were found as well as both hatchlings and juveniles. In cooperation with The Nature Conservancy, two of these sites have been protected through a combination of purchase, perpetual easements, and voluntary agreements. I have instituted mark and recapture studies at these sites to determine the populations sizes, as well as survivorship and habitat utilization. As these populations are at the species' northeastern range limit, I anticipate ecological and life history parameters may differ from populations in the central and southern portions of its range.

Financial assistance and logistical support for this work have been provided by the Massachusetts Division of Fisheries and Wildlife, The Nature Conservancy, and Simon's Rock College.

Giant Asian River Terrapins Hatch at the Bronx Zoo

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On April 21, 1990, after an incubation period of 80 days, the first of six giant Asian river terrapins (*Batagur baska*) hatched at the Bronx Zoo's Reptile House. It is the first captive breeding for this Endangered Species. The female parent, a 64-pound, 30-year captive, came to the zoo in April 1987 on loan from the Columbus Zoo [a photo, taken in October 1970, of this animal appears in the *Encyclopedia of Turtles*, page 296. —Ed.]. Her mate is one of seven male "batagurs" received as four-year-old juveniles in May 1985 as a gift of the Department of Wildlife and National Parks, Peninsular Malaysia. The eggs that hatched were deposited on the 1st and 2nd of February and pipped between the 21st and 28th of April. The full clutch was 33 eggs, laid over a two-week period. Incubation temperature ranged from 78–85°F.

The Bronx Zoo displays nine giant Asian river terrapins in the Gharial Exhibit in JungleWorld. For the past several years, beginning in October, the male batagurs have displayed startling color changes as they enter their breeding season. During this period the normally drab, gray males turn jet black and the cream-colored irises of their eyes turn pure white. It is presumed that the breeding coloration functions in courtship, but the nature of this relationship is unknown.

Tortoise Exploitation in Sumatra

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Several species of at least four different families are currently killed for commercial utilisation in Sumatra.

Soft-shelled turtles (Trionychidae): Although only a single species, *Trionyx cartilagineus*, could be accurately identified, there is a strong likelihood that at least two more species of trionychine turtles (Trionychinae) are also exploited.

Freshwater turtles (Emydidae): *Cuora amboinensis* was offered for sale and exported on a large scale in 1988.

True Tortoises (Testudinidae): *Testudo forstenii* is exported on a large scale; one *Manouria emys emys* was on sale.

Sea Turtles (Cheloniidae): Stuffed hawksbills, *Eretmochelys imbricata*, and lesser numbers of green turtles, *Chelonia mydas*, were available at most souvenir stores at Medan (North Sumatra).

Sea turtles are commonly named *penyu* in Bahasa Indonesia. All turtles presented to me as *labi-labi* were soft-shelled turtles.

Turtles offered to me as *kura-kura* included true tortoises and fresh-water turtles, *Cuora amboinensis*. *Kura-kura durat* is presumably the more correct usage for the true tortoise but is seldom used.

Further investigation should be carried out to determine how many species are in fact affected by the excessive commercial exploitation throughout Sumatra.

Conservation Status of Exploited Species

Except for the true tortoise, none of the identified species (*Cuora amboinensis* and *Trionyx cartilagineus*), which are known to be taken intensively for domestic consumption and for exports, are listed in the Appendices of the Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES). No species identified in this report is protected by any laws of Indonesia.

According to the Department of Forestry (Departmen Kehutan) in Kutacane, Aceh Province of Sumatra, there are no conservation measures to ban or to control the exploitation, although the department is aware of the local "turtle problem."

Ten years ago certain regional populations of soft-shelled turtles in Aceh had already been significantly depleted (Griffith, pers. comm. 1989). It is a well-known fact that Indonesia nature reserves do not represent an effective protection for turtles or any other endangered species—even the teeth, penises, and claws of the highly threatened Sumatran tiger, *Panthera tiris sumatrae*, are available in souvenir shops at Medan.

Utilisation of Turtles

In Sumatra the vast majority of turtles exploited belong to the subfamily of trionychine turtles (Trionychinae). Due to the thin carapace, stuffing or further processing into jewelry is not workable. The meat, follicles, eggs, and plastron of these species are sold for food. The main group consuming turtles seems to be the Chinese. Turtle flesh is generally used for turtle soup, but in some instances the flesh of softshells is also fried.

The Islamic religion forbids the consumption of turtle meat. Nonetheless, Moslems do eat the boiled turtle eggs. Eggs are presumably available from November to January since the nesting season of trionychine turtles in Aceh covers this period (D. Heckman, pers. comm. 1989). Chinese people told me that turtle meat is consumed as a medicine against rheumatism and "lung dysfunction." Furthermore, it is believed that it has some cleaning effect on the blood.

Fresh-water turtles and true tortoise species are a less valuable resource of meat than the soft-shelled turtles. Species of these two families are rather small and not in demand as much as *labi-labi*, which grow larger than two feet.

I learned from a Chinese man that some species of *kura-kura*, which are darker in colour, are not eaten since these darker species are said to be extraordinarily long lived. If anybody catches and releases such a turtle, the life expectancy of the animal is believed to transfer to the liberator. The *Cuora amboinensis* is indeed rather dark in colour, but such superstitious taboos do not preserve it as secularism becomes more widespread.

In contrast to trionychine turtles, the true tortoise species and fresh-water turtles are not only minor meat and egg suppliers, but also play a certain role in the stuffing and jewelry industry.

I was told that ashtrays and adornments are ostensibly manufactured out of the shell of fresh-water turtles. Furthermore, many processed turtles are ostensibly available in the streets of Tapak Tuan (Aceh).

The Major Areas of Exploitation

The major areas fresh-water turtles are exploited are the provinces Riau, West Sumatra, South Sumatra, and Tanjung Balai, North Sumatra.

Concerning the true tortoises, it was not evident which species was meant by informants nor was the place of origin. However, I was told that the domestic market in Medan was provided with *kura-kura* from Tanjung Balai and Sibolga, North Sumatra. The largest amount of trionychine turtles are collected by

villagers throughout Aceh, especially around Tapak Tuan and probably the adjacent islands. They are also killed extensively in the area of Tanjung Balai, transported by car to the local meat market in Medan, and/or exported via Medan. Soft-shelled turtles are collected in the provinces of Riau and West Sumatra on a large scale. (Due to the lack of time, I could not investigate all these places. I concentrated on Medan which appeared to be the center of the turtle trade.)

Labi-labi are either collected directly from the nesting beaches or fished using chicken viscera or crickets as bait. I was told that they are also harpooned with spears.

According to the staff of the nature conservation group, "Friends of Leuser Foundation" (Yayasan Leuser Lestari), turtles are sold alive and prepared for transport at Tapak Tuan, Ujung Kupiah, further north in Meulaboh, Ujung Tube, and Pulau Raya. Enormous amounts of *labi-labi* are killed at many places in the Alas River region, North Sumatra.

Increased forest clearing and human settlement in the Alas Valley with a high density of population on both banks threatens the integrity of the Gunung Leuser National Park. Therefore, it is most likely that villagers poach turtles also from the National Park. During the nesting season, eggs are collected in large quantities in the Alas Valley.

Export Statistics of Turtles in 1988

Three turtle species were legally caught for commercial export in 1988.

Trionyx cartilagineus (kilograms)	
Aceh	35,000
North Sumatra	10,000
Riau	5,000
West Sumatra	15,000
West Kalimantan	1,500
Total	66,500
Cuora amboinensis (individuals)	
South Sumatra	20,000
North Sumatra	7,000
Riau	5,000
West Sumatra	5,000
Total	37,000

Testudo forstenii (CITES Appendix II)
No data available.

According to these data, almost all turtles exported were caught in Sumatra, except for two percent of *Trionyx* from Kalimantan. Assuming that this is one of the few reliable statistics, the amount of turtles that were exported without the knowledge of the authorities were not taken into account.

(The allusion to *Testudo* (=*Indotestudo*) *forstenii* is puzzling. Neither Iverson nor Moll (*in* Swingland and Klemens) record either species of *Indotestudo* from Sumatra, and *I. forstenii* is only recorded from southwestern India, except for rare introduced specimens from Sulawesi and Halmahera. Perhaps there is indeed a population of some species of *Indotestudo* in Sumatra. —PCHP).

Reproductive Biology of *Acanthochelys spixii* (Testudines: Chelidae) in Captivity

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ROBERTO DE ROCHA E SILVA
FEEMA

Acanthochelys spixii is a fresh-water chelid turtle that occurs from the Upper Rio São Francisco and coastal basins in São Paulo State southward to the Rio Parana Basin in Argentina, Uruguay, and southern Brazil. It is listed in the Red Data Book (IUCN, 1982) as "insufficiently known," and according to this publication there is no information about its reproduction in captivity.

In the group of *A. spixii* held at the São Paulo Zoo, we observed some courtship from November to February each year. It seems that mating is stimulated by increasing temperature. Males are distinguished by the bigger tail and the plastral concavity. Nesting took place from the end of February to mid-May; 1 to 4 eggs were laid per clutch (mean: 2.4; n=5). The eggs were almost spherical and weighed from 7.4 to 10.4 g (mean: 9.4 g; n=12).

We still have not succeeded in hatching any eggs, but one of us (R.R.S.) examined a hatchling that had a black ground color with some reddish spots on the ventral surface, producing a complex symmetrical figure on the plastron. These spots fade with growth, and the adults are uniformly black.

This species feeds well on meat, fish, insects, and chicken liver. During the cold season they show little activity, suggesting the possibility of hibernation in the wild.

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Hard-shelled Eggs May Need Special Care During Incubation

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In the last decade the conditions under which turtle eggs are incubated, both in natural nests and in artificial surroundings, and their effects on the hatchlings, have been intensively studied. Most of these studies are in a laboratory setting,. and we just begin to grasp the significance of these conditions for the life history of turtles. ESD (Environmental Sex Determination) and the relation between humidity and hatchling size are well-known examples.

However, very little attention seems to be paid to the effects of humidity, embryonic metabolism, or nesting substrate on the eggshell. Ferguson (1981) presented the mechanism of eggshell breakdown in the American alligator. In this species the eggshell is composed of the eggshell membrane and a calcareous layer subdivided into a mammillary zone, a honeycomb zone, and an outer, densely calcified zone. At the time of laying, many small surface defects are present in the dense outer zone and these enlarge over the period of incubation because the calcite crystals are dissolved by acids produced by bacteria that ferment the nesting medium, as well as by carbonic acid formed when respiratory CO_2 dissolves. Because the honeycomb and mammillary zones are porous, the breakdown of the outer layer results in increased porosity which facilitates respiration. Also, an extensive network of cracks forms between surface defects, weakening the eggshell.

The structure of turtle eggshells is different. Here the calcareous layer is composed of conical spherites formed from aragonite crystals (an unstable calcium carbonate crystal lattice). These spherites, or shell units, are attached to the shell membrane by their apices, and their broad bases touch to form a smooth, closed outer surface facing the environment (fig. 1). The shape, size, and spacing of spherites vary from species to species and determine the flexibility of the eggshell. Flexible-shelled eggs (e.g., those of *Lepidochelys kempi*, fig. 3) have small, low, widely spaced shell units, while hard-shelled eggs (e.g., those of *Chelus fimbriatus*, fig. 4) have large spherites, the sides of which grow solidly against one another. For an extensive review of shell structure, consult Schleich and Kästle, 1988.

During incubation, this structure is under attack from various sources. On the outer surface, substrate acids degrade the calcium carbonate crystals, and this appears to have its greatest effect on the lines of contact between spherites. Simultaneously, the egg expands because it absorbs water, so the spherites become separated from each other. Near the end of incubation the surface of the shell resembles cracked, dry mud when viewed under a microscope. The grooves thus formed facilitate interaction between the shell membrane and the environment. Also, the apices of the spherite cones often detach from the membrane. The actual mechanism is not clear and could either involve degradation of proteins by which the spherites are attached to the membrane or the dissolution of the apex crystals. Bacterial metabolites, respiratory carbonic acid, and absorption of calcium through the shell membrane by the embryo may all be involved. Although one would expect that the areas where the extra-embryonic membranes attach to the shell membrane are more susceptible to metabolic degradation and calcium resorption, these areas appear less affected than the head and tail ends, which sometimes lose their whole calcareous covering.

Regardless of the actual processes involved, it is clear that hard eggshells are considerably weakened during incubation. The species on which I concentrate my investigations, the Chinese pond turtle, *Chinemys reevesi*, lays smooth, hard-shelled eggs. During the 70 days' incubation period the calcareous layer is so far degraded that near hatching the crystal cones simply drop off when touched, so that emerging is a simple event for the hatchling. It just needs to puncture the shell membrane, already stretched by absorbed water. Once punctured, the membrane easily tears along the whole length of the egg, so the hatchling just steps out of the lower half of the egg.

When attempting to incubate hard-shelled eggs artificially, it happens too often that full-grown, normally developed hatchlings must be helped out of their eggshells, or they are found dead when the egg is opened (e.g. Grossman, 1988). I feel that in these cases the hatchling is simply trapped in an eggshell that is too hard to break out of, and it will remain inside and vegetate until its reserves run out.

It appears to me that full consideration of all environmental conditions during incubation will help to avoid unnecessary fatalities. Temperature and humidity are obviously the most important. I will not deal with temperature here, and I refer to Packard et al. (1988) for the influence of humidity on hatchling size and fitness. Although hard-shelled eggs appear less drought-sensitive than parchment-shelled eggs, which collapse when dehydrated, they still need to absorb water, and the resulting expansion causes the network of cracks in the calcareous layer of the shell. Water also combines with CO_2 to form carbonic acid and brings the eggshell in contact with acids in the nesting medium. Bacteria can travel through the water film, on soil particles, and have access to the eggshell where it touches the surrounding nesting medium.

It is not clear to what extent soil bacteria are involved in the degradation of eggshells. Until such data become available, it seems best to me to use a nesting medium that contains bacteria and other

micro-organisms. I fully appreciate the inherent risk of infections, but eggs, especially the albumin, are well able to deal with external sources of infection (Ewert, 1979, p. 398).

It will be clear that I disagree with the use of sterile, inert incubating media like vermiculite or washed sand. After trials with various substrates and mixtures, my choice of incubating medium would be coarse, peaty soil, more or less like peat granules (2–5 mm) with some plant-potting soil mixed in. This has excellent water-holding characteristics, is acidic by itself, and supports a good microbial community. An additional advantage is that its moisture content can be judged by the colour, i.e., pale brown: too dry; black: too wet.

A final point of discussion is the practice of half burying eggs in the medium, leaving the upper half exposed to allow easy inspection. I prefer to bury eggs at a depth of 3–5 cm, so they can make as much contact with the medium as possible. Because the medium is rather coarse, gas exchange can still take place, although it may be somewhat restricted. The resulting buildup of CO_2 around the eggs is probably even beneficial.

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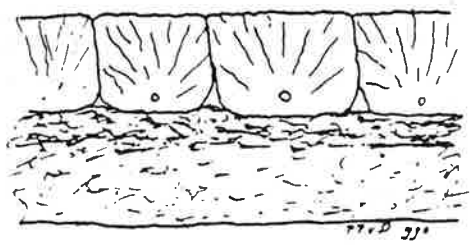

FIG. 1. Spherites in the eggshell of *Chinemys reevesii* at the time of laying.

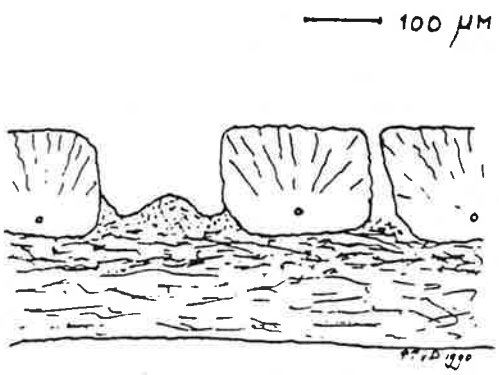

FIG. 2. Spherites in the eggshell of *Chinemys reevesii* at the time of hatching.

FIG. 3. Spherites of *Lepidochelys*

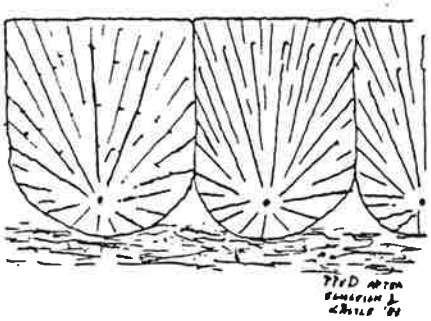

FIG. 4. Spherites of *Chelus*.

VI Meeting of the Project to Manage and Protect Amazonian River Turtles

8–15 May 1989, Porto Velho, Rondônia, Brazil

RICHARD VOGT
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During the last 10 years Brazil has been conducting an outstanding effort to protect and manage populations of *Podocnemis expansa*, *Podocnemis unifilis*, and to a lesser extent, *Podocnemis sextuberculata*. In 1976 IBDF published an inventory of the major nesting beaches of *P. expansa* in the state of Amazonas. Afterwards they mounted a program to protect the nesting females and the eggs from humans and other predators in eight Amazonian states. In 1977 the project was centered primarily in Amazonas with the production of 60,000 hatchlings; now there are over 100 beaches protected in reserves with the known production of at least 1,840,000 *P. expansa* hatchlings in 1987 and 1,654,315 in 1988. Many of these reserves, such as those on the Rio Trombetas, Rio Tapajós, Rio Guaporé, and Rio Purús have permanent field stations and staff devoted to protection and propagation of turtles. The main aim of this program over the last 10 years has been to protect the nesting females, protect the nests, and confiscate and release turtles that are found in the boats of fishermen and in the markets. To a lesser extent, in some of the areas attempts are made to grow the hatchlings in captivity until they are large enough to be less susceptible to predation.

Victor Hugo Cantarelli, the coordinator of the project, gave an overview of what has been done over the last 10 years. Another IBDF official gave a talk regarding laws and enforcement. Afterwards I spoke regarding my project involving turtle community ecology in Amazonas and the future direction of the IBDF project, including: incubation temperatures to produce five females per male; transplanting nests above the high water line (extremely important in some areas—Trombetas lost 400,000 hatchlings due to high water in 1988); solving problems with head starting; the need for inoculation of hatchlings for head-start programs with adult intestinal flora; feeding; growth; and cooperation between my project and the IBDF project.

Annual reports were presented from the 11 groups working in different regions. Amazonas reported 99,000 *P. expansa* and 102,000 *P. unifilis* hatchlings from Praia Abufari on the Rio Purús (25,000 hatchlings were found in one night alone!), and 8900 *P. expansa* hatching at Walter Buri beach on the Rio Juruá.

Acre had a 62 percent hatching success on three beaches producing 73,924 *P. expansa*. They found a mean of 120 eggs per nest. In addition, *P. unifilis* and *P. sextuberculata* also nest on the beaches protected. One of the problems at this site as well as others is that the hatchlings are maintained in captivity for 15 days after hatching. The idea is that the shells will then be harder and less susceptible to predation. However, I pointed out that most predators eat the turtles whole and a harder shell would be ineffective in discouraging predation. Also, because the turtles hatch with a high-energy food source (yolk, needed for travel to wherever they go to forage and grow, away from the nesting beaches), this practice should be discontinued to avoid depleting the hatchling of stored food reserves. If it were an evolutionary advantage to enter the water with a harder shell and with less food reserves, one would have expected an alternative behavior to have evolved: the hatchling would remain in the nest or the egg for an additional two weeks. In Acre, 2,000 hatchlings have been growing in captivity for three years. Data on growth rates and size were not given.

The project in Amapá was started in 1981. Two *P. expansa* nesting islands in the mouth of the Amazon and two *P. unifilis* nesting beaches are protected. During these eight years a total of 44,253 *P. expansa* and 27,075 *P. unifilis* were hatched. 1988 was the most successful year with 190 nests, 20,801 eggs, and 18,666 *P. expansa* hatchlings. The 652 nests of *P. unifilis* produced 11,858 eggs, and 8,353 hatchlings emerged. To protect the nests against flooding, 96 *P. expansa* nests were transplanted in 1988 with a 92 percent hatching success. Variation in the number of eggs per nest in *P. expansa* is high (39–153), suggesting that recruitment to the population is occurring. The population of *P. unifilis* also had a high variation in clutch size (7–40 eggs).

Protection of the nesting beaches on the Rio Araguaia, Goiás, was initiated in 1985 with a yearly increase in hatchlings:

Year	Nests	Eggs	Hatchling *P. expansa*
1985	330	28,000	25,000
1986	253	26,000	24,000
1987	280	33,000	31,000
1988	875	90,000	85,000

The project began protecting the Taboleiro de Monte Cristo on the Rio Tapajós in Pará in 1972 when they produced 11,040 *P. expansa* hatchlings. The number of hatchlings has increased yearly to 130,463 in 1988. An estimated 1,600 females nest on this beach. Transplantation of 30 nests was also successful in 1988.

The largest and most intensively protected beach is that of the Rio Trombetas in Pará. Protection started there in 1973. One of the advantages of this nesting beach is that it is within a large nature reserve and it is thought that the adults and hatchlings spend

their entire lives within the confines of the reserve. Production of hatchlings in 1988 was low due to flooding of the beach, which killed over 400,000 hatchlings before they could emerge. However, 304,000 did emerge successfully, making the beach one of the most productive in the Amazonas. Within this reserve *P. unifilis* and *P. sextuberculata* also nest and forage, but data on populations are not available. The main problem is lumber boats that anchor near the beaches, disturbing the nesting females. Restriction of boat movement in the area from September 15 to November 1 is needed.

There is an active group of young biologists beginning work on the Rio Xingú, Pará. They are protecting a beach area of 7,400 m^2. In 1988 they found 68 nests per 100 m^2. A mean of 83 eggs and 78 live hatchlings per nest suggests a high survivorship. Data for five years shows the variability inherent in a program where the workers, available funding, and weather conditions vary from year to year:

Year	Nests	Hatchlings
1983	5,797	583,752
1984	2,350	200,787
1985	4,860	84,841
1986	3,100	50,220
1988	5,032	367,886

The protection project on the Rio das Mortes in Mato Grosso produced 250,000 hatchlings in 1988. Sonia Moreira and Nelly Tocantins are planning to do master's theses at this site. The study will involve head starting and feeding the hatchlings using my techniques of inoculating the hatchlings with adult feces during the first few weeks after hatching.

The protection of turtles on the Rio Branco, Roraima, involves 12 beaches. The project was started in 1976, but the data from 1976–1979 are missing. This area is extremely interesting in that nesting occurs in January, while in all other areas in the Brazilian Amazon nesting begins in September with October or November the peak months. The hatchlings are retained 15 days and then released into the lakes and streams away from the beaches to limit predation. Albino hatchlings are regular occurrences at this site, but no statistics were given on numbers. Data were given for the following years:

Year	Nests	Nests Protected	Hatchlings	Eggs/Nest
1980	1603	1508	152,765	117
1981	1717	1637	175,189	115
1982	2486	2368	214,314	102
1983	2758	2587	275,478	105
1984	1660	1541	154,814	106
1985	2366	2230	209,730	100
1986	1603	1501	173,553	104
1987	2914	2746	254,021	102
1988	3035	2872	306,367	105
1989	3236	2774	305,140	119

The Rio Guaporé in Rondônia has been producing an increasing number of nests and hatchlings since the beginning of the project in 1976. It is important to note that even though the number of beaches protected in 1987–1988 was reduced to three from a high of 19, more nests and hatchling are being produced. This suggests that this population is recovering due to the intensive efforts of the team in Costa Marqués. The following data were presented:

		P.expansa		*P. unifilis*	
Year	Beaches	Nests	Hatchlings	Nests	Hatchlings
1976	11	152	7,935	780	10,465
1977	18	213	8,302	974	9,975
1978	17	109	4,451	645	7,137
1979	19	265	11,924	1,419	16,702
1980	18	280	14,760	757	8,957
1981	19	248	9,669	1,197	10,998
1982	4	109	9,767	343	5,301
1983	3	182	4,535	333	4,187
1984	5	364	12,868	600	5,387
1985	5	621	21,135	627	7,735
1986	6	794	44,584	576	5,971
1987	3	678	48,188	281	4,073
1988	3	728	40,109	337	2,541

During the last two years 5,000 hatchlings were marked and released after being head started for six months.

The rest of the week was devoted to standardizing the methods of data collection and reports among all of the regions, to problems with turtle farming and headstarting, to long-range plans, and to basic administrative problems. I was highly impressed with the group in general, and in particular by the level of participation and interest in the Amapá, Trombetas, Tapajós, Rio Branco, Mato Grosso, and Costa Marqués teams. I am planning to set up joint projects or give technical assistance to the programs in these areas.

I spent two weeks (May 25–June 10) in Rio Branco, assessing population levels and defining adult and juvenile habitat away from the nesting beaches. June 15–September 5 was spent at Costa Marqués trapping for a long-term study of feeding and habitat use by adults and juveniles. Natural growth rates possibly will be determined by the recapture of hatchlings marked and released in 1986 and 1987.

We also conducted experiments to study growth and feeding of hatchlings in captivity with and without the inoculation of adult feces. The effect of different concentrations was also studied.

October 15 to January 10 was spent at Rio Trombetas where I put transmitters on 10 female *P. expansa* after they had nested. They are to be followed for a year to see how far they migrate away from the nesting beaches, where they feed, and if they nest in the same area each year. Gloria Moreira of INPA will continue this aspect of the study with the cooperation of the IBDF team in Trombetas.

Intensive trapping was also done within the reserve at Trombetas to determine where the hatchlings and juveniles are feeding, what they eat, and the population dynamics of all of the species occurring in the reserve.

I made a visit to the Tapajós site in November with my turtle methods course to advise them on nest-site selection for the production of more females than males and to advise them on the best methods for head starting.

Rubens da Rocha Portal of Amapá has a great interest in increasing the production of *P. unifilis* for commercial farming. One of the experiments I will run with him this year is determination of which incubation temperature range produces females and which produces males. These experiments will be set up in September.

My year in Brazil was a success. In Rondônia, Rio Guaporé, 900 adult turtles of five species were marked: *Podocnemis unifilis, Podocnemis expansa, Phrynops geoffroanus, Phrynops rufipes*, and *Chelus fimbriatus*. Natural nests of all five of these species were found. Temperature data was recorded from 43 *Podocnemis unifilis* nests from laying until hatching. 700 *Podocnemis expansa* nested on one beach, Praia Alata. Incubation experiments were run in the laboratory at 28°, 30°, 32°, and 34°C with *P. expansa, P. unifilis*, and *Phrynops geoffroanus* eggs. Agusto Fachin of Peru is doing his master's thesis under my direction: stomach flushing analysis of all specimens captured throughout the year of these five species. He will continue trapping in this site until June.

In October, Gloria Moreira and I put transmitters on 10 adult female *Podocnemis expansa* captured by hand at the nesting beach, Praia Jacaré at the Rio Trombetas station. I caught two females of 32 kg by diving in 1.5 m of water near the basking sites before they had nested. Transmitters did not effect their behavior; they stayed in front of the beach after release and eventually came up to lay. Eight others from a single nesting group had transmitters attached and were released in front of the beach. (Five of these had not nested but later came up to nest.) The most interesting bit of data collected with transmitters showed that after nesting, females remained in front of the beaches in deep, 10-meter pools for up to two months. We followed some of the turtles downstream into the Amazon in January.

Enquirer Reports on Wealthy Tortoise Heir

According to the August 7, 1990, issue of the tabloid, *National Enquirer*, a British tortoise named Fred (species was not indicated) has inherited nearly $45,000! Fred's 61-year-old spinster owner, Dolly Duffin, was reported to have carried him around on her shoulder and walked him in a baby carriage.

After Dolly died last March, her nearest relative, a niece, was "shell-shocked" to learn that she was to receive a mere $600 while Dolly's house had been willed to the humane society with instructions that all proceeds from its sale were to go to the care of Fred for the rest of his life. The *Enquirer* estimated that to be another 60 years.

Too Many Turtles Now

(From the *Tallahassee Democrat*, August 29, 1990.)

I'd like to say just a few words to some of the endangered species fanatics.

First, our dear legislators demanded that the fishermen install Turtle Excluder Devices, TEDs. Well, I can say firsthand that they really work great. I just wonder what these people are going to do when these turtles become a nuisance.

I live on the Ochlockonee River* just west or upstream from the Highway 319 bridge. Prior to the TEDs I was able to go out onto my dock and catch decent fish, such as channel catfish, bass, and bream. I used to feed the bream around my dock and they were plentiful. However, I did not fish for them, preferring to simply watch and enjoy their antics. I could lay on my belly on the dock and see them swimming all over the place. Especially when I threw in handfuls of fish food.

But this is no more. The place is simply full of turtles. Just recently I went out and put out three different baits, and I caught three different turtles. These turtles are from 6 to 18 inches in diameter. Now I'd just like to know what am I to do with these nuisances? They are not worth the trouble of cleaning, which you need a chain saw and a chisel to clean one of them and the stingy tough meat that you get off the four legs and the neck isn't worth the effort of going to the trouble of cleaning one of these worthless varmints.

I just wonder if these endangered species addicts are aware of the damage that these turtles do to the good fish population.

—Robert M. Aylor, Sopchoppy

* Freshwater! —Ed.