

Conservation Genetics of the Jamaican Yellow Boa (*Epicrates subflavus*)



Report, by Athanasia Tzika & Michel C. Milinkovitch,
on the field-trip to Jamaica (March 6-26, 2006)

In March 2006, our first field-trip to Jamaica took place. We (Michel C. Milinkovitch and Athanasia Tzika, from the Laboratory of Evolutionary Genetics, Université Libre de Bruxelles, Belgium, and Alasdair McMillan, from the Durrell Wildlife Conservation Trust, Jersey), visited the island for a period of three weeks. Workshops, days spent in the 'bush', as well as constructive discussions allowed them to gather information on the current status of the species in the wild. In addition, 65 specimens were pit-tagged and sampled (blood and/or scales) for genetic analyses.

Introduction In 1851, Gosse described the Jamaican Yellow Boa as a species common in many parishes. A century later, Lynn and Grand (1940) found it only in remote localities and, according to Oliver, during the 1980's, the distribution of the species was widespread but localized and patchy. Finally, in 1996, Gibson referred to '*fragile*' populations. It is likely that the Yellow Jamaican Boa is, today, under serious threat, due to predation by introduced mammals (mainly mongooses), habitat loss (up to 90%, Oliver 1986) and resulting fragmentation of remnant forest patches, as well as human persecution. For this reason, a captive-breeding program of this endangered species was initiated in the 1970s at the Durrell Wildlife Conservation Trust (Jersey). Thirty years later, approximately 80 individuals are being kept at 14 institutions affiliated to the European Association of Zoos and Aquariums (EAZA). The breeding program is coordinated since 2001 by Christophe Remy (Museum/vivarium Tournai, Belgium).

We aim at using molecular markers (nuclear and mitochondrial) for gathering information on the genetic diversity of the initial and current captive population. The same markers will also be utilized to investigate the phylogeography, population diversity and structure, and demographic history of the species in its natural habitat. Genetic analysis of the samples collected in the wild will allow:

- Measurement of the overall genetic variability of the remnant natural population(s) and the characterization of the population structure of the species in Jamaica;
- Allocation of captive breeders to existing or extinct natural populations and improvement of the breeding program by retaining the population structure observed in the wild;
- Allocation of individuals to be released to natural populations (identification of the most relevant releasing site) (Milinkovitch *et al.* 2004).

March 7th, 2006. A workshop took place at the 'Seven Oaks Sanctuary (SOS) for Wildlife' (www.sos-wildlifejamaica.org.jm) organized and hosted by its operator, Wendy Lee. Approximately 25 participants with a diverse background attended, including:

- Ricardo Miller & Canute Tyndale, National Environment and Planning Agency (NEPA);
- Susan Koenig, DFES, Director of Research, Windsor Research Centre;
- Andrew Ross, former Scientific Officer for the Montego Bay Marine Park;
- Karen Sharpe, Instructor, Montego Bay Community College (MBCC) with eleven students;
- Denmark Perry, Wildlife Caretaker, SOS-Wildlife;
- Quincy Grant & Davon Davy, residents of the Discovery Bay Area who regularly assist at the rescue of Boas.



Workshop at SOS for Wildlife

Michel Milinkovitch gave a presentation on the utility of molecular techniques for conservation genetics in general and the Yellow Jamaican Boa in particular. He discussed the importance of combining field and molecular data. Alasdair McMillan talked about the captive husbandry of the species and referred to basic housing requirements, nutrition and general health issues. Finally, Ricardo Miller gave a general introduction on the current status of the species in the wild as well as an outline of the goals set by NEPA for the conservation of the Boa. We distributed posters and CDs with additional information on the project. Presentations were followed by a constructive discussion on environmental issues in Jamaica in general and on the major threats for the Yellow Boa in particular. An important conclusion to this discussion is that human behavior and activities repre-

sent the greatest threat: (i) most people directly eliminate any specimen they encounter and (ii) destruction of the habitat is frequent (for example, a large construction site at Pear Tree Bottom causes the Boas to leave the area such that many are found killed on the nearby roads).

Part of the *SOS for Wildlife* activities is the rescue of Boas found in the parish of St Ann. Eight Boas were kept at *SOS* at the time of our visit. We pit-tagged and sampled all animals in the presence of the workshop's participants, giving them the opportunity to realize that this species is actually harmless. All animals were found in an excellent physical condition, despite that several had suffered severe injuries prior to their transfer to *SOS*.



Wendy Lee

March 8th to 13th, 2006. Cockpit Country has always been regarded as the stronghold for the Yellow Boas, mainly because the area is relatively undisturbed by human activities. We stayed for a period of six days at the Windsor Great House, i.e., the main building of the Windsor Research Center (WRC), run by Susan Koenig and Michael Schwartz. During that period, we searched (with the help of a local guide) an area about 4 to 9 square km around the Windsor Great House. Searches were performed about 6 to 8 hours a day around locations where sightings of the animals had already been reported by Susan Koenig. Only three wild specimens were found (a pair of adults and a single sub-adult male), pit-tagged and blood-sampled.



One of the three boas from Windsor



Trap made at WRC

This experience demonstrated the rarity of these animals and/or the difficulties of spotting them in their natural environment.

After a discussion on alternative approaches for finding the animals, we decided to make a trap (designed by Alasdair McMillan and built at WRC). The trap was bait with a dead rat and placed in two different locations during 3 days. The rat disappeared from the trap on the third day but it was impossible to assess whether it had been taken by a boa (or, e.g., a mongoose).

Susan Koenig and Michael Schwartz have been scale-clipping (for marking purposes) all specimens found in the area around the Windsor Great House for several years, which probably represents the only systematic work on this species so far. Indeed, local people are encouraged to provide to WRC any specimen they encounter. This also provides Susan Koenig and Michael Schwartz with the opportunity to educate local people on the interest to protect the Yellow Boa (the harmless nature and actual benefits of the species are emphasized). Discussions with Susan Koenig and Michael Schwartz provided us with valuable information on the behavior and distribution of the species in the Cockpit Country.



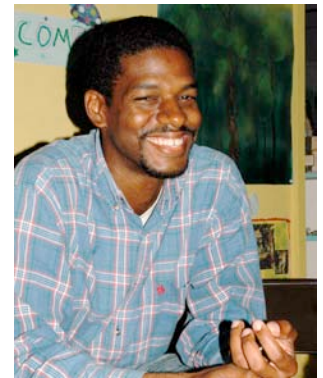
Left to right: Ian, A. McMillan, M.C. Milinkovitch, S. Koenig, A. Tzika, & M. Schwartz

We trained Susan Koenig for pit-tagging and blood sampling of the snakes and we provided her with the necessary material for the process of 50

specimens (pit-tags, implanters, electronic reader, syringes, needles, vials with preservation solution, one snake tong, etc). Indeed, Susan Koenig and Michael Schwartz indicated their clear interest to start a long-term collaboration with us on the conservation of the Yellow Boa.

March 15th, 2006. A workshop was organized by NEPA and the Hope Zoo in Kingston. The numerous participants included:

- Yvette Strong, Head of the *Biodiversity Branch*, as well as Ricardo Miller & Canute Tyndale (NEPA);
- Orlando Robinson, Director of the Hope Zoo as well as 4 zoo keepers (Ordell Williams, O'Neil Dawkins, Gary Lawrence & Audrey Smith);
- Pr. Byron Wilson, University of West Indies.



Y. Strong (NEPA) & O. Robinson (Hope zoo)



Weighting and blood sampling of snakes at the Hope Zoo.

Presentations by Ricardo Miller, Michel Milinkovitch and Alasdair McMillan were followed by measurements, pit-tagging and sampling of 18 adult Boas (blood and/or scales) and 19 juveniles (scales or shed skin) from three different litters.

This workshop was an opportunity to visit the

facilities of the Zoo and discuss the possibilities of a captive breeding program in Jamaica. Byron Wilson, who mostly works on the conservation of the Jamaican Iguana (*Cyclura collei*) at Hellshire Hills, St Catherine, provided information on extremely rare

sightings of the Boa in this area (although it is intensively surveyed) and allowed us to sample a Boa he keeps in a -20°C freeze after it had been killed through its attempt to eat a cane toad.

March 15th to 21st, 2006. For these five days, NEPA organized field-work at the parish of *St Ann* as well as the collection of samples from specimens held by privates. The first day, the area of *Belle Air* (Discovery Bay) was visited by:

- Michel Milinkovitch & Athanasia Tzika
- Ricardo Miller & Canute Tyndale
- Instructor from the *College of Agriculture, Science and Education* (CASE) & 12 students

No wild specimens were found but the opportunity was given to explain to locals that the Yellow Snake is harmless and useful (and illegal to kill it).

Later during the day, the same team visited the facilities of Charles Swaby “*Swamps Safari*” at *Half Moon*, Falmouth. Although, the attraction is no longer functioning, one specimen of Yellow Boa is kept in conditions that do not meet minimal requirements (neither water nor a hiding place nor a gradient between direct sunlight and shade were available to the snake). The animal itself was found in poor condition (underweight, loose skin), i.e., probably dehydrated.

The next stop was the “*Dolphin Cove*” attraction. Two Boas were sampled. Both animals were hardly reacting to any stimulus and their body temperature was low. Their poor condition is probably a result of the constant direct contact with the public in combination with housing conditions that are likely not to meet minimal requirements (unfortunately, we were not shown the enclosures). Note that a Green Iguana (*Iguana iguana*) was also found in similar poor condition (no coloration, probably due to the lack of direct sun light).

We also stopped at the *Green Grotto Caves*, where sighting of the Boa have been reported ten years ago (Gibson, 1996). The guards confirmed that Yellow Snakes have been found in and around the caves, but unfortunately none was present during our visit.

On Saturday March 18, a short version of the previous workshops was presented to the students of CASE by Ricardo Miller, Michel Milinkovitch and Alasdair McMillan. In the afternoon and early evening (the period that the Boas are supposed to be more active), *Belle Air* and the *Pear Tree Bottom* con-

struction site were visited with Davon Davy as a guide. No snake was found.

On Sunday March 19, a field-trip to the outskirts of *Oracabessa* and *Galina* (where sightings of the Boa have been reported to NEPA) took place. Miss Yvette Strong, head of the Biodiversity branch participated to the trip. No boa was found.

The following two days (March 20 & 21) were dedicated to the collection of samples from additional boas kept by privates. *Dwany Smith* was the first person visited; he keeps two boa specimens at *Savanna-La-Mar* and uses these animals for public awareness activities in collaboration with local NGOs. Both Boas were in excellent condition, demonstrating that a basic (yet non-esthetic) enclosure designed with care to meet basic requirements allows snakes to be kept in good health.



The enclosure at Savanna-La-Mar (Dwany Smith)

We failed to sample the two animals that Charles Swaby keeps at his attraction site at *Black River* because the keys of the enclosure were not available. Two other snakes in the possession of Charles Swaby and kept at *Mandeville* were sampled. These animals were in poor condition: underweight (300g for 5 years old male), loose skin (probably dehydrated) and kept in conditions that do not meet minimal requirements



The enclosure at Mandeville (Charles Swaby)

(neither water nor a gradient between direct sunlight and shade were available to the snakes). The last stop was the *Denbigh Agricultural Show Grounds* where a mini-zoo exists although it is currently closed to the public. The only specimen present seemed to be in a fairly good condition but the zoo seems to be degrading at an accelerated pace.

March 22nd, 2006. The CITES export permits were issued by NEPA and we provided them with the necessary material for the process of 50 specimens (pit-tags, implanters, electronic reader, syringes, needles, vials with preservation solution, one snake tong, etc). The same day, a request was submitted to the *Institute of Jamaica* for the sampling of seven specimens in their collection. Permission was not granted. The library of the Institute provided historical information (dating back to 1851) on Yellow boas.

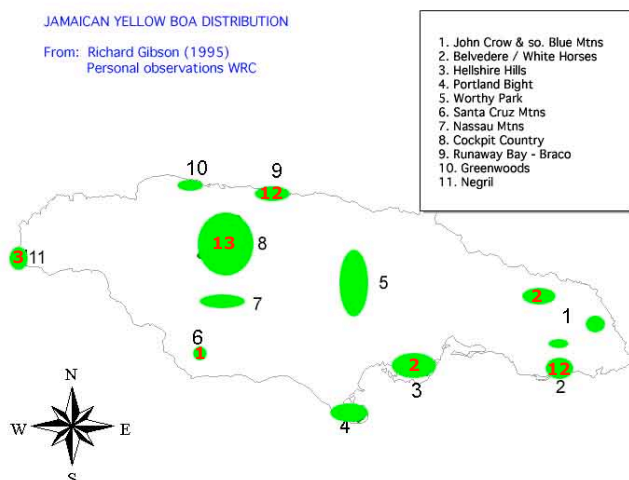
Conclusions and Suggestions The three-week period we spent in Jamaica was of course largely insufficient for a thorough assessment of the status of *Epicrates subflavus* in the wild. However, the workshops, the field work as well as our numerous discussions with the environmental authorities, local scientists and aware citizens, provided us with loads of information pertinent to our work on the conservation of the species. Below, we provide suggestions regarding (a) sampling methods, (b) improving methods for finding/studying snakes in the wild, and (c) improving welfare of the captive animals.

(a) Sampling We sampled sixty-five individuals from numerous localities around the island. Unfortunately, samples are not distributed evenly among the localities (some regions are much better represented than others). In order to facilitate genetic analyses and ensure meaningful results, a serious effort should be made to expand the sampling. The appropriate material as well as the knowledge has been passed on to key-individuals (Environmental Officers from NEPA, Susan Koenig from the Windsor Research Center and keepers from Hope Zoo) for the collection to continue.

(b) Field-work. Opportunistic sampling will remain important but it should be supplemented by organized field-work in order to increase the number of samples and gather information on the distribution of the species. Given the possible rarity of the species as well as its secretive and cryptic nature, yellow boas are very difficult to find in the wild. Hence, systematic search across the bush is inefficient (about 0.02 boa found x man/hour). Hence, we make the following suggestions for possibly improving the efficiency of sampling and information recovery.

(i) A systematic investigation of the status of the Yellow Boa across the island should be performed through the use of a questionnaire (interviews of people). This approach could provide information not only regarding the presence/absence of the Boa, but also on the locations and period of the year they are most often encountered (depending on weather conditions and specific human activities). Representatives of NEPA (Canute Tyndale) declared their interest into performing this important task. Furthermore, the approaches used on similar species (such as *Epicrates inornatus*, Reagan, 1984; Puente-Rolon and Bird-Pico, 2004) should be investigated.

(ii) Given the secretive nature and the possible rarity of the species, 'active searching through the bush' is clearly not the most efficient means (in terms of each dollar invested) for gathering samples and relevant information. However, we propose that snakes could be effectively captured by the use of traps. Gosse (1851) already referred to the use of traps for snakes. Different types of commercially-available traps are being used to capture snakes without harming them and even special solutions to lure them are available. Byron Wilson mentioned that Yellow Snakes have been captured



Origin of samples obtained during our March 2006 filed trip. Numbers in red refer to number of samples. Numbers in black refer to localities.

in mongoose traps baited with rat's blood. If traps are to be used, it is recommended to place each of them in shade with water provided and check them not less than every two days.

Furthermore, we propose that the search for snakes could be very effectively assisted by the use of dogs. Indeed, dogs are used for finding specific targets such as birds, mammals, mushrooms, drugs, etc. Given that Yellow Boas have a very distinct smell and are available at the Hope Zoo, it should be relatively easy to train dogs for finding the snakes in the wild. Note that Jamaican Customs train dogs to locate drugs. Hence, the required skills should be available locally and representatives of NEPA (Ricardo Miller) declared their interest into developing this approach.

(iii) The above-mentioned approaches should provide many additional samples for genetic analysis as well as information on the distribution of the species and estimation of the populations' size. However, in order to better understand the ecology of the species, radiotelemetry would be an ideal additional approach. Dedicated personnel should first be trained in implanting radio transmitters (by surgery) and then perform extensive field work to follow the individuals. Note that, in a study on the Puerto Rican Boa (*Epicrates inornatus*), only 15 percent of the snakes detected by telemetry could be visually detected (Wunderle and Mercado, 2004). Despite these difficulties, Susan Koenig indicated her interest into performing such a work if she can obtain the necessary financial support.

(c) Captive animals. The quality of the conditions under which captive Yellow Snakes are kept in Jamaica is very variable (from excellent to poor) from site to site. Although snakes, in general, are very resistant animals, it is important to emphasize the **minimum** requirements in husbandry and care (see below, information provided by Christophe Remy). It is very likely that people keeping snakes in sub-minimal conditions do so only because they have not been provided with the relevant information (hence, we do not imply that these people have no interest into keeping their animals in good condition). NEPA should provide the relevant information and should not issue permits for keeping snakes in captivity if these requirements are not met.

☑ Minimum size of the cage:

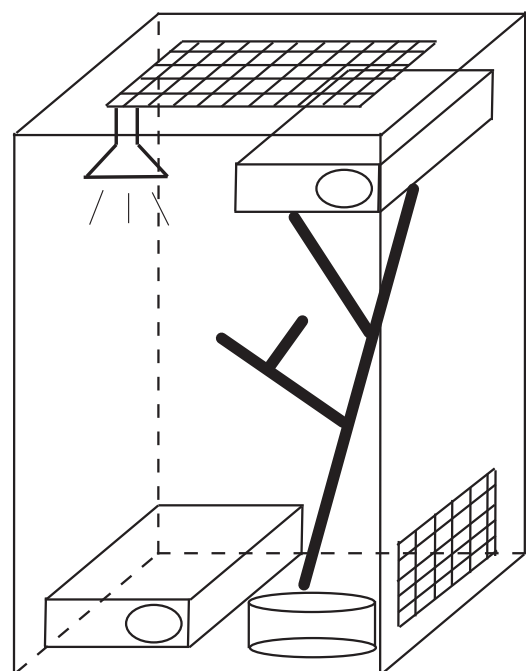
For newborns and juveniles (<60 cm):

ground surface = 0.1 square meter;
height = ~40 cm for 2-3 individuals.

For subadults (60-120 cm):
ground surface = 0.3 square meter;
height = ~ 80 cm for 2-3 individuals.

For older individuals (>120 cm):
ground surface = 1 square meter;
height = ~ 120 cm for 2-3 individuals

- ☑ Individuals <120 cm should be fed once per week and the bigger ones should be fed once every two weeks with prays of adapted size (lizards, rodents, chicken). The individuals with difficulties to feed (especially newborns and juveniles), should be given prays impregnated with the smell of lizards, amphibians, or chicken.
- ☑ Hiding places should be provided at different heights (minimum one on the ground and one higher).
- ☑ Branches should be available for climbing.
- ☑ Ventilation of the terrarium is important (to avoid overheating). Ideally, the cage should be made of wires or include ventilation vents (in the lower and upper parts).
- ☑ UV light is not necessary for these snakes but light is (sun light, light bulb, neon tube). If a light bulb is used, the snake should not have access to it (to avoid burns). A day-night light cycle must be followed.
- ☑ Fresh water should be available at all times.
- ☑ If the terrarium is exposed to direct sun-light, shade should be available.



Note that several people dedicated to conservation and education issues in Jamaica (e.g., Wendy Lee, SOS for wildlife; Susan Koenig & Michael Schwartz, Windsor Research Center) have difficulties to keep boas in captivity and/ or sample animals because of the lack of funding for building and maintaining the required enclosures and/or purchasing the sampling material. In addition to providing the minimum requirements for keeping boas in captivity, NEPA should consider the possibility to provide funds for making such enclosures.

Finally, as it is generally difficult to maintain large numbers of Yellow Snakes in captivity, the issue of when, how, and where releasing snakes has been raised multiple times. We simply suggest to release the snakes where they have been found unless the releasing site is unsafe (unfortunately, a frequent situation). The genetic analyses we are performing will provide (probably in the following 6 months) information on population structure and, hence, will assist allocation of individuals to be released to natural populations (i.e., identification of the most relevant releasing sites).

Brussels, April 3, 2006.

Acknowledgments:

Filed work costs have been supported by the “Fonds Léopold III pour l’Exploration et la Conservation de la Nature”, the “Belgian Fund for Scientific Research (FNRS)” and the “Fonds Brachet”.

References

- Gibson, R. (1996) The distribution and status of the Jamaican boa *Epicrates subflavus* (Stejneger, 1901). **Dodo, Journal of the Jersey Wildlife Preservation Trust** 32: 143-155
- Gosse, P. H. (1851) A Naturalist’s sojourn in Jamaica. **Longmans, London**
- Lyne, W. G. and Grand, C. (1940) The herpetology of Jamaica. **Bulletin of the Institute of Jamaica Sciences** Series No. 1
- Milinkovitch M. C., Monteyne D., Gibbs J.P., Fritts T.H., Tapia W., Snell H. L., Tiedemann R., Caccone A & J. R. Powell. (2004) Genetic analysis of a successful repatriation program: Giant Galapagos tortoises. **Proceedings of the Royal Society of London B** 271: 341-345.
- Oliver, W. L. R. (1982) The coney and the yellowsnake: The distribution and status of the Jamaican hutia *Geocapromys brownii* and the Jamaican boa, *Epicrates subflavus*. **Dodo, Journal of the Jersey Wildlife Preservation Trust** 19: 6-33
- Oliver, W. L. R. (1986) Nanka or Yellow Snake: a Jamaican boa. **Jamaican Journal** 19 (2): 2-23
- Puente-Rolon, A. R. and Birdo-Pico, F. J. (2004) Foraging Behavior, Home Range, Movements and Activity Patterns of *Epicrates inornatus* (Boidae) at Mata de Platano Reserve in Arecibo, Puerto Rico. **Caribbean Journal of Science** 40 (3): 343–352
- Reagan, D. P. (1984) Ecology of the Puerto Rican Boa (*Epicrates inornatus*) in the Luquillo Mountains of Puerto Rico. **Caribbean Journal of Science** 20(3-4): 119-127
- Wunderle, J. M. and Mercado, J. E. (2004) Spatial Ecology of Puerto Rican Boas (*Epicrates inornatus*) in a Hurricane Impacted Forest. **Biotropica** 36(4): 555–571

All pictures copyrighted M.C. Milinkovitch 2006