Developing and testing effective tracking for the pygmy hog.

Final report to the People's Trust for Endangered Species.

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The Pygmy Hog Conservation Programme is a collaborative project of Durrell Wildlife Conservation Trust, IUCN/SSC Wild Pig Specialist Group, Forest Department, Govt. of Assam and the Ministry of Environment & Forest, Govt. of India. It is implemented in Assam by the Rare & Endangered Species Conservation Unit (RESCU) of EcoSystems-India

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SUMMARY

Thanks to the support of the Peoples Trust for Endangered Species, Durrell Wildlife Conservation Trust and Ecosystems India were able to develop and test multiple radio telemetry solutions to monitor the release of pygmy hogs back to the wild. We engaged external experts to support the development process and tested a new form form of tag attachment using ear tags. Unfortunately during two field seasons, the ear tags were not able to withstand the stress of the hogs life in the thick Assam grasslands. The project provided a highly valuable proof of concept and tantalising potential for the ear tags being successful in the wild. The outcome is that we will continue to develop the tag design and housing to try and increase the robustness, whilst also continueing to explore alternative approaches. A final trial of ear tags will be made during the 2016 release of hogs to a new protected area, Barnadi Wildlife Sanctuary.

Introduction

The main purpose of this project was to develop and test a new method to track individual pygmy hogs post release. A series of specific outputs were outlined in the proposal to identify a new approach to attaching a transmitter to pygmy hogs with the consultation of telemetry experts, then testing at least two approaches using animals within the captive breeding programme, before using the most successful technique to track animals in the wild. This is the final report for the project and it provides an overview of activities during the whole project, as well as results, next steps and a report on the budget.

Project background

The pygmy hog (*Porcula salvania*) is often categorised as one of the most endangered wild mammals on the earth. It is the rarest and smallest member of the pig family and belongs to a unique monospecific genus. The pygmy hog is categorised as Critically Endangered by IUCN Red List of Threatened Species. An inhabitant of the tall alluvial grassland plains south of Himalayan foothills the pygmy hog was reduced to a tiny and declining population in Manas Tiger Reserve of

Fig 1. Goutam, Richard and Parag (L to R) discuss the collar attachments (Left) and the Basistha pygmy hog breeding centre (right).

Assam by mid-1990s. The Pygmy Hog Conservation Programme (PHCP) started a conservation breeding and reintroduction project using six wild founders captured from the last surviving population in Manas in 1996. Although the captive breeding was highly successful, the reintroductions began only in 2008 after improving the management and protection of habitat at the release sites and preparing the captive bred animals in a pre-release facility with simulated natural grassland. In the last eight years 94 captive bred hogs have been reintroduced by PHCP in two protected areas of Assam and its two captive populations of about 60 hogs continue to provide animals for reintroductions (Fig 1).

IUCN's Reintroduction guidelines state that "Monitoring the course of a translocation is an essential activity. It should be considered as an integral part of translocation design, not to be merely added on at a later stage" (Section 4.3, IUCN 2013). The monitoring programme provides the basis to assess the effectiveness of the release programme, supports the adaptive management of future releases and is a vital tool in managing restoration strategies. This has always presented a major challenge for the PHCP.

Currently released hogs are largely monitored by locating field signs such as nests, foraging marks, footprints and droppings, and by using camera traps. This is a challenging task as these shy animals rarely emerge from the tall and dense grass where dangerous animals such Indian rhinoceros (*Rhinoceros unicornis*), Asian elephants (*Elephas maximus*) and tiger (*Panthera tigris*) also live.

Given the secretive behaviour of the hogs and their challenging environment, radio tracking individuals presents the most effective strategy to monitoring release efforts. However to date, all efforts to use different telemetry methods have failed. In 2008 radio harnesses were tested and radio implants in 2011 and 2012. Both methods were unsuccessful as they caused injuries to the animals and suffered failures due to difficulties with transmitter attachment. The central problem is that the morphology of the animal does not lend itself to fitting collars, commonly used with other species. Equally any harnesses that fit behind the legs or across the abdomen seem to quickly cause abrasions or the animals become entangled. The third challenge is that this species performs social grooming and will focus on

'foreign' objects as something to remove. Therefore there is a central challenge that if solved, would open the way to the collection of a huge amount of data and would give a major step forward to the restoration programme. This project set out to use specific expertise with radio-tracking other species to develop a working solution to the tracking of pygmy hogs.

Project activities

1) Design the transmitter attachment

In 2014, Durrell started working with Dr. Richard Delahay from the ecological consultancy, Biocensus Ltd. Richard has considerable experience radio tracking badgers in particular and therefore we identified that he would be well-placed to help advice on the development of telemetry methods. We also worked with the UK-based company, Biotrack Ltd., to develop and supply the transmitters. Both Durrell and Richard Delahay have a good experience working with Biotrack.

The first stage of the project was to develop a short list of approaches that would be trialled. The methods that were taken forward were a re-assessment of using 1) collars, given their widespread use and the ability to add a variety of transmitter types; 2) gluing the transmitter on the guard hairs and 3) ear-tag transmitters.

Richard visited the Basistha breeding centre with a number of different collars and attachment methods. Biotrack had supplied some dummy transmitters that were the same weight and shape of those that would be attached.

It was clear as the team inspected the animals and started to test the different methods, that attachment via glue would not be effective. This was due to the limited density of hairs for anchoring the tags and concerns over damage to the sensitive skin of the hogs.

A collar of soft leather was fitted to a separate hog and the animal was closely monitored within the breeding enclosures. In the original proposal we suggested that we could use different collar materials, however there was also concern that these different materials were either going to cause abrasions (e.g. nylon rope) or would be too flexible or not enable the skin to breath (e.g. neoprene). Therefore leather was identified as the most appropriate material to use.

However within a week of fitting the collar, the concerned hog was moving with an unusual gait and that the collar began to slip over the head and moved forward such that it was partially covering one ear. We also had a situation where the animal was able to get its foot through the collar and became trapped. It is difficult to ensure that any collar is fitted tight enough to as not to fall off or slip, but that does not limit the animals welfare in any way. Trials with collars were not continued. There may be future potential to test a range of different collar materials and thicknesses. But for the moment it was clear that this was not a viable approach.

The final method tested was the ear tag. As this is an invasive procedure, approval was sought and granted from Durrell's internal Ethics Committee for the test and pilot procedures. The ear tag transmitter assembly were made using standard livestock ear tag (Tip Tag 7 Rockall France) that comprises a male part having a stem with a head portion at one end which is pierced through the pinna and is passed through an opening of the female part to lock and fit the tag on the ear. The VHF radio transmitter and a silver oxide button cell were potted either in extremely hard dental acrylic coating or less hard 'plastidip' onto the female potion of the tag. The antenna emerging from the potted transmitter was either NiTi antenna made with strong, thin and flexible titanium alloy wire like hair (Fig. 2). The tags weighed around 4-5 g.

The site chosen for piercing the ear was in the

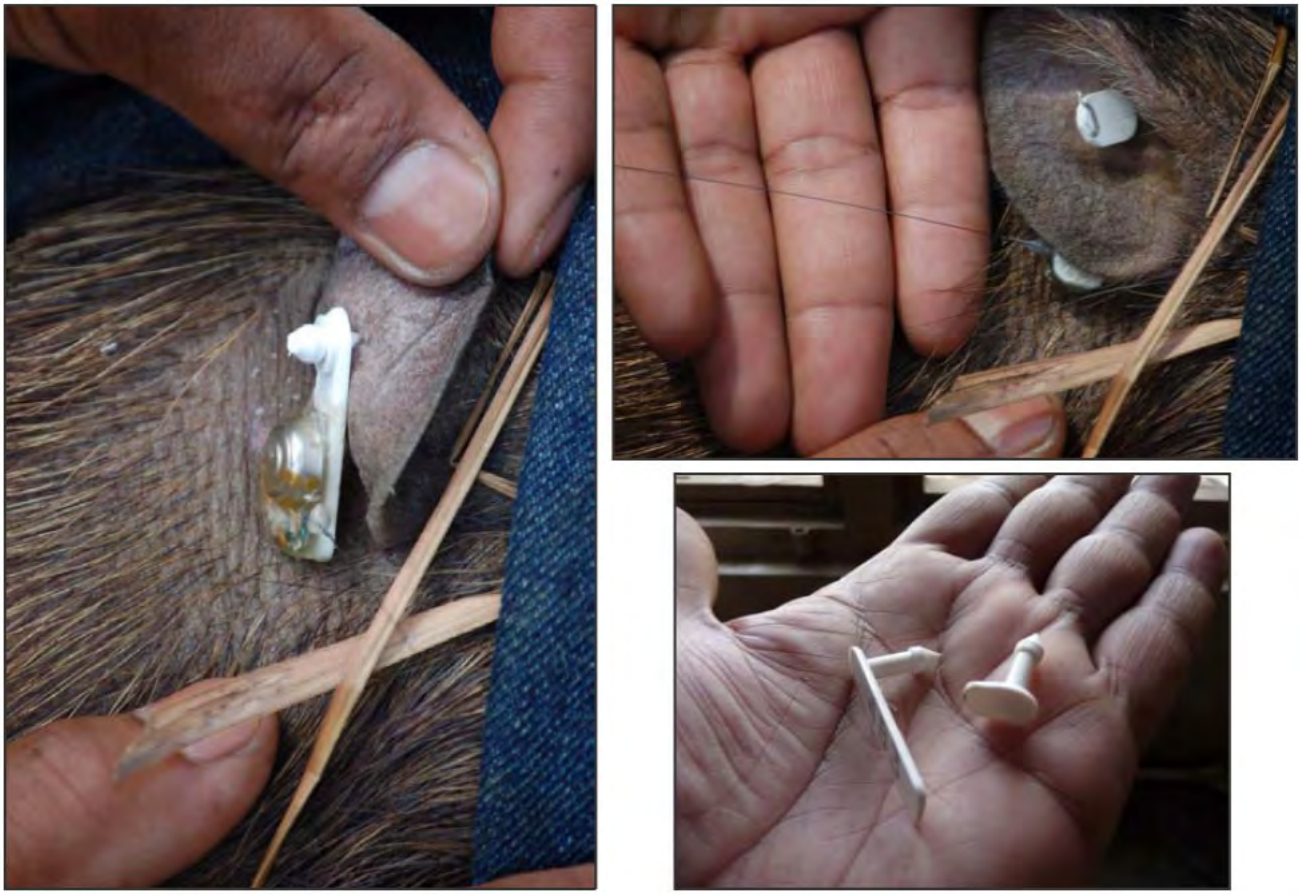

Fig. 2. *Left*: The ear tag fitted on a pygmy hog. *Right above*: The hair-like NiTi antenna. *Right below*: The male component of the tag before and after reducing its size.

upper part of the pinna with relatively thicker cartilage as this was likely to reduce the chances that the ear would tear. The length of the male component of the tag was cut down prior to fitting (Fig. 2) to reduce the amount of material potentially available for other pygmy hogs to chew while grooming the tagged animal. The sharp tip of the male component was also blunted after fitting the tag to prevent discomfort or injury to the hogs. In the initial trials during the pilot study, ear tag pliers (Fig. 3) were used for pressing the two portions of the tag to pierce the ear and fit the tag, but since this method was cumbersome it was decided to first make a small hole in the pinna using a leather belt punch, push the ear tag through by hand and then use the pliers to press the male part of the tag through the opening of the female part. Even this method was reviewed when it was found during the pilot study that the hole wound on the pinna remained raw due to free movement of the ear tag and took a long time to heal. It was decided to make a clean hole using the belt punch (Fig. 3), apply antibiotics and allowing the wound to heal for a week or ten days before fitting the ear tag.

2) Pilot testing the transmitter attachment

Ear tags were tried on three different animals at Basistha and Potasali centres of PHCP during the pilot study. The tags stayed in place and did not cause animals to exhibit aberrant behaviour. However, the NiTi antennae on two hogs broke on 2^{nd} and 7^{th} week weeks under captive conditions. Since the ear tags was the most promising approach in this study, it was decided to use them on three hogs for release operations in May 2014, and Biotrack was requested to provide ear tags with stronger antennae. A full report by Biocensus

Fig. 3. *Left*: The leather belt punch and hole on the pinna (the wound is allowed to heal before attaching the ear tag) *Right*: Ear tag pliers being used for attaching the tag.

is included as an appendix to this final report.

3) Training and field implementation

In the original proposal, we proposed using the Mataki transmitters being developed by staff at Zoological Society of London. However it was felt that they were currently too large for an ear tag attachment method. Therefore we used the small transmitter design (5g) from Biotrack.

4) Release of hogs in 2014

In 2014 two social breeding groups comprising 11 (5 male, 6 female) pygmy hogs were released in RG Orang National Park. Three of them were fitted with radio ear-tags – a male and a female in the group of six and a female in the group of five, using the method described above.

The hogs were released in the wild under a soft release protocol spanning a period of about 6 months. First, the social breeding groups were formed at the breeding centres using unrelated hogs and each of these groups were translocated to large pre-release enclosures with simulated natural grassland habitat at Potasali after mid December 2013. They were prepared for independent survival in the wild under minimal human care and greatly reduced supplementary feeding for about 5 months. After mid May 2014, they were taken to separate release sites where they were kept in small release enclosures for two days before being allowed to escape to the wilderness. Supplementary feeding, that had been stopped in the pre-release area, was resumed for these two days to encourage the hogs to visit these baiting sites for several weeks after release. The two groups were released on 17 and 19 May 2014 and the radio ear tags were fitted two days before their release. Initially, the tags worked well and the hogs were tracked from a distance of 350-400 m. The tracking distance improved to about 500 m from the height of a watch tower or a tree.

Fig. 4. *Left*: Mite infestation on the tagged ear of the 2014 male. *Right above*: VHF receiver checking activated ear tag *Right below*: Recovered ear tags; the one on the right lost the transmitter assembly.

Date of release	Sex & age class	Transmitter & antenna type	Battery type & life	Status of the ear tag (as per baiting site camera trap) and remarks
17-May-14	Female, young adult	Pip (173.291 MHz, 30 ppm); single NiTi antenna	Ag 357; 8 months	The antenna was lost 6 days after release; recaptured about 3 weeks after release; tag recovered.
19-May-14	Female, sub-adult	Pip (173.217 MHz, 30 ppm); single NiTi antenna	Ag 357; 8 months	The acrylic casing along with the transmitter and battery slipped off the tag about a week after release; recaptured 11 days after release; transmitter and battery lost; bare plastic tag recovered.
19-May-14	Male, young adult	Pip (173.315 MHz, 30 ppm); single NiTi antenna	Ag 357; 8 months	The antenna was lost about 16 days after release; the hog was recaptured and tag recovered. Pinna, heavily infested with mites was cleaned and dressed before the hog was released.

Table 1. Details of 2014 pygmy hog ear tagging experiment in Orang.

However, within a few days of release the tags either lost their antennae or disintegrated and the experiment came to an end. Although the titanium alloy antennae ware strengthened on our request, they probably were not strong enough for repeated bending at the base as the hogs moved back and forth through thick grass. While the antennae on two tags fell off within a week or two, the third tag lost the entire transmitter and battery contraption in a week (Fig. 4). Since the hogs were being monitored at the baiting stations using hides and camera traps, we were able to recapture them to recover the tags after persistent efforts to trap them. Table 1 provides some details of the 2014 experiment.

5) Release of hogs in 2015

A report on the failed 2014 ear tagging

Fig 5. Hogs being released from their temporary enclosures in May 2015 in Orang National Park.

experiment and the recovered tags were sent to Biocensus and Biotrack UK in order to improve upon the design of the ear tags for 2015 experiment. Altogether four tags were ordered with request to further strengthen the antennae in particular and the tag in general.

In 2015, the Nameri National Park was being actively considered as the third reintroduction site in Assam, however, due to poor accessibility at the potential release locations it was thought that regular monitoring of the released hogs will be very difficult in the Park. Since we were eager to monitor the hogs with radio ear tags on a daily basis, it was decided to repeat the experiment in Orang where it was possible to access the release locations fairly easily.

Two social breeding groups with nine captive bred pygmy hogs – one group with 5 (2 males and 3 females) and another with 4 (1 male and 3 females) hogs were prepared independent survival in the wild for five months in Potasali pre-release facility. Three days before their release, the hogs were recaptured from the pre-release enclosures, and two hogs (a male ad a female) in each group were fitted with improved ear tags before taking them to the soft release enclosures in Orang. In addition to strengthening the point on the ear tags where the NiTi antenna emerged from the dental acrylic pot, steps were taken by Biotrack to prevent disintegration of the transmitter-battery assembly by drilling a hole through the plastic base of the tag in order to create a lock against accidental slippage of the assembly. Moreover, the thin and flexible titanium alloy (NiTi) antennae on two of the four tags were replaced with double Trace antennae made with harder and thicker metal wire.

This time the two groups were released on 20th and 25th May 2015 at two different sites in RG Orang NP following the same protocol as described under 2014 experiment (Fig 5 & 6). Despite all the precautions the experiment faced problems similar to the ones in 2014 and this time it also inflicted injury to the tagged hogs causing permanent deformation of the pinna in two animals. While both the NiTi antennae of the two tags broke off in 4 to 9 days after release, the Trace antennae on the third tag fell off in 12 to 14 days of release. The fourth hog with the Trace antennae tag disappeared soon after release and when she returned five weeks later she had lost the upper part of her tagged ear along with the

Date of release	Sex & age class	Transmitter & antenna type	Battery type & life	Status of the ear tag (as per baiting site camera trap) and remarks
20-May-15	Male, young adult	Pip (173.306 MHz, 35 ppm); double Trace antenna	Ag 357; >8 months	One antenna bends and later both antennae break off – one after 12 days and second after 14 days of release. Recaptured after 19 days and kept in a temporary enclosure for treatment of abrasion on pinna; tag recovered. Escapes from temporary enclosure two days later but reappears at the baiting site after another couple of days.
20-May-15	Female, sub-adult	Pip (173.261 MHz, 35 ppm); single NiTi antenna	Ag 357; >8 months	The antenna was lost 9 days after release. Later the entire tag fell off as it slipped through enlarged hole on the pinna. Recaptured about 2 weeks after release, treated successfully for injury in a temporary enclosure and released 19 days later, but the top of her pinna becomes deformed.
25-May-15	Male, young adult	Pip (173.212 MHz, 35 ppm); single NiTi antenna	Ag 357; >8 months	The antenna was lost 4 days after release and the hog had sustained injury on pinna and neck behind the tagged ear. Recaptured 10 days after release and the tag is recovered. Treated successfully for the injury in a temporary enclosure and released 16 days later.
25-May-15	Female, young adult	Pip (173.285 MHz, 35 ppm); double Trace antenna	Ag 357; >8 months	Disappears soon after release only to reappear at the baiting site 5 weeks later. By then she had lost the top half of her pinna along with the tag, but her deformed ear had healed fully so she was not recaptured.

Table 2. Details of 2015 pygmy hog ear tagging experiment in Orang.

ear tag. The tags had caused abrasions and injury on the pinna and the area of neck behind the ear in the other three hogs. These hogs were successfully treated for the injury in a temporary enclosure in Orang. Details of the 2015 experiment are given in the Table 2.

Evaluation and assessment

We set out to develop an effective attachment method for transmitters and we were partially successful. The use of ear tags seems to show huge promise. Through this project we were able to engage a radio-tracking expert and to test some of these alternative designs. We have continued this relationship with both Biocensus and Biotrack. However we saw that post-release the tags failed quickly and this was primarily due to the stress placed on the base of the antenna most likely through abrasions from the animals' movement through the grasses. Despite reinforcing the connection point, the antennae still broke. In 2015 there was also concern about damage caused to the ears of the animals, although we do not know why this differed from the conditions in 2014.

We are building on this experience. In 2016 we will make a final test of using the ear tag method. The two differences are that the holes are being made far in advance and are completely healing while the animals are in captivity and second we are using a thicker antenna material and housing, which means that we have to reduce the battery size to stay within weight limits. We have purchased, with other funding, four of these transmitters and they are going

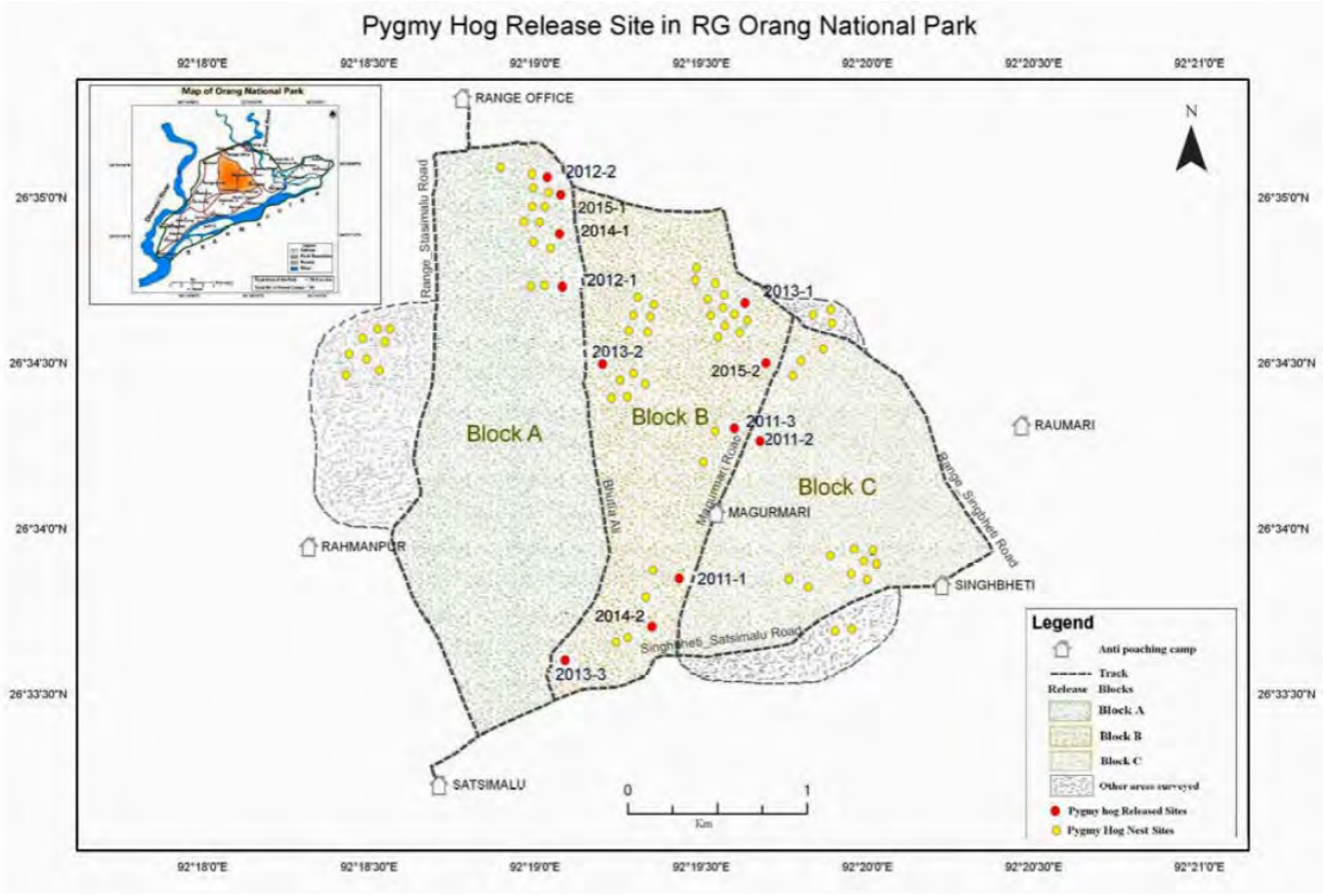

Fig. 6. The pygmy hog release and nest locations in RG Orang National Park. Release locations are indicated by red dots and the digit after the year denotes the social breeding group number of the year. The locations of pygmy hog nests found during ground surveys in March 2014 are indicated by yellow dots. The grassland blocks where the pygmy hog were released are highlighted in the inset map of Orang NP.

to be fitted to hogs for release in May 2016.

At the same time we will continue to explore alternative methods. Based on experience with the original collars, we will test a narrower collar type with animals in the captive facility, to see if they react similarly to past designs. We will also investigate the use of sub-cutaneous transmitters (not the internal versions tested before), which would also have to be very small and would therefore have limited range and battery life.

2016 Update on the conservation programme

Planned breeding of pygmy hog continued at Basistha and Potasali centres of PHCP. By the end of 2014, the captive population of the species stood at 61 (29.32) including three animals given to Assam State Zoo, Guwahati, and two groups in Potasali pre-release enclosures. While these two groups with 11 (5.6) hogs were released in Orang in May 2015, 24 (13.11) hogs were born in captivity in 2015 breeding season. As a few older animals died the current captive population stands at 69 (34.35).

In 2015, four litters were born at the Potasali and 15 (7.8) young hogs survive there. At Basistha, five litters were born but only three of them with 9 (6.3) young hogs currently survive.

Plans are being made to reintroduce the hogs in Barnadi Wildlife Sanctuary in 2016. Barnadi Wildlife Sanctuary was the second site in the world where pygmy hogs survived till 1992. After meetings with senior officials of the PA we were able to convince them convince them to give permission for habitat

restoration. Since the grassland area or the sanctuary has been invaded by trees, restoration work includes removal of trees from erstwhile open grasslands, and this work is being carried out by PHCP in collaboration with local authorities. In addition, strict prevention against livestock grazing and indiscriminate dry season grass burning must be ensured for the habitat to become suitable again for pygmy hogs. If the assessment in April 2016 shows that the habitat has become suitable trial release of pygmy hogs will be attempted in Barnadi in May 2016.

Fig. 7. Some camera trap images of the released hogs at bait stations in 2015.

Fig. 8. Several other important Indian species were captured in the camera traps, including tiger (left) and bush pig (right).

Financial report

Below we provide a summary of the budget for the pygmy hog project, showing the balance of PTES funding and co-funding. The table shows the two disbursements made by PTES and expenditure against this income. We were able to maintain the budget and made savings on the cost of the receiver—as we were able to get the existing receiver refurbished, and given the smaller scale of the assessments, a second receiver was not needed. Equally we purchased a smaller number of transmitters and therefore were able to make a saving on this line. This means that there is balance of £1,827 on the project. We stand ready to return this amount to PTES, although we would welcome the opportunity to discuss how these remaining funds could be used effectively to support the development of telemetry approaches.

Budget	**Source**		**Total**	**PTES disbursement**		**PTES Expenditure**
Description	**PTES**	**Co-funding**		**1**	**2**	
Staff						
Staff time - Goutam Narayan		£ 1,000	£ 1,000			
Staff time - Parag Deka	£ 2,400		£ 2,400	£ 2,400		£ 2,400
Tracking consultant	£ 1,000		£ 1,000	£ 1,000		£ 1,000
Field staff	£ 1,200		£ 1,200		£ 1,200	£ 1,200
			£ -			
Travel			£ -			
International air fare	£ 1,000		£ 1,000	£ 1,000		£ 971
Vehicle use		£ 200	£ 200			£ 200
			£ -			
Equipment			£ -			
Dummy tags and harnesses	£ 520		£ 520	£ 520		£ 517
receiver	£ 1,265		£ 1,265		£ 1,265	£ 322
Radio-transmitters	£ 2,800		£ 2,800		£ 2,800	£ 1,314
			£ -			
Consumables			£ -			
Subsistence for consultant	£ 600		£ 600	£ 600		£ 884
Animal management costs		£ 4,000	£ 4,000			
Consumables		£ 300	£ 300			£ 150
			£ -			
Overheads (at 5%)	£ 540	£ 275	£ 815	£ 276	£ 264	£ 540
TOTAL	**£ 11,325**	**£ 5,775**	£ 17,100	**£ 5,796**	**£ 5,529**	**£ 9,498**
				Balance		**£ 1,827.21**

Appendix 1: Report from Biocensus Ltd. on the development of telemetry methods.

biocensus
Consultancy • Research • Training

The feasibility of radio-transmitter attachment for monitoring Pygmy Hogs

A report to Durrell Wildlife Conservation Trust

April 2014

biocensus
Consultancy • Research • Training

Executive summary

- The release of captive-bred pygmy hogs is an important initiative in the conservation of this critically endangered suid.

- A feasibility study was carried out on methods for the attachment of radio transmitters to allow post-release monitoring of pygmy hogs.

- An initial review of potential methods for transmitter attachment identified collars, ear tags and gluing to the fur/skin as the lead methods to test on captive pygmy hogs in Guwahati and Potasali, Assam.

- Following close inspection of pygmy hogs, the gluing of transmitters was deemed inappropriate owing to the sparse coat and potential for adverse impacts on the sensitive skin and so was not trialled.

- A leather collar was deployed on a captive pygmy hog but had to be removed 7 days later as it impeded normal locomotion. The collar was found to have caused minor abrasions to the skin.

- Three different animals were fitted with an ear tag transmitter. The location and method of fitting was refined during successive events.

- In all three cases the tags stayed in place, were undamaged and did not cause animals to exhibit aberrant behaviour. In one instance the antenna became detached from the ear tag transmitter several days later. Some changes to the design of the transmitter are recommended.

- We recommend the deployment of 2-3 ear tag transmitters on pygmy hogs destined for release in May 2014.

1. Background

The pygmy hog (*Porcula salvania*) is a critically endangered wild suid, which has disappeared from much of its former range in India and Nepal. Its natural habitat is the tall grassland plains that previously spread throughout the area south of the Himalayan foothills from Uttar Pradesh to Assam, through Nepal and Bengal. Today the global wild population is restricted to parts of north-western Assam, in Manas Tiger Reserve, and a couple of reintroduced populations in Sonai Rupai Wildlife Sanctuary and Orang National Park. The Durrell Wildlife Conservation Trust, the IUCN/SSC Wild Pig Specialist Group, the Forest Department of the Government of Assam, and the Ministry of Environment and Forests of the Government of India together run the Pygmy Hog Conservation Programme (PHCP) which is implemented in Assam by the Rare & Endangered Species Conservation Unit (RESCU) of EcoSystems-India.

The work of the PHCP includes efforts to reintroduce captive bred pygmy hogs to the wild. Pygmy hogs captured from Manas National Park in 1996 formed the basis of a captive breeding programme based in custom-built facilities in Basistha near Guwahati, Assam. Captive breeding has proved extremely successful and from 2007 onwards it was decided that approximately 12 animals should be released to the wild every year. This required the construction of a large pre-release facility with simulated natural grassland at Potasali in Nameri Tiger Reserve. Here the captive reared animals have less human contact, access to natural foraging habitat and are provided with decreasing rations of supplementary food in preparation for release. After about five months they are taken to a smaller enclosure at the reintroduction site where they are kept for 2-3 days prior to release. Between 2008 and 2013 captive bred hogs were released in Sonai Rupai Wildlife Sanctuary and Orang National Park (n = 74 animals) and another group are currently being prepared for release in 2014.

Monitoring of the released pygmy hogs is challenging as it is extremely difficult to observe them in the tall grass of their favoured habitat. Efforts have been employed to detect field signs such as nests, foraging marks, footprints and droppings, and to use video camera traps. In 2008, in Manas National Park some animals at the pre-release facility were fitted with a radio-transmitter attached to a harness. However, as this approach caused some injuries to the animals (see below) other methods required investigation.

2. Terms of Reference

Biocensus were approached by Durrell Wildlife Conservation Trust to provide expertise in regards to attachment of radio-tracking devices to pygmy hogs and other methods of post-release monitoring. In February 2014 we were contracted to provide consultancy to;

1. Develop and pilot test a new collar for radio-tracking pygmy hogs.
2. If unable to develop a collar, to try an alternative approach.
3. Make recommendations for improvements or developments to methods for collection of field data on released hogs.

Desired outputs from the study were;

1. Prototype collar or radio-tag attachment approach.
2. Recommendations for data collection and monitoring within the PHCP.

Biocensus adopted the following approach;

1. Conduct an initial review of options for radio-transmitter attachment.
2. Select candidate approaches to trial on captive Pygmy hogs in Assam.
3. Arrange production of dummy transmitters by Biotrack for captive trials in Assam.
4. Visit Basistha Pygmy hog captive breeding facility in Guwahati, Assam to conduct pilot trials of different approaches.
5. Visit Potasali Pygmy hog pre-release facility, Assam, to conduct further trials of selected approaches on group-living animals.

3. Initial Review of Options.

We first conducted a review of potential options for radio-transmitter attachment, involving recourse to personal experience, selective review of relevant literature and discussion with experts from Biotrack. The results of this Initial review of options are described below.

Harness

The previous design of harness employed on pygmy hogs was found to be seriously flawed owing to the nature of the material used and the configuration. The straps of the harness consisted of rubber tubing material encasing wire antennae loops. These straps caused serious abrasions behind the front legs when fastened tightly, but came off when the harness was fitted loosely. It is possible that the harness might be less prone to cause injury if constructed from a different material such as a soft leather. However, a solution would also need to be found for the antenna as looping it around the animal inside any material will potentially limit the flexibility of the strap and if it somehow breaks free then the flailing antenna could cause risk of serious injury. A very thin external antenna (e.g. NiTi) could be the solution.

One advantage of a harness is that it can be employed to carry a relatively large payload, unlike for example an ear tag. It is nevertheless clear that harness re-design, construction and testing of prototypes on captive animals would be a protracted process so this option was not proposed as an initial candidate to trial.

Collar

Although no published information describing attempts to put collars on Pygmy hogs is available, there was a dominant perception that this approach is unlikely to work and hence it may never have been tried. The principal argument for the unsuitability of collars is that Pygmy hogs have virtually no discernible neck, with a head that appears to be a tapered continuation from the back to the snout. Hence it is perceived that the collar would have no place to sit and would therefore easily fall off. However, given the relative simplicity of collaring and the potential for collars to carry a wide variety of relatively large payloads, it was deemed prudent to investigate this option further.

The development of radio-tracking collars for European badgers (*Meles meles*) in the UK has faced similar morphological challenges as are perceived in pygmy hogs as many individuals also have a tapered profile. However, using a combination of the appropriate leather materials and experience in fitting collars has allowed many badgers to be successfully fitted with radio transmitters, GPS and proximity loggers. Given the current availability of collars of a potentially suitable size for pygmy hogs and a range of different devices available for attachment to the collar, it was decided that this approach should be taken forward to trial on captive animals.

Gluing to skin/hair

Small radio-transmitters have been successfully glued to the skin and hair of a variety of mammal species. Initial discussions with Biotrack indicated that transmitters of potentially suitable dimensions and weight were currently available. However, attachment to the skin using clinically approved glues is only likely to achieve relatively short-term attachment as these adhesives do not persist but generally flake off within weeks. The use of commercially available glues which may potentially persist for longer could incur risk of an adverse skin reaction. An alternative approach would be to glue the transmitter in a clump of hair somewhere on the back where the coat is thickest. This could perhaps be achieved best by incorporating some perforated material (e.g. muslin) to create a larger surface area for adhesion to the coat and perhaps by weaving the hair around the transmitter. Potential challenges to this approach include damage or detachment of the tags arising from mutual grooming, aggressive interactions, wallowing and rubbing behaviours. These risks might be mitigated by careful placement of the transmitter on a less susceptible region of the body. As pygmy hogs appear to have a coat of coarse hair and given the ready availability of the necessary materials it was decided to take this option forward for trials on captive animals.

Ear tag

Ear tags have been used to successfully attach small radio-transmitters to several species of wild mammal including deer and wild boar. The pygmy hog appears to have sufficiently large ears to carry an ear tag with a small device attached. Previous attempts to fit numbered identifying tags to Pygmy hogs resulted in them being torn out relatively quickly, although positioning the tag in a different part of the pinna might potentially address this issue. Initial discussions with Biotrack suggested that transmitters of an appropriate size and weight to fit onto ear tags are currently available. This approach faces similar risks of damage or detachment of transmitters arising from social, wallowing and rubbing behaviour as the glued on tags (see above) and again the exact location of the tag will be important in this respect. Given the contemporary availability of suitable ear tags and the relative simplicity of fitting them, it was decided to take this method forward for trials on captive pygmy hogs.

Implants

In recent years a range of species have been fitted with surgically implanted transmitters in a variety of body cavities. For species in which the external attachment of a transmitter presents serious problems, this has clear advantages. However, fitting internal transmitters requires veterinary expertise, surgical intervention and associated facilities, and recuperation time for the animal. Surgical implantation has been carried out on pygmy hogs in the past with an encased transmitter and antenna implanted in three animals in 2011 and four more in 2012. As the facilities at the pre-release centre were unsuitable for intra-peritoneal insertion, the implants were inserted extra-peritoneally, behind abdominal muscles.

Unfortunately the implants were not successful. In 2011, three hogs were implanted with Telonics IMP-200-L implants, two of which stopped working within a month, and the third in less than three months after insertion. The cause of the failure was suspected to have been related to battery malfunction. No significant physical problems were observed amongst the animals fitted with implants. In 2012 a further four hogs were fitted with lighter and smaller Holohil AI-2M(12) implants with external antenna. After inserting the implants behind the abdominal muscles the antenna was lightly woven in the muscles close to the skin before the incision was sutured. Following release these hogs were tracked in the wild for periods of two weeks to five months. While one of the animals was recaptured to remove an exposed implant two weeks after release, the other implants had emerged and fallen out after five weeks. The fourth hog was successfully tracked for about five months after release but as thereafter the signal stopped and so it is not known whether the animal moved out of range or the transmitter stopped working.

Given these problems, and the absence of any existing alternative prototype implant to test, this approach was not selected for trials on captive Pygmy hogs during the present study.

4. Approaches selected for trial on captive Pygmy hogs.

As a result of the initial review of existing information and discussions with Biotrack on the likely availability of suitable transmitters, the following options were short listed for trialling on captive Pygmy hogs in Assam in 2014.

a) Leather collar and buckle.
b) Gluing onto the hair.
c) Ear tag.

5. Production of dummy transmitters.

Following the initial discussions with Biotrack and the identification of three approaches to trial on captive Pygmy hogs, six dummy transmitters were produced (see Table 1). Three transmitters were designed for gluing into the hair and three were attached to ear tags. No dummy transmitters were attached to collars as if this approach worked then it could clearly be used to carry a payload of at least the size of the transmitter designed for ear tags or gluing, and larger.

ID	Transmitter details	Method of attachment	Coating	Weight (g)	Antenna
A	V1910 Pip3	Glue to hair	Dental acrylic	2.92	NiTi
B	V1910 Pip2	Glue to hair	Dental acrylic	3.38	NiTi
C	V1911 Pip3	Glue to hair	Plastidip	2.58	NiTi
D	V1911 Pip2	Glue to hair	Plastidip	3.00	NiTi
E	V1912	Ear tag	Dental acrylic	4.47	NiTi
F	V1913	Ear tag	Plastidip	4.19	NiTi
G	V1914	Ear tag	Dental acrylic	4.92	Trace
H	V1915	Ear tag	Plastidip	4.57	Trace

Table 1. Dummy transmitters supplied by Biotrack for trials on captive pygmy hogs.

All the supplied transmitters incorporated an AG357 silver cell battery and components equivalent to a 'Pip' 'two-stage' VHF transmitter circuit board with separate oscillator and amplifier/antenna matching circuits. An active transmitter of this type would be expected to have a battery life of approximately 6 months at 20 ms pulse length and 50 bpm pulse rate.

The battery life could be extended up to a maximum of about 8.5 months by changing pulse length and rate settings. The approximate range of the transmitter on the ground would be 400 - 1200 m depending on terrain and animal position, but could be 2 - 6 km with a clear line of sight.

6. Visit to Basistha Pygmy hog captive breeding facility in Guwahati, Assam.

The visit to the Basistha Pygmy hog captive breeding facility (Photo 1) provided an opportunity for initial discussions on the likely feasibility of various approaches for the attachment of radio transmitters. In addition, it was possible to physically examine sedated animals closely for the first time.

During the visit the following approaches were investigated. Animals were captured by hand and using a bag on a hoop in their enclosure and sedated by intra-muscular injection with azaperone. Decisions on actions to take were based on discussion between myself, Parag Deka and Goutam Narayan.

1). Collar

As an initial attempt at fitting a collar we chose an animal representative of the larger individuals that would be released alongside juveniles. The selected animal was a sub-adult male approximately 1 year, 9 months of age, with a neck circumference of 35 cm and weighing 6 kg. The rationale behind this choice was that if collaring was going to work then it would be most likely to be successful in a relatively large animal where the distance between the front legs and the origin of the lower mandible would be greatest.

On 06/03/14 a leather collar measuring 405 mm long x 18 mm wide and with a brass buckle (Photo 2) was fitted around the neck (Photos 3 - 5) of the sedated animal. It was noted that the collar width almost filled the space between the front legs and the origin of the lower mandible. Also, the thick musculature on the back of the neck was a hindrance to snug fitting of the collar on the dorsal surface. Also, as the hair was very sparse on the underside of the neck, the animal's skin was in direct contact with both the collar and the buckle which sat at the bottom of the fitted collar. The collar was fitted relatively loosely such that if pulled firmly forwards it could potentially be removed over the ears. Nevertheless, as it could be turned around the animal's neck, it was deemed possible that it might become accustomed to it and hence not attempt to remove it.

Observations of the collared Pygmy hog the following day (07/03/14) showed that it was behaving in an aberrant way, exhibiting an unusual posture and gait, and was very nervous.

The collar could also be seen to be pushing the ears forwards and outwards slightly. A decision was made to leave the collar on for the time being whilst continuing to closely monitor the animal.

2). Ear tag

For the initial attempt at fitting an ear tag we also chose an animal representative of the larger individuals that would be released alongside juveniles. The selected animal was an adult male approximately 2 years, 9 months of age and weighing 8.2 kg. The rationale behind this choice was that if an ear tag was going to work then it would be most likely to be successful in a relatively large animal with a correspondingly large pinna.

The selected animal was fitted with ear tag E on 06/03/14 (see Table 1 & Photo 6) in the right ear. The exact site chosen for piercing was in an area of the pinna with relatively thicker cartilage (Photo 7) as this was likely to reduce the chances that the ear would tear. The side of the tag on the inner surface of the pinna (the male component) was cut down prior to fitting (Photo 8) to reduce the amount of material potentially available for other pygmy hogs to chew. This was then swabbed with disinfectant before it was pushed through the pinna and into the female portion of the tag, using a pair of ear tag pliers (Photo 9). The side of the tag with the transmitter attached was fitted so that it hung behind the ear with the transmitter components and battery facing the pinna (Photo 10). Once the tag was in place the end of the shaft was cut down and sanded down to a smooth surface with sand paper to avoid abrading the skin behind the ear. The antenna (a thin filament of flexible NiTi) was barely visible against the coarse hair of the animal.

Once the animal had recovered from sedation several hours later, it was observed feeding in the enclosure. The transmitter had rotated around so that instead of hanging down behind the ear, it stood in an upright position and protruded above the pinna. This is likely to have arisen as a result of its position in the ear and the weight distribution of the tag (the heaviest part being the battery which was positioned at the end of the tag). The animal however appeared unaffected and was observed to behave in a normal fashion.

The following day (07/03/14) the ear tag was observed to have rotated out of the upright position and back to its original location behind the ear as intended (Photo 11). However, the combined weight and position of the ear tag was causing the ear to bend down slightly (Photo 12). A decision was therefore made to sedate the animal once more and relocate the tag in the other ear in a position that would reduce the chances of it rotating or causing the ear to bend down. Nothing could be done about the weight distribution of the tag as it was potted in dental acrylic but note was made that relocating the battery (the heaviest component) next to the ear tag aperture and placing the lighter components towards the end, would likely reduce

the chances of rotation. The animal was therefore recaptured and sedated so that the ear tag could be removed. On examination the punctured hole was in good condition showing no signs of bleeding, exudate or abrasion (Photo 13) and the tag itself showed no signs of damage. The tag was removed from the right ear and replaced in a more central position near the base of the left ear (Photo 14) and with the transmitter facing towards the body to provide a snugger fit (Photo 15).

3. Gluing

During close examination of these two animals it became clear that the hair of the Pygmy hog is too sparse to be able to successfully attach a radio transmitter by gluing. Although the hair is very coarse, it is also distributed in a very thin coat thus providing little opportunity to bring a sufficiently thick bunch of hairs together around a transmitter. Following discussion it was decided not to attempt to pursue this approach.

7. Visit to Potasali Pygmy hog pre-release facility, Assam.

Pygmy hogs at the Potasali pre-release facility are kept in large enclosures (Photo 16) in groups of 5-6 Individuals. In preparation for release to the wild the animals are fed decreasing rations and hence encouraged to forage for naturally available food in the enclosures, and contact with humans is kept to a minimum. Hence, the animals at Potasali are exhibiting a more natural range of behaviours, including social interactions. This provided an excellent opportunity for further trialling of radio transmitter attachment in a more natural setting following the initial pilot studies in Basistha. Decisions on actions to take were based on discussion between myself and Parag Deka. Given uncertainty over the suitability of the collar fitted to the animal in Basistha, we decided to concentrate efforts on trialling ear tag transmitters in animals living in groups, where grooming and other interactions could potentially impact on the success of this approach. Animals could be observed by eye and using binoculars whenever they came into view in the enclosures, which was usually in the smaller feeding area (Photo 17).

The following case studies were conducted.

1). Ear tag

Following the relative success in attaching an ear tag transmitter on a mature animal in Basistha a decision was made to trial this approach in a younger animal living in a group with four others. On 10/03/14 we captured a female of approximately 9 months old, and weighing 4.5 kg. The animal was sedated and fitted with ear tag transmitter F in the same position as the tag that we relocated in Basistha (Photos 18 & 19).

Several hours later on the afternoon of the same day, we observed the ear tagged animal when food was provided in the enclosures. The tagged animal accompanied the other group members when they came to the food and was observed to be behaving normally, exhibiting feeding and social behaviour that did not differ from the other animals. The tag could be seen to be sitting comfortably behind the ear, and the pinna did not appear to be misshapen or protruding out as a result.

On the following day (11/03/14) the ear tagged animal was observed during feeding time. It was again acting normally and the ear tag had remained in its original position. The tagged ear could now be seen to be sticking out very slightly more than the other, although the difference was almost imperceptible. The tagged animal was observed to scratch each of its ears with the corresponding hind foot but this was only a fleeting action which suggested that the tag was not causing any particular discomfort.

On 12/03/14 the animal was again observed to be behaving normally. On one occasion it was seen to scratch at the tagged ear very briefly with its hind foot. The ear in question showed no obvious signs of swelling or abrasion.

2). Ear tag

Following discussion it was decided to test a different approach in fitting the ear tag transmitter. Instead of using the ear tag pliers which were cumbersome when using on an ear tag that had been cut down in size, we decided to use a leather belt punch to make the hole in the pinna and then push the ear tag through by hand. On 12/03/14 we captured a male of approximately 9 months old, weighing 3.3 kg and from a group with a further five members. The animal was not sedated but just restrained in a sack with its eyes covered. A hole was punched in the left ear in the same position as in the previous animal and some antibiotic cream applied (Photos 20 & 21). The animal was then fitted with ear tag transmitter G (Photos 22 - 24), although the trace antenna had been removed as it was too rigid and could potentially cause injury. Once the tag had been pushed through the ear the end of the shaft was cut down and sanded down (Photos 25 & 26). The process of fitting the tag went very smoothly and only took approximately 3 minutes, 30 seconds. The animal was then immediately released into the enclosure.

Observations of the animal later that day showed it to be behaving normally apart from occasional brief (and not vigorous) shaking of its head and similarly brief scratching with the corresponding hind leg. The ear in question showed no signs of swelling or abrasion but could be seen to be very slightly pushed outwards, but not significantly. Also, on one occasion the animal was seen to be lying down receiving grooming from another group member (Photo 27) which briefly sniffed at the tag but did not bite it or show any further interest in it.

Both the ear tagged animals at Potasali remained under observation. On 25/03/14 it was reported that the NiTi antenna on ear tag transmitter F had fallen off after breaking at the point where it emerged from the plastidip coating. It is not clear when the antenna broke or why, nor whether this might also be an issue for the transmitters coated in dental acrylic.

8. Return to Basistha Pygmy hog captive breeding facility in Guwahati, to check on progress.

On 13/03/14 we returned to Basistha to re-examine the collared and ear tagged animals.

1). Collar

On 13/03/14 the keepers at Basistha had noticed that the animal that had been collared on 06/03/14 was still moving with an unusual gait and that the collar itself had moved forward such that it was partially covering one ear (Photo 28). Consequently, on that afternoon it was captured and restrained whilst the collar was removed. This revealed minor abrasions to the backs of the ears and on the neck, with some indication of adverse pressure on the back of the neck. Anti-biotic cream was applied and the animal was released. The removed collar had marks on it indicating where the animal had most likely been scratching at it with its hind foot and had probably managed to push it forwards. Following release the animal still exhibited an unusual gait, although less severe than previously.

2. Ear tag

On 13/03/14 the animal that had been ear-tagged on 06/03/14 was observed to be behaving normally and the keepers reported having not seen any aberrant behaviour. On 14/03/14 we recaptured the animal in order to examine ear tag E after 7 days of attachment. The animal was examined without sedation and the tag was seen to be in good condition and sitting in the appropriate position behind the ear (Photos 29 & 30). There were some minor pressure wounds to the ear tissue beneath and immediately around the puncture hole but nothing significant. Antibiotic cream was applied to the area, the animal was released and remains under observation.

The minor injuries associated with the ear tag were deemed likely to heal without intervention. However, in future the risk of such injury could potentially be reduced by punching the hole in the ear and treating with antibiotic several days before recapture for the tag to be inserted.

9. Conclusions

This pilot study on captive pygmy hogs has demonstrated clear differences in terms of the likely suitability of the three candidate approaches to fitting transmitters. The gluing of transmitters to pygmy hogs can probably be ruled out owing to the sparse coat and potential for adverse impacts on the sensitive skin. The collar in its current form can also be ruled out in the short term owing to its impact on locomotion, the injuries that it can cause and the likelihood that it may fall off. However, given the potential for a collar to carry a relatively large payload (perhaps with opportunities for GPS, mortality detector or proximity logger technology) it would seem prudent to explore the use of a thinner band of softer leather material on captive animals in the future.

The most promising approach demonstrated during this pilot study was the use of ear tags to carry radio transmitters. We fitted three different animals with ear tags, each time adding a further refinement to the methodology. In all three cases the tags stayed in place, were undamaged and did not cause animals to exhibit aberrant behaviour. However, in two instances the antenna became detached from the ear tag transmitter several days or weeks later. Some changes to the design of the transmitter are recommended (see below).

There were some indications that the animals were aware of the presence of the ear tag but it is likely that they would become accustomed to it in time. Close inspection of the animal which had been tagged for 7 days did reveal some minor abrasions of the ear associated with the tag but these were not deemed sufficient to cause serious concern and would be likely to heal without intervention. Furthermore, these abrasions might be avoided completely if captive animals were captured for ear piercing a few days in advance of recapture for ear tag fitting.

10. Recommendations

a) Radio-tracking

1. Deploy 2-3 ear tag transmitters on Pygmy hogs destined for release in May 2014.
2. Tags to be deployed should be of approximately the same dimensions as those already trialled on captive animals, and with a dental acrylic pot. Secure attachment of the NiTi antenna should be investigated and the battery and transmitter locations reversed.
3. Investigate means of extending battery life of transmitters of similar dimensions and weight as those trialled. Twelve months or more of battery life would be ideal.
4. Investigate the fitting of a thinner collar made from softer leather material in captive Pygmy hogs.

b) Other monitoring

1. Investigate the potential for bait-marking to provide spatial data on ranging behaviour of released animals. Initial trials with captive animals to ensure bait palatability and recovery of pellets in droppings, followed by deployment of marked bait in the field.
2. Investigate whether more subtle fur clips involving cutting hair short in unique identifying patterns rather than shaving are visible by eye and camera traps.

c) General

1. Formulate a list of key questions relating to the release of captive bred Pygmy hogs. This document should be used to guide the investment of resources in field research, including technological requirements and should be subject to periodic review.

11. Photographs

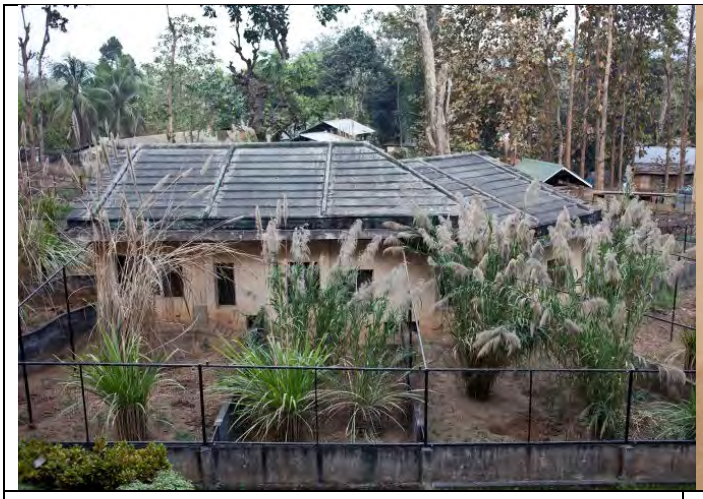

Photo 1. Enclosures at the pygmy hog captive breeding facility in Basistha.

Photo 2. Leather collar with brass buckle.

Photo 3. Fitting the leather collar (initial placement).

Photo 4. Fitting the leather collar (punching hole for buckle).

Photo 5. Fitting leather collar (assessing fit).

Photo 6. Ear tag transmitter (dummy) coated in dental acrylic, with NiTi antenna.

Photo 7. Position in the pinna for the location of the first ear tag transmitter.

Photo 8. Male portions of an ear tag, before (left) and after (right) cutting down and smoothing off.

Photo 9. Ear tag transmitter E being fitted in the pinna using pliers.

Photo 10. Ear tag transmitter E showing the components and battery on rear of ear facing the pinna.

Photo 11. Pygmy hog fitted with ear tag transmitter E in position behind the ear.

Photo 12. Ear being bent down by the combined weight and position of ear tag transmitter E.

Photo 13. Ear tag transmitter E one day after fitting.

Photo 14. The more central position near the base of the left ear where ear tag transmitter E was relocated.

Photo 15. The relocated ear tag (E) with transmitter facing towards body. Note the fine NiTi antenna in the palm of the hand.

Photo 16. The pre-release facility at Potasali showing a large enclosure (see fence in distance) also containing a smaller fenced area for capture.

Photo 17. The watchtower at the pre-release facility at Potasali allowed animals in groups to be closely observed.

Photo 18. Ear tag (F) in young female pygmy hog's ear at Potasali, showing the inside of the pinna. Note discolouration from disinfectant.

Photo 19. Ear tag (F) in young female pygmy hog's ear at Potasali, showing the outside of the pinna and transmitter.

Photo 20. Leather punch being used to pierce a hole in the pinna prior to inserting ear tag transmitter G.

Photo 21. The hole in the pinna created by the leather punch prior to inserting ear tag transmitter G.

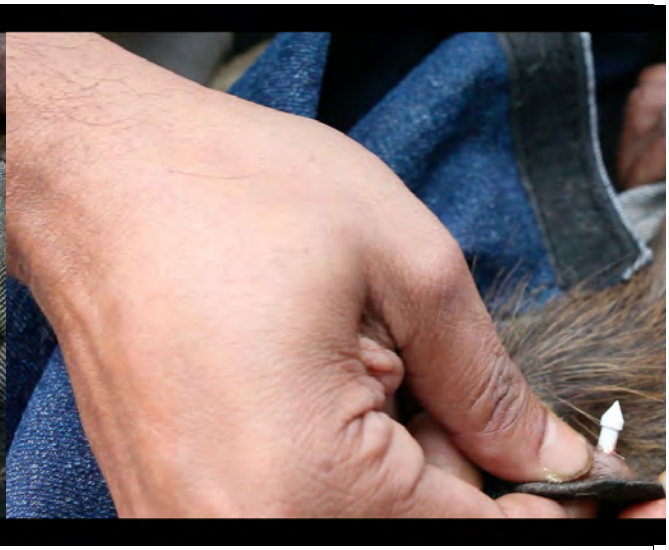

Photo 22. Insertion of the male component of the ear tag in the hole created by the leather punch.

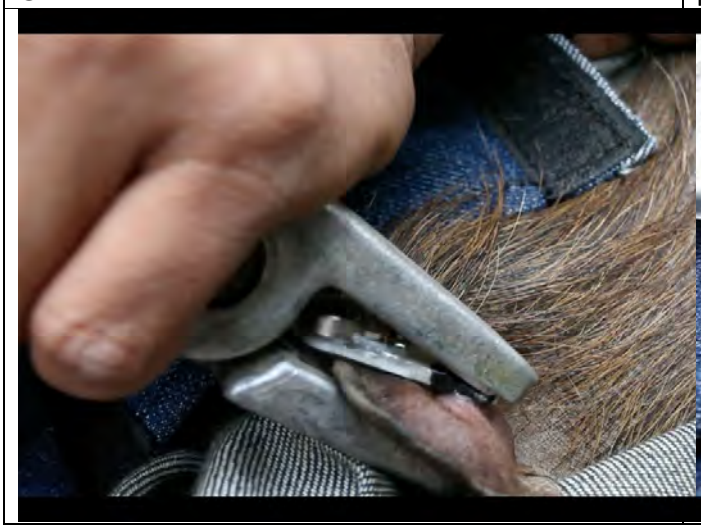

Photo 23. Attachment of the female component of the ear tag (with transmitter G attached) to the male component using pliers.

Photo 24. Fitted ear tag transmitter G prior to smoothing off the sharp end of the shaft.

Photo 25. Cutting down the sharp end of the shaft of ear tag transmitter G once fitted in the ear.

Photo 26. Sanding down of the cut end of the shaft of ear tag transmitter G to provide a smooth flat surface.

Photo 27. Pygmy hog grooming another as it lies the ground.

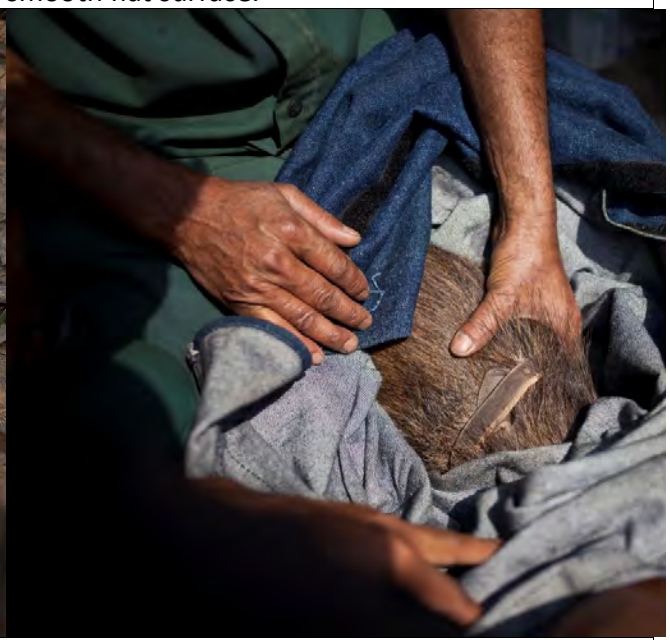

Photo 28. Recapture of the pygmy hog fitted with a leather collar, showing how it had moved forward and was sitting over the ear.

Photo 29. Inspection of ear tag transmitter E after 7 days of attachment on a pygmy hog at Basistha.

Photo 30. Pygmy hog fitted with ear tag transmitter E 7 days after attachment.

Appendix 1

Table summarising tag deployment.

Device	Location	Date fitted	Animal			Notes	Last observation
			Weight (kg)	Sex	Age		
Leather collar	Basistha	06/03/14	6.0	male	1 yr, 9 mths	Caused aberrant gait.	Removed on 13/03/14.
Ear tag E	Basistha	06/03/14	8.2	male	2 yrs, 9 mths	Re-fitted to right ear in new location at base of pinna.	Behaving normally on 14/03/14. Very minor abrasions to ear.
Ear tag F	Potasali	10/03/14	4.5	female	9 mths	NiTi antenna reported on 25/03/14 to have fallen off.	Behaving normally on 12/03/14.
Ear tag G	Potasali	12/03/14	3.3	male	9 mths	Ear punctured first and tag inserted by hand.	Behaving normally on 12/03/14.

Appendix 2: Short report on the 2014 release of pygmy hog.

Pygmy Hog Conservation Programme

RELEASE OPERATIONS

2014

Fifty captive-bred pygmy hogs released in Orang in four years – this time with radio ear-tags on three hogs

With the release of eleven more pygmy hogs in RG Orang National Park of Assam in May 2014 the total number of captive-bred hogs reintroduced in the Park has reached a milestone figure of 50. Over the last seven years the Pygmy Hog Conservation Programme (PHCP) has released a total of 85 (41 male, 44 female) hogs in better managed grassland of two PAs in the state. The good news is that the released hogs continue to breed independently and disperse in the wild. This year the 11 (5 male, 6 female) hogs were released in two social breeding groups and three of them were fitted with radio ear-tags for telemetric monitoring.

It has been estimated that less than two hundred hogs may survive in the world's last original (not reintroduced) population of the pygmy hog (*Porcula salvania*) surviving in Manas National Park of Assam, India. This Critically Endangered species under the IUCN RedList is often categorised as one of the most endangered wild mammals on Earth. It is the smallest and rarest member of the pig family belonging to a unique genus with no surviving close relative. A recovery programme to save the species from extinction, PHCP was launched in 1996 with capture of six individuals from the last wild population for conservation breeding and reintroduction.

The first such reintroduction of captive-bred pygmy hogs was undertaken by PHCP in the Sonai Rupai Wildlife Sanctuary, where a total of 35 (18 male, 17 female) hogs were released in the Gelgeli grasslands between 2008 and 2010. The exercise was carried out in close collaboration with the sanctuary management and Assam Forest Department which instituted improved management and protection activities in the grassland. Once the reintroduced hogs multiplied and began to disperse it was decided to shift the operations to Orang NP where the releases since 2011 followed similar improvements in habitat management and protection by Park staff, including extra efforts to control the spread of dry season grass fire, one the major causes of pygmy hog's decline. Altogether 10 social-breeding groups with 50 (23 male, 27 female) hogs have been released since Orang in 2011. Most of the released animals have survived, and successful reproductions have been recorded in Orang every year since then. The released hogs and their progenies settled in preferred patches of grassland habitat in the Park spreading to areas up to 3 km from their release locations (Fig. 1).

In Orang, the pygmy hogs were released in a grassland area divided into three blocks and efforts are being made to populate all suitable locations in these blocks. These blocks are separated from each other by jungle track. Fire breaks are created by clearing the vegetation along these tracks in order to limit the spread of grass fire from one block to the other. The released hogs are monitored through field signs, such as footprints, foraging marks, droppings and nests (unlike the wild pig, the pygmy hogs use unique grass nests round the year). Surveys carried out in these grassland blocks of Orang in March 2014 soon after controlled burning of grass revealed 62 pygmy hog nests (Fig. 1). A few of these nests were active but a large proportion of them were old or abandoned. The active nests were mostly hidden in tall and dense grass and such areas were too unsafe to survey due to presence of rhinoceros and other dangerous animals. The surveys however clearly indicated that the released pygmy hogs are thriving in Orang.

This year three of the released hog, a male and two females, were fitted with custom-built VHF radio ear-tags imported from United Kingdom. Under a project funded by People's Trust for Endangered Species, the Durrell Wildlife Conservation Trust collaborated with two specialist British concerns, Biocensus and Biotrack, to find an effective and way to attach radio transmitters to released hogs for

better monitoring in the wild. Past experiments with radio harness and implants on the released hogs had caused complications and were not successful.

The captive bred hogs are released in the wild under a soft release protocol spanning a period of about 6-7 months. First, the social groups are formed at the breeding centres using unrelated hogs and each of these groups are translocated to separate pre-release enclosures with sprawling and natural grassland habitat. The social breeding groups are prepared for independent survival in the wild under minimal human care for 5-6 months. Thereafter, they are taken to separate release sites where they are kept in small release enclosures for three days before being allowed to escape to the wilderness. Supplementary feeding, that had been stopped in the pre-release area, is resumed for these three days to encourage the hogs to visit these spots after release. The groups often settle down in the vicinity and visit these baiting stations once everyday for 3-5 weeks. After they stop visiting these spots, the hogs are monitored by searching field signs.

In the meanwhile the selected pairs continue to breed in captivity and produce fresh litters at the two breeding stations augmenting the captive population for next year's release. This year too a couple of litters have been born in the captive facilities as the hogs were being released in Orang and 5-6 more litters are expected to arrive over the next few weeks.

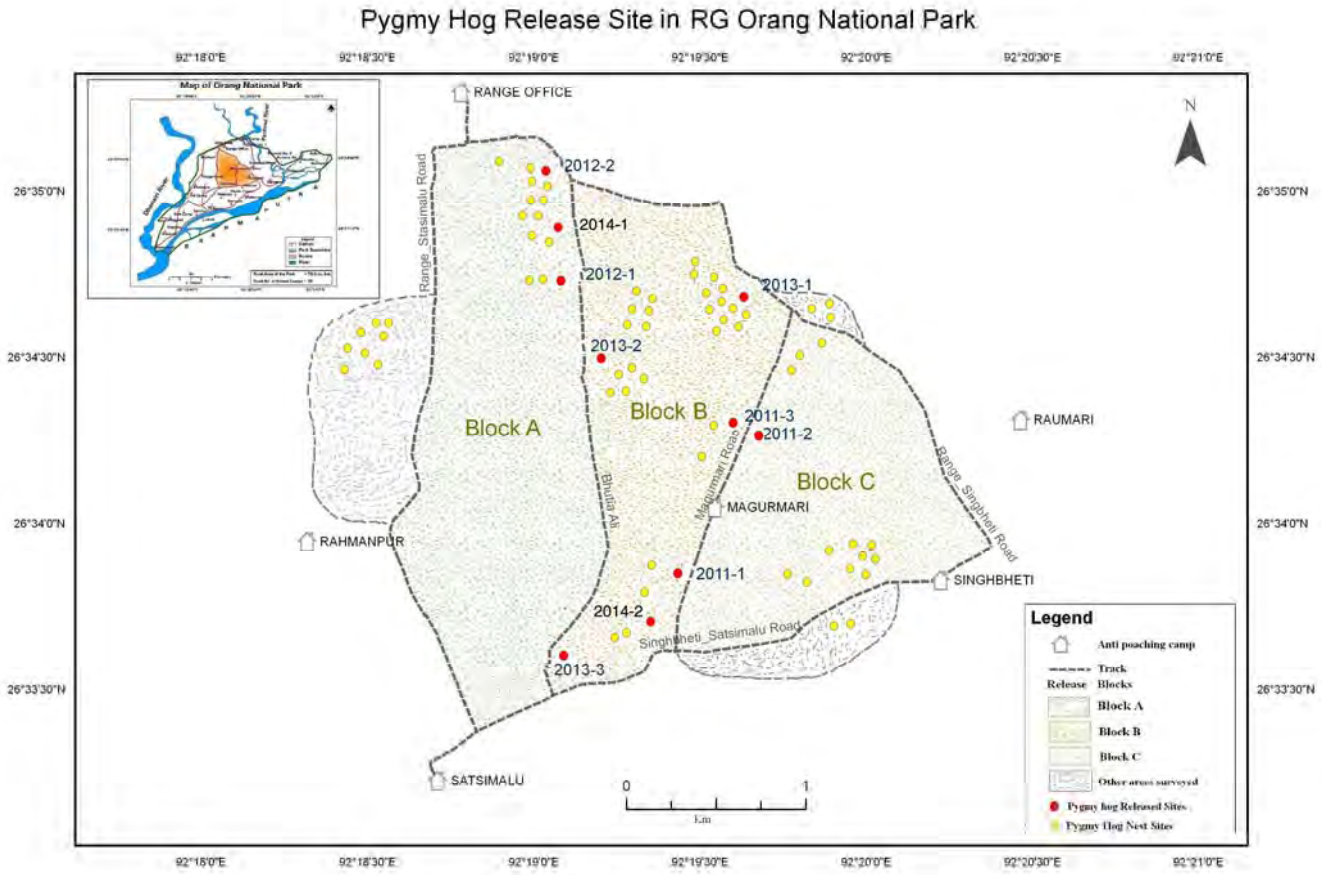

Fig. 1. *The pygmy hog release and nest locations in RG Orang National Park. Release locations are indicated by red dots and the digit after the year denotes the social breeding group number of the year. The locations of pygmy hog nests found during ground surveys in March 2014 are indicated by yellow dots. The grassland blocks where the pygmy hog were released are highlighted in the inset map of Orang NP.*


Sika

Previous page:
Top: Project team near the first release enclosure with Orang Range Officer Mr. Chakrapani Roy and his staff.
Bottom left: The social group of five hogs in the first release enclosure.
Middle: The radio ear-tag being tested after being fitted on one of the hogs a couple of days before release.
Bottom right: The first release enclosure being opened for allowing the hogs to escape.
This page:
Top: A hog escaping into the wild from the release enclosure.
Bottom left: One of the released hogs spotted on the track near the second release location.
Bottom right: Tracking radio tagged hogs after release in Orang NP.