Applying "Diffusion of innovation" theory and social marketing for the recovery of pileated gibbon *Hylobates pileatus* in North Ta-riu watershed, Khao Soi Dao wildlife sanctuary, Thailand

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SUMMARY

Population density of endangered pileated gibbon *Hylobates pileatus* in 9 km^2 of North Ta-riu watershed, located in the centre of Khao Soi Dao wildlife sanctuary, dramatically declined from 6.4 groups/km^2 in 1979 to 2 groups/km^2 in 2006. Opportunistic poaching during non-timber forest product (NTFP) collection and insufficient patrolling were considered the main cause of decline. An alternative strategy is needed to enhance pileated gibbon conservation. We applied diffusion of innovation theory to change and expand conservation behaviour among NTFP collectors, although this study does not endorse illegal NTFP collection. After a meeting with NTFP collectors in May 2009, a network of NTFP collectors for pileated gibbon conservation was successfully established with 16 members. The aim of the network was to abstain from poaching on pileated gibbon during NTFP collection. Interpersonal persuasion along with social marketing were used to expand the network. In December 2009, the network had expanded to 101 members. In 2012, six new groups of pileated gibbons (24% increase) were found in the North Ta-riu watershed. The density had increased to 2.8 groups/km^2.

BACKGROUND

The pileated gibbon *Hylobates pileatus* is categorised as endangered by IUCN (IUCN 2013). Its global distribution covers eastern Thailand, western Cambodia and part of south-western Lao PDR (Boitani *et al.* 2006). The first study of pileated gibbon was a rapid survey at Khao Soi Dao wildlife sanctuary in 1977 (Brockelman *et al.* 1977). Among seven survey sites, the highest density was at the North Ta-riu watershed with 0.9 groups/km^2, which was higher than at the wildlife sanctuary headquarter with 0.3 groups/km^2 (Figure 1). After this rapid survey, an intensive study on the ecology and behaviour of the species was set up in the North Ta-riu watershed. This study arrived at a more precise density estimate of 6.4 groups/km^2 (Srikosamatara 1984), which was later found to be the highest density recorded among gibbon species (Phoonjampa & Brockelman 2008).

Losses due to non-timber forest product (NTFP) collectors who opportunistically poached pileated gibbon for food during NTFP collection was mentioned as a major threat at that time (Srikosamatara 1980). Following this study of pileated gibbon, conservation intervention from the wildlife sanctuary increased. In 2005, a Thai documentary film was made at North Ta-riu watershed to raise public awareness of pileated gibbons. One of the researchers, S. Srikosamatara, who had conducted the intensive study in 1979, was invited as an academic adviser and found that the difficulty of finding pileated gibbons had increased while the threat from NTFP collectors also appeared to have increased. Therefore, a rapid re-survey was conducted in 2006 that found that the density had decreased to two groups/km^2. Although density at the North Ta-riu watershed had decreased, when compared with four other sites surveyed in 2005 using comparable methods (WWF Thailand & DNP 2005), the density at North Ta-riu watershed was still the highest, while the density near the wildlife sanctuary headquarter was 1.4 groups/km^2 (Figure 1). Finding the highest densities in the North Ta-riu watershed in both the 1977 and 2005-2006 surveys was unexpected, since North Ta-riu watershed is the furthest from the forest border (6.6 km), which implies it has the lowest protection, while densities near the wildlife sanctuary headquarter should have been the highest due to the increased protection there. However the correlation between the density of pileated gibbon in 2005-2006 and distance from the nearest guard station, which should be strongly negative if the guard stations are effective, was not significant (Pearson correlation = -0.1, $p = 0.8$). This reflects the ineffectiveness of conservation interventions in the wildlife sanctuary. The 1979 study mentioned that patrols were conducted only at forest borders due to the lack of manpower and low budgets (Srikosamatara 1980). From 2008 to 2013 the managers of Khao Soi Dao changed four times, while only one patrol was made through North Ta-riu watershed (I. Kolasartsanee, personal observation). Frequent changes of management practices, low budget and low manpower mean an alternative strategy was needed to improve pileated gibbon conservation alongside current conservation interventions.

During the documentary film making in 2005, an NTFP collector in North Ta-riu watershed agreed to join our conservation project after persuasion by S. Srikosamatara. This suggested that conservation behaviour of NTFP collectors can be initiated and might be expanded in the NTFP collecting community. The adoption of conservation behaviours among NTFP collectors to mitigate hunting pressure on pileated gibbon is the subject of this study.

Most theories about changing conservation behaviour only explain how individuals change their behaviours and ignore the expansion of conservation behaviour into the community (Jacobson *et al.* 2006). The *diffusion of innovation* theory (Rogers 2003) describes both. According to this theory, to change behaviour a process linking innovation to decision

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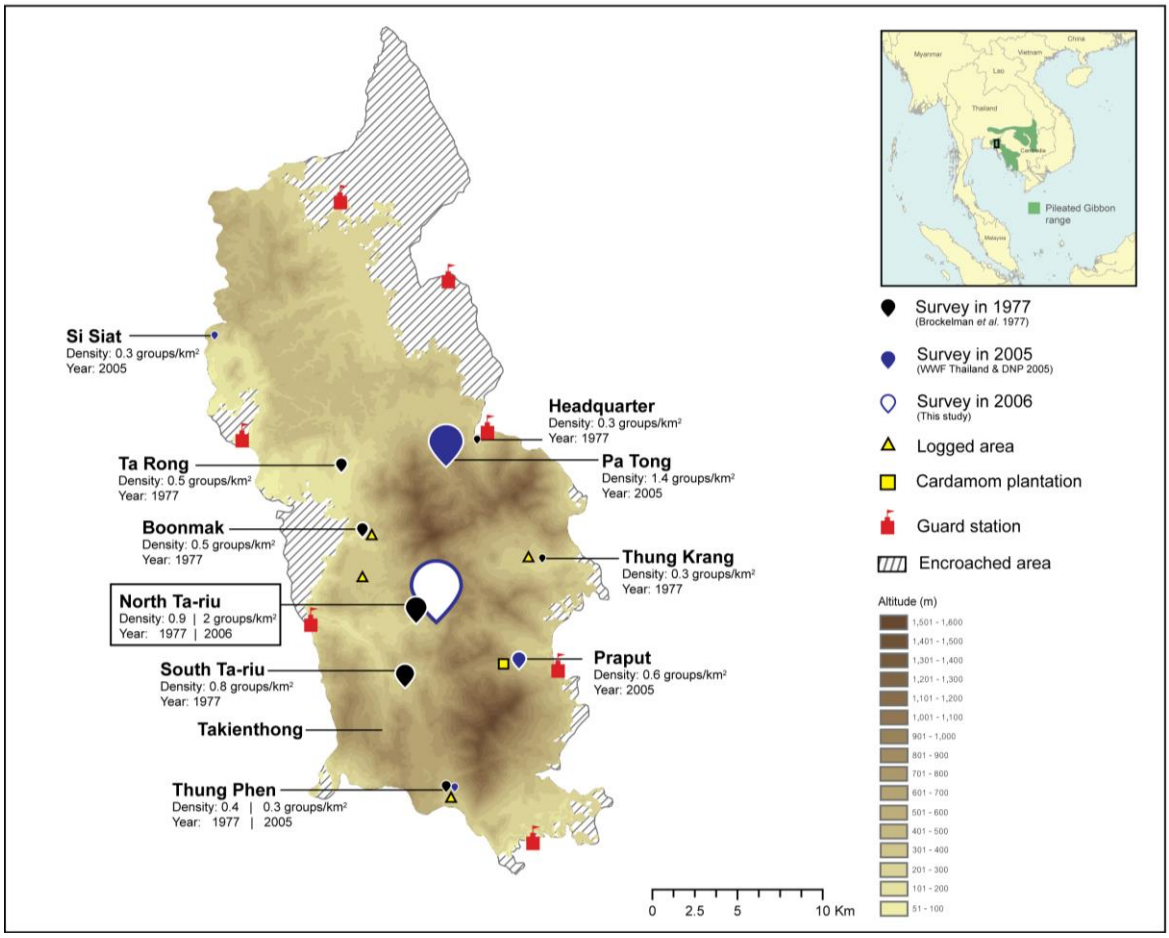

Figure 1. Survey results of pileated gibbon population in Khao Soi Dao wildlife sanctuary in 1977 and 2005-2006, encroached area, and world distribution (Brockelman *et al*. 1977, WWF Thailand & DNP 2005, Boitani *et al*. 2006, Land Development Department 2008).

taking and implementation is required. This process, called the *innovation-decision* process, starts with a *knowledge* step. Mass media is the most rapid way to inform the community of the required conservation behaviour and in this study this step mainly involved showing the documentary film made in 2005. The film let the community recognise the pileated gibbon is a rare species. The next step is *persuasion*, during which individuals change their attitude towards the new behaviour. Interpersonal communication plays an important role in this step, and can be enhanced by social marketing. Next are the *decision* and *implementation* steps of the innovative conservation behaviour. The last step is *confirmation* in which individuals decide to continue the adopted conservation behaviour. At this step, people may also reverse their decisions and reject the new conservation behaviour. Factors that can result in reversal of a decision are dissonance, replacement of new behaviour, and dissatisfaction.

It was hypothesised by Rogers (2003) that during the expansion of innovation in a community, members can be categorised into five groups following a logistic pattern of growth in numbers of participants over time (S-shaped curve):

1. Innovator: (2.5% of the group) this group can also be called "gatekeepers" since behaviour change is brought to the community by this group. The NTFP collector who committed to join our conservation project during the documentary film making was categorised into this group.
2. Early adopter: (13.5%) this group is usually closely related or familiar to the innovators and is respected in the community. This group plays an important role in the persuasion step of the innovation-decision process.
3. Early majority: (34%) this is the first major group who adopt conservation behaviour by the persuasion from early adopters, along with the impact of mass media and social marketing.
4. Late majority: (34%) the decision to adopt the conservation behaviour of this group is slower than the others since this group is not likely to change until the others have already done so and it is sure that the new behaviour is safe and of benefit to them. In other words peer approval is required.
5. Laggard: (16%) this group resists adopting the conservation behaviour but this can be reversed at the confirmation step of the innovation-decision process.

ACTION

Change and expand conservation behaviour: The conservation behaviour we aimed to change and expand among NTFP collectors was to stop poaching of pileated gibbon during NTFP collection. The innovator was the senior NTFP collector, who was highly respected amongst other NTFP collectors as he had collected NTFP for a long time and taught the others to collect NTFP. Before he decided to conserve pileated gibbon, he used to poach and keep baby pileated gibbons as pets. The loss of a pet pileated gibbon made him sympathetic towards this species. The early adopter group was closely related to, or well known to the innovator, e.g. son, son's friends, son-in-laws, other relatives or neighbours. These group members were not leaders in the community but respected among other NTFP collectors.

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A meeting with the early adopter group was held in May 2009 to carry out the knowledge and persuasion step in innovation-decision process. Fifteen collectors were involved due to the persuasion of the innovator. In the meeting, information was provided to make participants aware of the value of pileated gibbon, such as the distribution of gibbon species in Thailand (emphasising the endemism of pileated gibbon and restriction of distribution to the eastern forest complex), the slow reproduction rate of gibbons and behaviours that are similar to human behaviour including monogamy. Following this meeting, all fifteen early adopters decided not to poach pileated gibbon. A network of NTFP collectors committed to pileated gibbon conservation was established including a commitment not to poach pileated gibbon during NTFP collection. Along with giving up poaching, early adopters continued to persuade others to join the network.

Due to the conflict between NTFP collectors and forest rangers, clarity concerning project status was necessary. The main field researcher identified himself as a PhD student from a university who aimed to conserve pileated gibbons, not inform government agents about their law violations. Another point of clarification was that permission to collect NTFP legally was not an incentive to join the network. Law enforcement of forest rangers still occurred whether NTFP collectors joined the network or not. Along with the persuasion among NTFP collectors, social marketing was set up in the community. Arm badges and identification cards were distributed to the network members as an incentive and to remind them of their commitment. A hand written message from a highly respected Buddhist monk ("Do not ruin other life") was placed on the back of the identification card. The network logo was printed on T-shirts given to network members. Educational posters about pileated gibbon and other mammals in North Ta-riu watershed were placed on local grocery stores and a pileated gibbon painting contest was set up at a local school. "Please do not shoot gibbons" notices were placed in the North Ta-riu watershed to inform outsiders.

Population survey before and after intervention: After the rapid re-survey in 2006, a more intensive and precise survey was conducted in April 2008 over seven days. The pileated gibbon population was surveyed by the triangulation method (Brockelman & Srikosamatara 1993). Gibbons live in family groups and duetting for territory demarcation can be heard clearly for long distances. Three listening posts were set up on the mountains around the valley to detect azimuth angles and times of each gibbon call during 08:00-12:00 h. Nine-hundred 1 ha plots were plotted on 9 km^2 of the North Ta-riu watershed map and presence or absence of gibbon calling was recorded in each plot. By triangulation of simultaneous records of calls from three listening sites, points of intersection which indicated the presence of a pileated gibbon group in the plot were determined. Among presence plots of each group recorded over seven survey days, the centre plot was identified using the mean centre tool of the ArcGIS 10 program. The centre plot of each group was buffered to 36 ha; the estimated home range of pileated gibbons in the North-Ta-riu watershed in 1979 (Srikosamatara 1984). The minimum bounding geometry tool of ArcGIS 10 program was used to create an area around the outer edge of overall presence plots which was used to calculate density. NTFP collection trails were recorded by carrying a GPS device (Garmin 60CSx) along every trail and the track log was transferred to the ArcGIS 10 programme.

CONSEQUENCES

Change and expand conservation behaviour: Seven months after network establishment, in December 2009, the network had expanded to 101 members. NTFP collectors from two nearby watersheds (Takienthong and Boonmak, Figure 1) had also joined the network. After December 2009, few new NTFP collectors joined the network, indicating saturation of the network. Early majority and late majority groups were categorised by time they joined the network. Defined as joining from July to September 2009, the early majority group consisted of 22 individuals (20%) while the late majority group, defined as joining from October to December 2009, contained 63 individuals (60%). The percentage of each adopter group in this study was significantly different from the theoretical prediction (χ^2 = 35.7, d.f. = 4, p <0.01). The early majority was smaller than theory predicted, while the late majority was larger (Figure 2).

NTFP collectors in the South Ta-riu watershed were considered as laggards, since the early adopters had less connection to them, which decreased the level of persuasion and resulted in failure to change behaviour. Although the exact number of laggards could not be evaluated, a group of four laggards were found to have shot two adult gibbons and taken a baby as a pet when collecting NTFPs in June 2010 in the South Ta-riu watershed. The network members provided information to the researchers immediately after a baby gibbon was found in the community. A few weeks later the laggards decided to give the baby gibbon to a rescue centre under persuasion from the early adopters. Coordination with the rescue centre was made by the researchers and the laggards committed not to poach gibbons in the future.

At the time of writing, opportunistic poaching is mainly of squirrel, monitor lizard, civet, and rarely on wild pig, for personal consumptions by the collectors. Up-to-date information accessed by rangers of the wildlife sanctuary from a local wildlife restaurant has suppressed the poaching of sambar deer and muntjac for sale. Poachers used to be arrested after selling muntjac to the local restaurant. Large mammals such as gaur, banteng, and elephant have not been poached by NTFP collectors since they may easily be detected by the local community and this would also put them in conflict with the wildlife sanctuary authority. During network establishment, early adopters took a consensus decision that they could give up only gibbon poaching but not poaching other mammals for their own consumption.

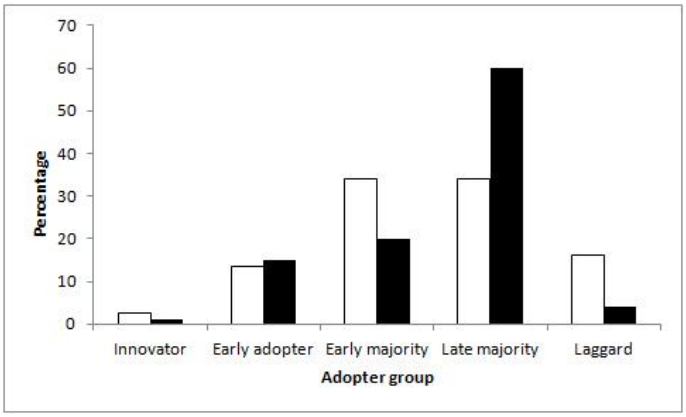

Figure 2. Percentage of individuals in each adopter group in this study (black bars) compared with those predicted by Rogers' (2003) diffusion of innovation theory (white bars).

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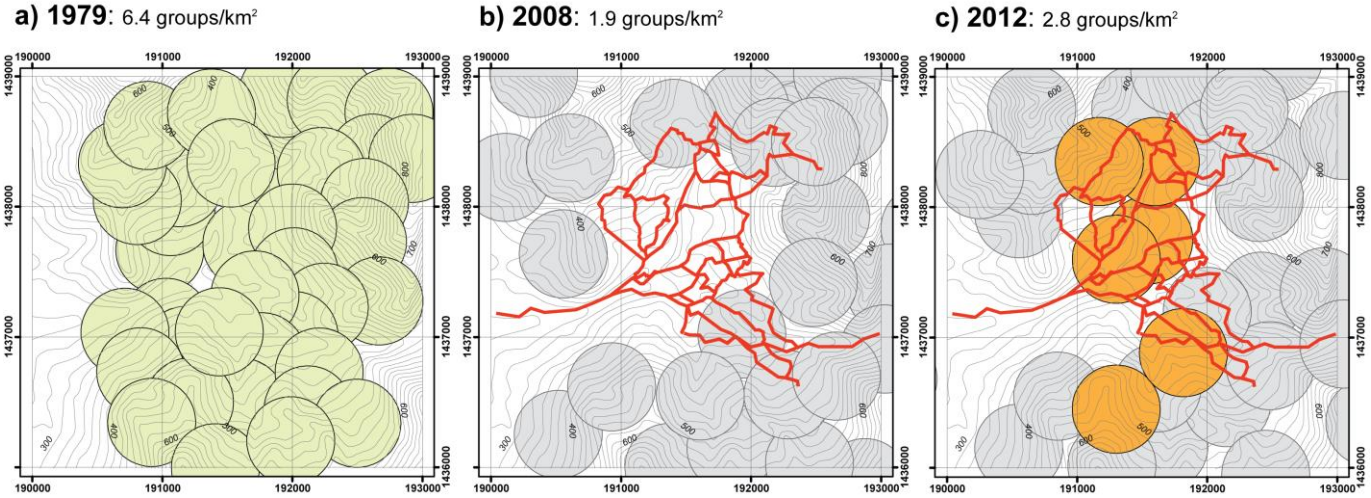

Figure 3. Map of pileated gibbon groups at North Ta-riu watershed: a) in 1979 (Srikosamatara 1980), b) before intervention in 2008 and c) after intervention in 2012. NTFP collection trails shown in red. Each circle illustrates the modelled home range of a group (36 ha). In Figure 3c home ranges of six new groups are indicated by orange circles.

Population survey before and after intervention: Over almost 30 years, between 1979 and 2008, 70.3% of the gibbon population in North Ta-riu watershed was lost. The density decreased from 6.4 groups/km^2 in 1979 to 1.9 groups/km^2 in 2008. Groups in the valley were lost, while the remaining groups were found on the mountains due to lower use by NTFP collectors indicated by low number of trails (Figure 3). Within three years of the establishment of the network for gibbon conservation, six new groups of gibbons (24% increase from 2008) were found. Two groups have set up new families in the vacant valley while four have established among other groups (Figure 3). The density in 2012 had increased to 2.8 groups/km^2.

DISCUSSION

We believe that the methods used in this study may be applicable to other small protected areas with low levels of patrolling by wildlife sanctuary rangers. Whilst we do not condone the illegal collection of NTFPs, a key aspect of this conservation innovation was that it did not interrupt the main propose of the target group, i.e. in this study collection of NTFPs. In the innovation-decision process (knowledge, persuasion, decision, implementation, and confirmation), we consider the critical information that early adopters used in the knowledge step was the rarity of pileated gibbon and the realisation by NTFP collectors that their commitment can help conservation. For the persuasion step, adopters from Takienthong watershed (25%; mostly from the late majority group) joined mainly through the persuasion of only one early adopter. Only a few early adopters successfully persuaded others. A leadership role is a critical characteristic of these individuals. People usually respect them as those who can approve or reject the outside innovation on their behalf. Finding these few people can have a high impact on the adoption of conservation behaviour in the community. Beside interpersonal persuasion, we believe that the decision step was also influenced by peer approval. Since NTFP collection is an illegal act in Thai law, peer approval and the fact that joining the network had no negative effect (e.g. being arrested) may have had a high impact on the decision step. The high percentage of network members in the late majority group, which usually uses peer approval in decision making, also supports our conclusion.

The *elaboration likelihood model for persuasion* (Petty & Cacioppo 1981) also suggests that peer approval and peripheral knowledge can change conservation behaviour in the short term and can stimulate people to seek further knowledge, in turn leading to longer term behaviour change. However such behaviour can disappear over time. Therefore, frequent repetition of conservation marketing and education outreach may help to maintain the long term conservation behaviour.

Laggards continued not to adopt conservation behaviour, due to their dissonance with the proposals of early adopters. However laggards remain afraid of arrest if they do not adopt conservation behaviour towards pileated gibbon. Thus, law enforcement can still play role as a penalty on the laggards and enhance the adoption of conservation behaviour among them.

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