Review of Cordyceps Collection Timing; Duration and Monitoring

Ugyen Wangchuck Institute for Conservation and Environmental Research
Lamai Goempa
Bhutan
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Executive Summary

Having established a brand for itself, *Ophiocordyceps sinensis*, commonly known as cordyceps has seen increase in its market value. It is taxonomically a fungus which infects a caterpillar and found above 4200 to 5200 meters above sea level in Bhutan. Collection of cordyceps in Bhutan was legalized only in 2004, after which various measures were adopted to ensure its sustainability, including, controlling the number of permits issued to collect and also restricting the collection only for a month.

Alpine region of Bhutan sees thousands of cordyceps collectors every year for a month and the number of collectors seems to be on an increasing trend every year. In Bhutan, people from 18 gewogs within eight dzongkhags are involved in collecting cordyceps, however number of permits issued vary widely within the gewogs. For this study, we administered semi-structured questionnaire survey in 15 gewogs [N=306] and sample size for each gewog was adapted based on the number of cordyceps collectors as some gewogs had more than 500 collectors and some just had 7 collectors registered in 2014; 2015 and 2016. We randomly selected the respondents using RANDBETWEEN function in excel; however we also made sure not to interview two collectors from same household.

We found that majority [46%] of the respondents subscribe to current collection time, however, given a chance 52% of the respondents expressed having the collection time rescheduled to first week of May. There were also about 44% of the respondents with the belief that starting collection from mid-May as not suitable and rest couldn't answer citing fluctuation in cordyceps growing time and thawing of snows every year. Overwhelming 88% of the respondents expressed the need to increase the collection duration from a month. Their rationale to have the collection duration increased is to consider the buffer for un-predictability of snow melts. However, their preference to allow collection from first week of May does not fit their reasons as going early would only mean snows still intact.

Based on the answers received from the cordyceps collectors, we believe that cordyceps collection may be allowed from mid-May and extend until third week of June and not beyond that to allow sporulation and spore dispersal. However, we still believe that information we received from the collectors may not necessarily hold true as we can't over-rule reservations and self-interests they might have had during the time of data collection. Thus, our findings will need to be backed by strong ecological evidences of cordyceps as well as the environment.

Introduction

Having established a brand name in the international market as a multi-benefit health tonic, *Ophiocordyceps sinensis* (commonly known as cordyceps) is now the most highly prized of all medicinal and aromatic plants found naturally in the Himalayan region (Cannon et al. 2009). The high value of cordyceps in the international market is probably playing an integral role in the transformation of the socio-economic status of highland Himalayan communities of Bhutan;

China, India and Nepal (Garbyal et al. 2004; Devkota 2007; Cannon et al. 2009; Winkler 2009; Wangchuk et al. 2012; Shrestha and Bawa 2013).

Cordyceps occurs in alpine ecosystems on the Tibetan Plateau and surrounding Himalayas. In China, the distribution area spans the Tibet Autonomous Region, Qinghai, Sichuan, Gansu and Yunnan Provinces (Cannon et al. 2009; Winkler 2009; Li et al. 2011). In the Himalayas it is known to occur in Bhutan, India (Uttaranchal, Sikkim and Himachal Pradesh) and Nepal. It is generally found in grass and shrub lands between 3500 meters to 4500 meters above sea level (Sharma 2004; Negi et al. 2006), however, the distribution range of cordyceps in Bhutan is recorded from 4200 to 5200 meters above sea level.

Since the habitat of cordyceps is in the high alpine areas of the national parks and near the border of Tibetan Autonomous Region of China, monitoring of un-authorized harvesting of cordyceps has always been a great challenge coupled by inadequate number of forest personal patrolling (Wangchuk et al. 2014) in those areas. Even before the legalization of its collection, more than 20 non-national collectors were reported to have apprehended with over 40 kg of cordyceps in the year 2002 (Cannon et al. 2009). This trend continues even with strict monitoring by the forestry and army personal of Bhutan (Wangchuk et al. 2014).

After the legalization of the harvesting of cordyceps by the Royal Government of Bhutan in the year 2004, it is harvested extensively in the alpine meadows of the country. Various conservation measures were put in place such as ban on collection except during the month of June and issuing permit to only one collector from a household (Cannon et al. 2009). However from 2008, 3 permits were issued to collect cordyceps (Wangchuk et al. 2013). Since, cordyceps has become the primary income source for the highlanders of Bhutan and may continue to be, it warrants attention to develop mechanisms to reduce pressures to the alpine environment (Wangchuk et al. 2012) and for sustainability of the species in question.

Recognizing the importance of cordyceps to the socio-economic development of Bhutanese highlanders, the Department of Forests and Park Services directed the Ugyen Wangchuck Institute for Conservation and Environmental Research to review cordyceps collection timing and monitoring followed in the country. The institute was directed through the letter no: SFED/NWFP/02/2016/143 on September 8, 2016.

Study Area and Methods

We designed the survey to undertake study in 14 gewogs of eight dzongkhags *(Table 1)*. Though there are 18 gewogs involved in collection and trade of cordyceps, we planned on skipping four gewogs [Laya and Lunana in Gasa; Naro and Lingshi in Thimphu] considering the logistical arrangements. However during the process of data collection; our team came across few Layaps and took the opportunity to interview them, taking the number of gewogs involved in this study to 15.

These gewogs were selected for the study as it is within the administrative boundaries of these gewogs where cordyceps grow and are harvested. We administered semi-structured questionnaire to obtain people's perception on the current timing and duration enforced by the Department of Forests and Park Services [mid-May to mid-June] to collect cordyceps.

We obtained the list of collectors from respective gewogs and forestry offices from 2014 to 2016 along with household numbers who were into collecting cordyceps. This arrangement was followed with the assumption that those having some years of experience will be able to give us the required answers. Owing to the huge differences in the number of collectors opting to collect cordyceps among the gewogs, we decided to have different sample size for each gewogs:

- For those gewogs with less than 50 collectors: 100%
- For those gewogs with number of collectors between 51 to 100: 50%
- For those gewogs with number of collectors between 101 to 200: 30%
- For those gewogs with more than 200 collectors: 10%

Table 1: Numbe of cordyceps collectors and number of collectors' interviewed

Gewog	Number of Collectors			Interviewed
	2014	2015	2016	
Bomdeling	92	118	130	25
Chokor	820	NA	NA	54
Chumey	27	51	66	15
Tang	70	19	15	19
Dangchu	229	268	212	45
Sephu	582	658	637	67
Gangtey	56	82	96	14
Kazhi	116	117	NA	17
Dotey	7	NA	NA	7
Tsento	125	140	132	11
Khoma	17	19	22	9
Khatoed	43	15	58	7
Laya	NA	NA	381	6
Lunana	NA	NA	247	
Nubi	22	22	19	8
Soe	108	94	84	2
Naro	NA	NA	194	
Lingshi	NA	NA	259	
			Total	**306**

From the list of those who collected from 2014, we randomly generated the list of individuals to be interviewed by [fx=RANDBETWEEN] function in excel. However, if the function selected

two individuals from same household, we selected next collector in our list to interview. This strategy was practiced to ensure not to interview two collectors from same household.

Our plan was to interview 530 collectors from different households within our planned study area; however we have been able to interview only about 58% of our target interviewees [N=306] as many of our target interviewees were not present during our visit to their place. This calculates to having interviewed about 12% of the total collectors who were issued permit to collect cordyceps in 2014; 2015 or 2016.

Results

We found that most of the collectors were into cordyceps collection even before the government legalized its collection. Almost all the respondents stated that the growth of the cordyceps is heavily influenced by the amount of snow fall and the time taken for the snows to melt. According to the respondents, best growth of the cordyceps is seen usually during the months of May and June, which happens to be right after thawing of snows.

When we asked if they subscribe to current collection time followed by the Department of Forests and Park Services, we received following answers:

Yes:	46%
No:	44%
Can't Say:	10%

Though, majority of the respondents were in agreement with current collection timing followed, only 10% of the respondents felt starting cordyceps collection from mid-May to be on time. Rest of the respondents suggests following:

April:	15%
First week of May:	52%
Mid-May:	10%
June:	13%
No comments:	10%

Overwhelming 88% of the respondents felt the need to increase cordyceps collection duration from the existing allowed period of a month. Respondents suggests following duration:

One month:	12%
One and half month::	43%
Two months: :	34%
Three months:	2%
No comments:	9%

The prominent reason which, stands out for the suggestion to increase the allowed collection duration from a month is due to the un-predictability of the time when the cordyceps grows every year. Another reason is also the time taken for snows to melt, which of-course is different every year. This is important according to the collectors as the growth of cordyceps is purely dependent on the amount of snowfall received and then obviously the snow has to melt in-order for the cordyceps to be spotted.

Gewog wise

Since Chokor, Dangchu, Sephu, Bomdeling and Tsento gewogs had more number of collectors interviewed, we tried to look at how collectors from these gewogs felt with regards to the current system in place on duration of collection and collection season followed or enforced upon them. Although, there are relatively more collectors from Lingshi, Naro, Lunana and Laya, we couldn't collect data from them on their perception with regards to the same. However, though we interviewed some cordyceps collectors from Laya, we didn't reflect the information collected from them since the sample size was too small to qualify.

Chokor

Majority of the respondents from Chokor do not subscribe to the current cordyceps collection timing practiced; followed by those respondents who couldn't give us definite answers stating that sometimes it is the right season and sometimes not depending on the time taken for snows to melt. However, few still subscribe to the current timing.

	Percentage of respondents		
	Yes	No	Can't Say
Do you think current time to collect cordyceps is right?	22	49	29

Reasons for 'No'	% of respondents
It is early	39
It is late	53
Fluctuating snow melts:	8

We found that 93% of those who responded as 'can't say' also reasoned as un-predictability of snow melts. When collectors were asked on the duration of collection followed, 86% of the respondents from this gewog stated as not sufficient [65% of those not subscribing to current duration suggests for one and a half month and rest for two months]. Their argument for desiring the extension of collection duration from one month is keeping the buffer of un-predictability of the snow melts.

Dangchu

Majority of the respondents from this gewog also indicated their inclination towards in-correct timing followed for collection of cordyceps at present.

	Percentage of respondents	
	Yes	No
Do you think current time to collect cordyceps is right?	36	64

We couldn't comprehend the reason for those who reported the present timing to collect cordyceps as not in line with the growing season in Dangchu. This is because 91% of respondents who desired the revision in collection time stressed on the need to increase collection period from existing one month instead of citing their reasons for answering the need to revise the current time followed.

Majority of respondents [96%] from Dangchu felt the need to increase the duration allowed to collect cordyceps and rest were satisfied with existing allowed duration of a month. Percentage of respondents desiring increase in duration were:

One and half month	: 32%
Two months	: 57%
Three months	: 7%

Sephu

Respondents from Sephu have almost equally divided beliefs with regards to the collection time followed till date [51% subscribing to it and 49% not]. However, we obtained only two reasons for those with the belief on the need to change the collection timing [15% of those who does not subscribe to existing collection time said that many illegal collectors collect before they arrive at the collection site and another 14% reasoned as un-predictability on the snow melts and the growth of cordyceps every year and rest chose not to answer].

When respondents were asked on the existing allowed collection duration of a month, 81% of the respondents suggested the need to increase collection duration from one month and rests were fine with one month. Respondents suggesting the need to increase collection duration suggests as:

One and half month	: 29%
Two months	: 49%
Three months	: 3%

Bomdeling

Majority of the respondents [83%] expressed their satisfaction with the current timing followed to collect cordyceps. However, 17% of the respondents expressed of not being happy with it, citing reasons as: snow melt and cordyceps growth fluctuating every year.

About 78% of the respondents were happy with one month collection duration, however rest expressed on having it increased slightly from a month [suggesting to have it as one and half month].

Tsento

About 70% of the respondents from Tsento expressed their agreement to current collection time adopted, however 30% didn't agree. Their dis-agreement to the existing collection time adopted was mainly due to the un-predictability of snow melt.

When we asked on the existing collection duration of a month, about 70% of the respondents feel the need to have it increased:

One and half month	: 40%
Two months	: 30%

Collection Time

Though some gewogs felt the need to revise the collection time, we found that when we looked at the information gathered from all the respondents, almost the same percentage of respondents believes that beginning of the collection timing followed currently is suitable as well as not correct. We believe that some respondents who subscribed to the present collection time probably didn't differentiate between first week of May and mid-May. We make this statement, as only 10% of the respondents chose mid-May as the right time to start collecting and majority of the respondents [52%] preferred the collection to begin from first week of May.

We found that those gewogs, which sees more number of cordyceps collectors seems to desire slight change in when the collection should begin. On the other side, majority of respondents from gewogs seeing lesser number of cordyceps collectors preferred present time of collection *(Figure 1)*. However, almost all of them agree that growth of cordyceps timing and snow melts are not predictable.

Duration

Majority [88%] of the respondents believe that increase in cordyceps collection duration is desirable considering various factors from existing allowed duration of a month. Among all the respondents, we believe that yak herders has genuine reason for asking the increase in allowed collection time from one month. Yak herders report that, collection of cordyceps falls exactly at the time when it is time for them to migrate to higher grounds with their yaks; and moving with

yaks would mean reaching the collection site about a week or two later than other collectors. This, according to them, gets only about two weeks to collect cordyceps unlike other collectors. Thus, to accommodate their tradition and also keeping in view the un-predictability of the time taken for the snows to melt, they believe it warrants increasing the allowed cordyceps collection duration.

Some of the respondents also mentioned three different growths of cordyceps. According to them, cordyceps grows in three different phases [end of April; mid-May and end of June]. They informed that the first phase of cordyceps is mostly harvested by poachers coming across the border and by the time third phase starts, their allowed cordyceps harvesting season ends.

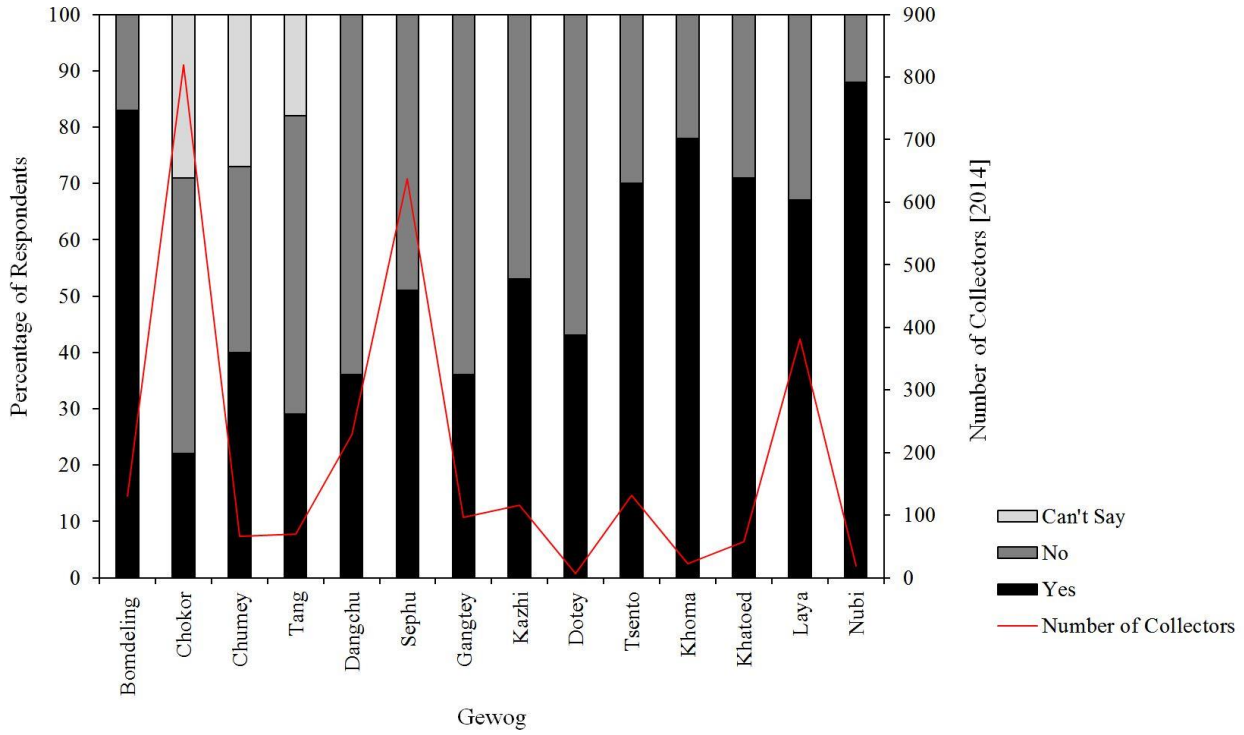

Figure 1: Respondent's answer to cordyceps collection time and number of collectors [2014].
(Note: We didn't get information on number of cordyceps collectors for 2014 from some gewogs. In such cases, we used information from 2016)

Monitoring

While we found that almost all the respondents were in agreement with regards to the job undertaken by forestry patrolling team to curb illegal collectors, there were some who expressed on the need to increase the patrolling team. According to the respondents, handful of foresters are finding hard to cover vast areas, thus having patrolling team stationed in all collection sites would prove more effective.

Conclusion and Recommendations

Since this report is purely based on the perception of the cordyceps collectors, we cannot over-rule the reservations and self-interest which, the respondents might have had during the time of data collection. There are many reports from Bhutan (Wangchuk et al. 2012; Wangchuk et al. 2013; Wangchuk et al. 2014) as well as from the region (Winkler 2009; Devkota 2010; Shrestha and Bawa 2013; Dong et al. 2015; Stone 2015) supporting claims on the significant contributions made to the livelihood of alpine dwellers, but there are also many reports on the environmental implications (Boesi 2003; Gould 2007; Wangchuk et al. 2013; Wangchuk et al. 2014) brought in by the collectors.

Though majority echo in agreement to have the collection duration increased from one month, we are certain that yak herders will still not be able to benefit much, should the collection be allowed from first week of May as suggested by the majority respondents. We believe that cordyceps collection may be allowed from second week of May till 3rd week of June; however it should not be extended beyond third week of June as Winkler (2009) reports that sporulation begins by then. Adopting this timing and duration of collection may be able to accommodate the concern of not being able to have more collection duration of yak herders and shall also provide buffer for the unpredictability of the growth of cordyceps and thawing of snows as reaching the collection site in first week of May would mean 'snows still intact'. Not allowing collection beyond third week of June may also ensure minimum disturbance to the species during the process of sporulation and its dispersal.

Thus, considering the contributions that the collection and trade of cordyceps has to the alpine communities of Bhutan as well as considering the impacts brought about by it to the environment, it is of utmost importance while revising such policies to consider both social and ecological aspect. We believe that deeper study on the biology and ecology of the species in question should be pursued to draw proper recommendations on existing policies and may be to ensure its sustainability. However, based on the perception of the respondents we believe that following may be adopted:

- Issue permits for collection by first week of May
- Begin collection from second week of May till third week of June
- Depute more forestry personal during the collection season
- Involve communities/collectors to help forestry team keep watch of the illegal collectors.

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For detail, please contact:

Sangay Wangchuk, UWICER – swangchuk@uwice.gov.bt
Jamyang Tenzin, UWICER – jtenzin@uwice.gov.bt
Karma Thukten, UWICER – kthukten@uwice.gov.bt