Declining records of Rufous-headed Robin in Northwestern Sichuan An Audio Survey for Singing Rufous-headed Robin in the Baihe Area of Northern Sichuan, China: to Ascertain Whether the Species is Still Present, with a View to Promoting a Future Conservation Plan

Sid Francis, Roland Zeidler, Jiawei Wu, Wendy Wright, Min Zhao

Sid Francis, Sichuanbirding, 611830 Dujiangyan, Sichuan, China, Chenduuk@hotmail.com

Roland Zeidler, Sichuanbirding, 611830 Dujiangyan, Sichuan, China

Wu Jiawei, Swild 610000 Chengdu, Sichuan, China

Wendy Wright, Faculty of Science and Technology, Federation University Australia, PO Box 3191

Gippsland Mail Centre VIC 3841, Australia.

Zhao Min, Institute of Zoology, Chinese Academy of Sciences; Department of Biology, University of Florida

Abstract

During the last 25 years the only known breeding range of Rufous-headed Robin *Larvivora ruficeps* has been a small area of North Sichuan, which attracts a regular stream of visiting birders. However, *Larvivora ruficeps* has been unrecorded since the 2015 breeding season. Concerns regarding the species' fate are compounded by an absence of birds being reported during recent passage or winter periods.

Here, we present a synthesis of the available information regarding recent records of *Larvivora ruficeps* at its known Chinese breeding sites and review a remote audio recording method as a survey technique for the species. We suspect a population decline is responsible for the lack of records and recommend a local action plan to protect any remaining birds.

The audio survey, made at Baihe National Nature Reserve, was conducted in late spring/early summer of 2017 and used pre-programmed audio recording devices that were left in the field for five days. Although 32 species were detected at a site where *Larvivora ruficeps* had been found in 2015, no recording of *Larvivora ruficeps* was made. The bird was not reported from any breeding site during 2017.

Introduction

Exact locations of records of Larvivora ruficeps are not provided within this report, in order to protect sites from disturbance from birding/photography and to reduce the risk of trapping of any remaining individuals by cage-bird or specimen collectors.

Rufous-headed Robin *Larvivora ruficeps* along with Firethroat *Calliope pectardens* and Blackthroat *Calliope obscura* makes up the triumvirate of iconic Chinese Robins. A bird of skulking behaviour, extravagant song and elegant plumage, it could be considered a 'trademark' world birding tick.

Larvivora ruficeps is listed as “Endangered” by the International Union for the Conservation of Nature (IUCN). It was upgraded from “Vulnerable” in 2013 in recognition of its very small population, which was thought to be declining as a result of habitat loss and degradation and possibly trapping for the cage bird trade (IUCN 2016; BirdLife International 2017). This article collates anecdotal evidence of a further decline and documents an attempt, made in late spring/early summer of 2017, to find evidence of breeding *Larvivora ruficeps* at a site in Northern Sichuan, China, where it was last recorded in 2015.

Authoritative data regarding the current status of *Larvivora ruficeps* is sparse. There are no field studies which provide information regarding population densities and habits. Although there are historic records from Shaanxi Province, China in 1905 (Hartert 1907), during the last 25 years, breeding season records have been restricted to a small area of north western Sichuan (Min Zhao et al. 2016). Most current information comes from sightings and observations made by visiting bird watchers to these breeding sites at Jiuzhaigou National Park (33.269890° 103.916342°) and neighbouring Baihe National Nature Reserve (33.261338° 104.137721°). Since the authorities at these parks do not publish current information regarding the status of Rufous-headed Robin, all existing records are derived from visiting birders . Most of the existing records of *Larvivora ruficeps* are from Jiuzhaigou. This location does not require an entry permit and is thus easily accessed by visiting birders. At Baihe, entry is controlled, and foreigners are required to obtain permits; and to hire a park-guide.

Through our involvement in Sichuan birding tourism, we estimate that, in the three breeding seasons leading up to 2015, at least 70 birders were visiting Jiuzhaigou each year, with *Larvivora ruficeps* as their main target species (Francis & Zeidler pers. obs.). Records of their sightings are available via various websites in the form of trip reports, sound recordings and photographs. These records and reports provide evidence of an ongoing population decline which is substantiated by additional unpublished records, collected by the authors, or their personal contacts. These include records of *Larvivora ruficeps* made by SF, WJ, and RZ, who have found the species on several occasions while working as bird guides in Sichuan. RZ noted a total of 4 singing birds at two Jiuzhaigou sites during 2014 (Zeidler pers. obs.), while in May 2015, SF found only two birds at one of these Jiuzhaigou sites. One of these two birds was observed being killed by a Least Weasel *Mustela nivalis* (Francis pers. obs. 2015). Despite the attention of numerous visiting birders, the bird was not reported at any breeding site during 2016; nor during 2017. One of the last available records from the Jiuzhaigou sites is a photograph taken on 29 May 2015 by Mike Nelson of Birdtour Asia (Surfbirds 2015). An accurate picture of the ongoing decline of *Larvivora ruficeps* is difficult to gauge but anecdotal evidence, from experienced bird-tour leaders, shows this species has become more difficult to find over the 10 years leading up to 2015.

The altitudinal range of breeding habitat for *Larvivora ruficeps* is reported to be restricted to a narrow band between 2400 and 2800m asl (Collar 2017). Our own experience of finding birds at Jiuzhaigou National Park, between 2650 and 2700m asl (Francis & Zeidler pers. obs.) is consistent with this information. Although regulations, which constrain activities within the park, can restrict access to habitat, even within this narrow elevation band the species can be described as both localised and rare. The localised occurrence of *Larvivora ruficeps* is indicated by its detection at only two regular breeding areas in the park. Its scarcity is indicated by the low number of birds that have been recorded at these sites. Our observations (Francis & Zeidler pers. obs.) are of a maximum of three birds heard singing at a site at any one time.

At Baihe, an area of restricted entry, fewer birders visit, which results in fewer reports. However, at least 5 singing males were reported from two trails from 27 - 29 May, 2014 (Adam Walleyn 2015

pers. comm.). In the same area, one bird was caught for blood sampling, and then released, at Baihe on 25 June 2015 (Min Zhao et al. 2016). SF visited the 2015 site during 2016 and did not find *Larvivora ruficeps*..

The scarcity of *Larvivora ruficeps* is further emphasised by only three records outside of the Chinese breeding sites. The most recent of these sightings was from Malaysia, in April 2014 (Malaysian Nature Society-Bird Conservation Council Records Committee 2014).

The only other reports of *Larvivora ruficeps* are of two male birds offered for sale in a Guangzhou bird market (Min Zhao et al. 2016), probably during 2007 (BirdLife International 2017). It is not known where these birds were captured from in the wild. While there have been no reports of netting or songbird trapping around the Jiuzhaigou area, pheasant traps, indicating poaching activity, were found close to a village inside Jiuzhaigou National Park during 2016 (Francis pers. obs.) Apart from the attentions of visiting birders and their guides there seems to be very little monitoring of Jiuzhaigou or Baihe breeding sites (Francis pers. obs.).

The absence of records since 2015 of *Larvivora ruficeps* at its known breeding grounds, and at passage or wintering sites, was the background and reason for the audio survey described below.

Finding *Larvivora ruficeps*

As a skulking species,*Larvivora ruficeps* is often difficult to observe. However, the loud, piercing, and characteristic song of this bird can be easily heard during breeding season. Most of our records of this species come from hearing but not seeing the bird (Francis & Zeidler pers. obs.). Playback is a popular method in bringing the bird to an open vantage point. In response to the possible damage being done by the over use of playback, audio recordings have been removed from certain websites (Xeno-canto Foundation 2017).

All our observations are of male birds. The adult female is a dull plumaged bird, and has been described as similar to female Siberian Blue Robin (McKinnon 1992) and female Rufous-tailed Robin (Mahood et al. 2013). The difficulty in identifying the female is well described by Mahood (2013, who discovered the first female bird in Cambodia), and by Clement (Clement et al. 2015).

Compared with other migratory Sichuan songbirds, it arrives late around mid-May. During 2015, birders waited until 19 May before song was first heard (Birdforum 2015). The earliest record we have found comes from a 1987 report, where the author, who was in Jiuzhaigou park between the 3 and 17 May, first heard and found the bird on the 15th (Goodwin 1987). A 2005 report gives a date of 16 May (Rheindt 2005). In comparison, a 2013 trip to Jiuzhaigou found another *Larvivora* species, Indian Blue Robin *Larvivora brunnea*, singing in and around a *ruficeps* breeding site on 4 May (Francis 2013).

Habitat description

Jiuzhaigou National Park and Baihe National Nature Reserve are located in forested gorge and ridge habitat in the NW Corner of the Min Mountain range in China's Sichuan Province. This is an area of rich biodiversity, within the range of Giant Panda *Ailuropoda melanoleuca* (Swaisgood et al. 2016).

There are around 25 km between the main breeding site in Jiuzhaigou National Park and the Baihe site where the bird was recorded in 2015.

The breeding habitat has been described as temperate, mixed coniferous and deciduous forest and scrub, particularly associated with steep and narrow river valleys (Collar 2017). In such habitat, which stretches and widens as a drainage basin, *Larvivora ruficeps* has been found well away from an actual water course (Francis pers. obs.). Our personal experience of the breeding habitat within Jiuzhaigou National Park broadly corresponds with this description. We also observed an association between the presence of the bird and areas of historic flood debris flow, overgrown with well-developed tree, scrub, herb and moss layers; indicating a possible requirement for previous ecological disturbance (Brawn et al. 2001) . However, the forest habitat is characterised by mature trees of diverse species, with a layered canopy. Dead standing timber is observable, as are fallen trees, which are replaced by new growth. Therefore, any requirement for disturbance is considered likely to be for infrequent ecological disruption, with the birds favouring a late successional phase.

Between the late 1960s and 1975, before its establishment as a national park in 1992, the Jiuzhaigou area had been subjected to intensive commercial logging (UNEP 2011). Replacement of agricultural and rural activities with tourist industry were gradual. There are reports of herding and related woodland activity around occupied breeding sites from 1987 (Goodwin 1987), 1994 (Phil Edwards pers. comm.), and 2003 (Francis pers. obs..). The current habitat at the breeding sites, has been influenced by forest regeneration that began around 50 years ago, and herding and woodland gathering activity which continued until at least 2000.

The Birdlife fact sheet on *Larvivora ruficeps* notes: '*it appears to be specialised to areas of successional scrub in valley bottoms which develop following flash-floods* (BirdLife 2017).' The park climate is described as sub-tropical to temperate monsoon (Wikipedia Jiuzhaigou 2017) and the area can experience heavy rain during the summer/early autumn wet season. We have never witnessed evidence of regular flooding events at any of the sites and would judge habitat-changing flash flooding as exceptional events rather than normal occurrences (Francis pers. obs.). However, examination of the breeding sites on the ground and via satellite imagery provides ample evidence of historic flooding (Zeidler pers. obs.). Historic flood debris, in the form of water-swept rocks can be seen at the breeding sites. Moss-growth and other organic covering indicates that such objects have been in their present positions for some time. When viewed on google earth, fan-shaped areas typical of historical deposits of flood debris are visible (Zeidler pers. obs.). Further evidence of past flooding includes flood protection walls, constructed in the two valleys associated with Jiuzhaigou breeding sites. These walls are overgrown, unmaintained and, although we cannot date them, look at least 20 years old. This might be evidence that the last episode of serious flooding may have occurred over 20 years ago (Francis, Zeidler pers. obs.). We assume the walls have been built to protect roads and boardwalks from flood damage, however they may have had an effect in restricting the scale of flood debris flow that could influence vegetation growth in the lower valley. In that capacity, they may also have had an influence over the successional development of vegetation in *Larvivora ruficeps* breeding habitat.

Today, all herding and forestry activity within Jiuzhaigou national park is banned and local people depend on tourism for their livelihoods. Most of the park habitat is allowed to develop and mature without any management intervention (pers. obs. SF & RZ). Tourist developments have not extended to *L. ruficeps* breeding areas, which are located away from the mainstream Jiuzhaigou tourist sites. Tourist disturbance at breeding sites is limited to the constant noise of passing tourist vehicles in areas close to the park roads.

At Baihe National Nature Reserve *Larvivora ruficeps* has also been associated with River valleys. Walleyn (2014 pers. comm.) noted on his 2014 visit, when he estimated hearing five birds over two days; '*as far as habitat they always seemed to be in these steep valleys and I think always close to the valley bottoms*.' Like Juizhaigou the watercourses at Baihe originate from nearby mountains and flow down steep valleys. Flash flooding, habitat damage and resultant habitat successional change, during periods of exceptional precipitation, would also be a feature in this area (Francis pers.obs.).

Breeding range

Ecological niche modelling in Zhao et al. (2016) concluded that the breeding distribution of *Larvivora ruficeps* is likely to extend to the mountain ranges that skirt the north and west of the Sichuan Basin towards the Yunnan border, and also to southern Gansu and Shaanxi. A further isolated potentially suitable area was identified in southeastern Tibet (Min Zhao et al. 2016). The Sichuan, Shaanxi and Gansu areas roughly correspond to the distribution of Giant Panda, which contain large areas of nature reserves and protected forests. It also encompasses the Qinling Mountains of Shaanxi where the bird was first described (Hartert 1907). The area is large and much of the prime habitat will be difficult to access because of nature reserve entry restrictions and demanding terrain. Although birdwatchers, researchers and nature reserve staff must have covered some of these areas, a combination of large area and few observers with the necessary identification skills means that coverage could be best described as thin.

Audio survey

Choosing a Survey Site

Despite predictions that the range of *Larvivora ruficeps* exceeds the small range represented by the Jiuzhaigou/Baihe, we chose to survey at one of the known breeding locations because of our experience at the sites and the existence of the breeding records up to 2015. Since we knew that Jiuzhaigou would be well covered by visiting birders and their guides in 2017 (including by RZ and WJ), we decided that Baihe National Nature Reserve, with its 2015 record of male Rufous-headed Robin, presented the best option for our audio survey. Lower numbers of birders and general visitors at Baihe also had the advantage of minimising the potential for disturbance to recording equipment that would be left in the field over a period of five days.

Survey Timing

The survey was conducted in a period from 29th May, when the recorders were set up inside Baihe, and 3rd June when they were recovered. Our chosen dates, around two weeks after the expected spring return, coincided with a period, when Larvivora ruficeps can be expected to be heard in song.

Remote audio survey recording approach

We employed an audio survey using pre-programmed sound-recorders that would remotely record over a five-day period, which is described as remote audio recording.

This method was used because male *Larvivora ruficeps* have loud and distinctive songs which can be recorded from distance. It was proven useful in previous surveys, when skulking species, with louder,

distintive song/call, such as, Chinese Francolin *Francolinus pintadeanus*, Lady Amherst's Pheasant *Chrysolophus amherstiae* and Hill Blue Flycatcher *Cyornis banyumas* were mainly found through audio recordings in southern Sichuan.

We used 10 recorders, which gave us a recording capacity of 10 hours/day

We split those 10 hours in the following manner –

A recorders - 4 recorders programmed to record 3 x 20 minute segments at 6.00 to 6.20, 7.00 to 7.20, 8.00 to 8.20

B recorders - 4 recorders programmed to record 3 x 20 minute segments at 10.00 to 10.20, 17.00 to 17.20, 18.00 to 18.20

C recorders - The remaining 2 recorders programmed to record 3 x 20 minute segments at 6.30 to 6.50, 7.30 to 7.50, 8.30 to 8 50

These settings gave us a total coverage of 6.00 to 6.20, 6.30 to 6.50, 7.00 to 7.20, 7.30 to 7.50, 8.00 to 8.20, 8.30 to 8.50, 10.00 to 10.20, 17.00 to 17.20, 18.00 to 18.20

We expected the mornings to be the most productive periods and 73% of recordings were programmed to take place in segments between 6.00 and 10.20.

Three A and three B recorders were placed together at three different sites, producing recordings that started at 6.00 and ended at 18.20. The remaining single A and B recorders, and two C recorders were placed at individual sites. This arrangement gave 7 separate recording sites.

The recording sites were located at same area where the 2015 bird was found. The elevation of the sites varied from 2630m to 2700m asl and the recorders roughly followed an easterly leading track. According to Google Earth, distance from first to last recorder on a straight-line axis was 250m but ground-distance in this ridge and valley habitat would have been greater. Other recorders were placed at an average of 20m to the north and south of the track line.

Physical Presence at Recording Site

During three visits to the recording sites four team members, with SF and ZM both experienced in identification of local species, spent a total of 6 hours within the habitat. We were present at the sites between 10h.30 and 13h.00. Our field observation gave further coverage to the site.

The field survey team consisted of four members, SF, ZM and two volunteers. We also used the same park guide, who had found the 2015 bird. Apart from the recording equipment all team members carried binoculars, and the two volunteers took photography equipment to record birds in the survey habitat.

Analysing Recordings

Sound recordings were later analysed by SF and RZ, using Wildlife Acoustics' Kaleidoscope Viewer. This software was employed in an audio-visual capacity, with both an interface to visually identify, through sonograms and audio playback. We trained with several sound recordings of *Larvivora ruficeps* in preparation for this task. Using this method, we could determine the species sings at a frequency range between 1.4kHz and 4.5kHz. When the viewer is set to view thirty seconds of song, it produces a characteristic sonogram, which shows two to three distinct spot like shapes, at varying kHz levels that represent the opening phrase and a double row of 6 to 9 near vertical lines that

illustrate the ending trill. Any similar sonogram that came within the frequency band for *Larvivora ruficeps* song was closely inspected.

Other sites surveyed

During our stay in the Baihe area we also other visited sites that were of suitable altitude and could provide access to suitable habitat. At these sites we made visual observation with a team of 4 persons walking through habitat. We did not utilise remote audio recordings at these sites.

May 28 - Nature reserve area open for public access, close to village of Wujiaoxiang, 32.994080° 104.158141°. 2500m ASL and 25km south of Baihe sites. Newly opened with paths around a lake. Typical ridge and valley containing natural, mature mixed forest. Valleys with running water. Extensive grazing observed at this site.

May 30 – roadside site on the S301, 33.277638° 103.781019°. 2500m ASL, 34km west of Baihe sites. Flatter area on the valley floor. GF has previous birdwatching experience of the area. Unmanaged plantation with secondary growth layer. Adjacent to a natural mixed growth forest containing bamboo. No valleys with running water.

May 30 – access road to Fairy Ponds scenic site, 33.319210° 103.762260°. 2590m ASL, 37km NW of Baihe sites. Unmanaged plantation with secondary growth layer. Adjacent to a natural mixed growth forest. River valley with evidence of habitat being affected by flooding. Evidence of grazing present.

June 1 –. Explored area along old road from Jiuzhaigou to Baxi around 33.57989 103.75052, 2630m ASL, 54km NW of Baihe sites; looking for sites of suitable altitude and habitat. Much evidence of agricultural development but some access into areas of natural mixed growth forest. Large area to explore, contains valleys with water courses. Evidence of grazing present.

June 2 – sites along road S205 to Dujuan Mountain. 32.911298° 104.243268°, 2675m ASL, 35km south of Baihe sites. Plantation adjacent to natural mixed growth forest. This is a protected area within a nature reserve. Evidence of grazing present.

Results

Remote Audio Survey - description of habitat at survey location

Altitudes at the seven remote audio survey sites varied from 2630m to 2700m ASL, which corresponds to the altitudes of the Jiuzhaigou breeding sites. The survey location was on a low valley ridge north of small fast flowing water course that ran to the west. The noise from this stream was picked up on recordings and increased in intensity after rain. The valley slopes were of steeper gradient than the flatter flood channel habitats of Jiuzhaigou, but flatter areas existed on the ridge-top. Although the ground was mostly covered in a thick herb layer, occasional smaller moveable boulders and areas of exposed rock were evidence of past erosive actions. These rocks and boulders were overgrown with moss and other organic matter, indicating their exposure was not a recent event. With an increase of water noise on our tapes after rain we assume that any flash flooding must be localised to valley bottoms. Examination of the site on google earth shows the area as being part of a valley and ridge complex where the valleys drain out towards a basin in the south

west. The site is consistent with reports by Walleyn (2014) that his five Baihe records came from sites close to the bottoms of steep valleys. The vegetation can be described as mature-growth mixed forest, featuring large trees and a multi-layered canopy of secondary growth. Underneath were well-developed scrub and herb layers. Dead timber had been left to stand or rot on the forest floor and there were no signs of current or past forest management. Patches of bamboo were present but within the recording area these were generally small and isolated. A strong moss layer was present on tree trunks, dead-timber, and any exposed rock surface. We were told by our guide that herders, were still living in the area around 15 years ago. We found no signs of human presence and agricultural activity has been halted; though the collection of herbs and other plant items for sale as traditional Chinese medicine still occurs. The wider track and bridges at the park entrance are evidence of earlier commercial logging that must have been active until at least 1975 when the practise was halted at Jiuzhagou. We assume that grazing and herding activities would also have continued until stricter enforcement was brought in after 2000. During our visit we found 2 cows, but these had apparently strayed, and were in the process of being herded out of the park by their owner.

Remote audio survey results

Ten recorders, all containing 5 hours of audio recordings, were collected on the afternoon of June 3. However, all the recordings from the last morning were badly affected by rain noise over which it was difficult to hear bird call and a further twenty-minute segment was unplayable due to a corrupt file issue. After eliminating these segments, we were left with 2540 minutes of recording, split into 127 twenty-minute segments of the necessary quality to hear and analyse avian sounds.

Larvivora ruficeps was not heard on the tapes.

The sonogram of Bianchi's Warbler *Seicercus valentine* came closest to resembling that of *Larvivora ruficeps.* However, the frequency range of *Seicercus valentine* occurs between 1.9kHz and 5.0kHz, and the song has two parts, with a pause of around five seconds in between. On *Seicercus valentine* sonogram, thirty seconds of song is represented by angled vertical lines making up a zig zag pattern. There are no distinct straighter double-row trill lines as shown by *Larvivora ruficeps*. The sonograms of the two species were quite different, but when those of *Seicercus valentine* were recorded from distant birds or suffered from interfering noise clutter, we were careful to check in case they may have represented sound from a distant *Larvivora ruficeps.*

Baihe's other Larvivora, Indian Blue Robin *Larvivora brunnea*, also has a trilling song. When viewed as a sonogram, it looks similar to *Larvivora ruficeps.* However, has a higher frequency; between 3.0kHz 8.2kHz, and is thus easy to distinguish from that of *Larvivora ruficeps*. When listening to the two songs the differences are easy to hear. However, confusion was avoided since *Larvivora brunnea* was only heard once at a recording site, by a single team member, and was not heard on any of the recordings.

However, the tapes were of sufficient quality to allow the positive identification of 32 other species of bird and one mammal species. Other bird and mammal sounds were heard that we were not able to positively identify to species level. These sounds were associated with woodpeckers, tits, bushtits, leaf warblers and flycatchers and we were certain none of these unidentified sounds came from *Larvivora ruficeps.* With the number of species identified, the quality of recording and the quality of software we were able to identify sounds both visually and aurally. SF and RZ are confident that if

Larvivora ruficeps had been present, and singing during the recording periods, we would have located these sounds.

It is also important to note that the level of song was much greater on many recording segments, especially the early morning segments, than we experienced during our walking visits into the recording area. The three-hour hike to the recording areas would have made it difficult to obtain the same sort of coverage by foot.

Bird Species Recorded by remote audio surveys

According to the number of times that specific songs/calls were heard on the recordings, a status was given to each species:-

Very common - heard on most tapes

Common - heard on many tapes

Fairly common - heard at most sites but on few tapes

Uncommon – heard at few sites and few tapes

Rare – heard infrequently at one site

Table x : Bird species recorded during remote audio surveys at Baihe Nature Reserve May 29-June 3, 2017.

1.	Temminck's Tragopan	*Tragopan temminckii*	rare -one recording
2.	Koklass Pheasant	*Pucrasia macrolopha*	uncommon
3.	Blue Eared Pheasant	*Crossoptilon auritum*	rare - heard twice
4.	Large Hawk-Cuckoo	*Hierococcyx sparverioide*	common
5.	Himalayan Cuckoo	*Cuculus saturates*	common
6.	Lesser Cuckoo	*Cuculus poliocephalus*	common
7.	Himalayan Owl	*Strix nivicolum*	rare - one site heard
8.	Darjeeling Woodpecker	*Dendrocopos darjellensis*	Dendrocopus calls common
9.	Grey-headed Woodpecker	*Picus canus*	rare - heard twice
10.	Long-tailed Minivet	*Pericrocotus ethologus*	common
11.	Red-billed Blue Magpie	*Urocissa erythrorhyncha*	uncommon
12.	Spotted Nutcracker	*Nucifraga caryocatactes*	very common
13.	Grey-headed Canary Flycatcher	*Culicicapa ceylonensis*	fairly common
14.	Green-backed Tit	*Parus monticolus*	uncommon
15.	Chinese Wren-Babbler	*Pnoepyga mutica*	uncommon

16.	Pygmy Wren-Babbler	*Pnoepyga pusilla*	uncommon
17.	Chestnut-headed Tesia	*Cettia castaneocoronata*	very common
18.	Chinese Leaf-Warbler	*Phylloscopus yunnanensis*	very common
19.	Claudia's Leaf-Warbler	*Phylloscopus claudia*	common
20.	Greenish Warbler	*Phylloscopus trochiloides*	uncommon
21.	Large-billed Warbler	*Phylloscopus magnirostris*	very common
22.	Bianchi's Warbler	*Seicercus valentine*	very common
23.	Giant Laughingthrush	*Garrulax maximus*	rare - heard once
24.	Elliot's Laughingthrush	*Garrulax elliotii*	uncommon
25.	Great Parrotbill	*Conostoma aemodium*	rare – heard once
26.	Chestnut Thrush	*Turdus rubrocanus*	fairly common
27.	Slaty-backed Flycatcher	*Ficedula hodgsonii*	fairly common
28.	Rufous-gorgeted Flycatcher	*Ficedula strophiata*	fairly common
29.	Himalayan Bluetail	*Tarsiger rufilatus*	rare - heard just once
30.	White-bellied Redstart	*Hodgsonius phoenicuroides*	uncommon
31.	Collared Grosbeak	*Mycerobas affinis*	uncommon
32.	Grey-headed Bullfinch	*Pyrrhula erythaca*	uncommon

Other Sounds Found on remote audio survey recordings

The one mammal species identified in the recordings was Golden Snub-nosed Monkey *Rhinopithecus roxellana*, which, throughout one twenty-minute segment, were clearly heard close to the recorders. Other mammals were heard but not identified. Bellowing sounds were presumed to come from ungulates.

The only sounds attributed to human activity were from infrequent, high-flying Jet aircraft. No human presence in the recording area was detected and no identifiable sounds from domestic animals.

Insect sounds were recorded but did not interfere with recording or identification of bird sounds.

Rain noise was picked up by the recorders and the heavy rain of the final morning (June 3) degraded the quality of recording. We could still identify the sounds of 'loud' birds, singing close to recorders – *Cettia castaneocoronata, Phylloscopus yunnanensis, Phylloscopus magnirostris, Seicercus valentine* – but it was extremely difficult to hear distant sounds. The visual clutter of the rain on the sonograms also made it very difficult to examine sounds using the Kaleidoscope Viewer.

The noise of running water also contributed to noise clutter that made analysing the tapes more difficult.

Bird species recorded during walking visits

The results of the remote audio survey produced six species that were not recorded during the three times we visited the site on foot.

Koklass Pheasant *Pucrasia macrolopha*

Blue Eared Pheasant *Crossoptilon auritum*

Himalayan Owl *Strix nivicolum*

Giant Laughingthrush *Garrulax maximus*

Great Parrotbill *Conostoma aemodium*

Collared Grosbeak *Mycerobas affinis*

Seven species were seen during the 6 hours we were present in the recording area that were not heard on the remote audio survey recordings

White-backed Woodpecker *Dendrocopos leucotos*

Rufous-vented Tit *Periparus rubidiventris*

Grey Crested Tit *Lophophanes dichrous*

Pere David's Tit *Poecile davidi*

Eurasian Nuthatch *Sitta europaea*

Indian Blue Robin *Larvivora brunnea*

Dark-sided Flycatcher *Muscicapa sibirica*

These seven species have song very different from *Larvivora ruficeps*. Song and calls of *Muscicapa sibirica* could be described as indistinct and of low audibility. The tits and nuthatch were seen traveling through the area in mixed feeding flocks where indistinct contact calls are commonly used. The tapes had unidentified calls that could be associated with these species, but since we listed only those species identified from recordings with a very high degree of certainty, these do not appear on the audio survey results list.

Dendrocopos woodpeckers have loud, distinct calls, with different species sharing similar vocalizations. Dendrocopos were commonly heard on the recordings but we were only able to positively identify *Dendrocopos darjellensis*. There was a possibility of at least three species being present in the area.

Other Sites

Larvivora ruficeps was not found at the five other sites visited. Good habitat was found on May 28, around 32.994080° 104.158141°. We recommend further exploration of this area and to the north towards Baihe reserve. Habitat accessed on June 1 around 33.57989 103.75052 also looked

promising. Although agricultural activity had degraded areas around the village, ridge and valley habitat to the east and west of this point looks promising.

After the survey was completed we discovered that no birdwatchers visiting Jiuzhaigou National Park reported hearing or seeing *Larvivora ruficeps* during the 2017 breeding season.

Discussion

Possible reasons for decrease in reports of *L. ruficeps*

Little is known about the nature of any threat within the breeding or wintering range of L. ruficeps. We believe factors associated with habitat change in the breeding areas would be a main area of investigation. Such factors may include habitat loss due to development of infrastructure for tourism, agriculture, and dams for hydro-electric power. Increased pressures from climate-change, bird-watching, the cage-bird trade and predation could also be considered as possible reasons for a population decline in the breeding areas. The dangers of mass trapping during passage and loss of wintering habitat must also be also factored in.

1 Changes to breeding habitat – loss of successional habitat

In Jiuzhaigou National Park the maturing of the forest habitat and the absence of disturbance leading to successional changes may be the key to the observed decline of *Larvivora ruficeps*. This species may have fared worst during the since the establishment of the park in 1992. Since that time, activities associated with livelihoods and activities derived from agriculture and forestry have ceased while forest protection and tourism has increased. This is also the most likely time for the building of the flood walls; so localised flooding is also thought to have reduced over the same time period. A reduction in the intensity and frequency of disturbance events may have resulted in a less dynamic habitat.

Other species are known to be dependent on successional woodland habitats. For example, Woodlark *Lullula arborea* uses transitional habitats and has benefitted from woodland management interventions (Wotton & Gillings 2010) and the British decline of Common Nightingale *Luscinia megarhynchos* has been linked to a decline in woodland management (Fuller 1992). In the United Kingdom, both species are examples of how a formerly common bird might decline, to the point where populations were nationally considered endangered, when habitats are left to mature. These two species have benefited from management techniques that are designed to replicate conditions found in their preferred breeding habitats.

However, since *L. ruficeps* has been regularly recorded (albeit in low numbers) until 2016, its recent absence at known breeding sites, could be considered a sudden and recent phenomenon rather than the tail end of a slow gradual decline.

2 Passage or Wintering Population Threats

Very little is known of *Larvivora ruficeps* during passage or wintering. The three records of passage/winter birds, from Malaysia and Cambodia, suggest that this species follows the East Asia – Australasian Flyway (Wikipedia Australasia Flyway 2017). This route contains increasing

anthropogenic threats for migratory Asian songbirds. These have been documented as including the loss and degradation of habitat, uncontrolled hunting (extensive mist netting) for both food and pet trade, invasive plant species and collisions with human-made objects (Yong et al. 2015). *Larvivora ruficeps* is assumed to be subject to same threats during passage and winter periods. The recent increase in the predominance of these threats (reference) coincides with the period of decline of this species and may be causal. It could be supposed that if *Larvivora ruficeps* is as localized on its wintering grounds as it at breeding sites, then loss of habitat could be a particular factor in its population decline.

3 Climate Change

The period from 2000 to 2015, over which declines in *L. ruficeps* have occurred, coincides with recent periods of climate change (NOAA 2017). The increasing influence of climate change on the timing of bird migrations and how it can lead to mismatches in availability of feeding possibilities at breeding sites has been well documented (Hurlbert and Liang 2012). However, the first spring observation dates for *Larvivora ruficeps,* although limited in number, are consistent throughout 1987 to 2015. All these reports are from mid-May and there is no evidence to suggest that arrival dates are becoming noticeably earlier. However, since accurate data on the timing of *Larvivora ruficeps* migration is limited, the effect of climate change on this critical event should be considered.

4 Economic Development and Habitat Loss

At Jiuzhaigou National Park, changes have occurred in the form of tourism and infrastructure development. A massive recent increase in domestic tourism within China has resulted in Jiuzhaigou, the most popular national park in China, attracting yearly visitor totals of several millions (Gu et al 2013). Inside the park, however, tourist activity is strictly limited to the boardwalks and the development footprint has not greatly affected the key known *Larvivora ruficeps* breeding areas (Francis, pers. obs). At Baihe, the breeding sites, which have restricted access, receive even less disturbance. We consider that habitat changes at Jiuzhaigou and Baihe have resulted from the maturing of forest habitat (i.e. a decrease in the frequency of ecological disturbance which previously maintained a successional habitat).

Even though Jiuzhaigou and Baihe seem to have escaped the worse effects of tourist related development, other potential (modelled) breeding areas may be at risk.

Significant infrastructure development and environmental change has accompanied China's growing economic status. An expanded tourism economy, intensified agricultural practices, the extensive development of road networks and flooding of valleys for hydroelectric power schemes have all been observed. Habitat loss associated with the increased infrastructure to support these developments is, in our opinion, likely to have affected potential *Larvivora ruficeps* breeding sites. On-going habitat destruction for Giant Panda, which has been documented at altitudes between 1,100 and 3,800m ASL (Weihua Xu et al. 2017). This habitat borders presently known and includes areas of modelled breeding range and could indicate parallel habitat threat/loss for *Larvivora ruficeps*.

Hydro-electric projects, which result in the flooding of many kilometres of river valleys to create large reservoirs, may have already caused the loss of several areas which could be considered as potential breeding habitat for L. ruficeps. Forty kilometres north of Jiuzhaigou, 33.606575° 103.734289°, nine

kilometres of flooded valley at 2,360m ASL is a good example of the scale of the hydro-electric habitat destruction.

5 Birdwatching pressure and Playback

It is difficult to gauge how the presence of birders affects Larvivora ruficeps. Our observations suggest that there are rarely are there more than 10 birders/day at the Jiuzhaigou sites, with peak numbers during late May and the first half of June. Birders, usually in small groups, could be described as well-disciplined and generally keep to paths and do not destroy habitat by walking through undergrowth. Apart from the use of playback (see below) they are generally quiet and do not leave litter. Once they have had a view of the bird they usually leave the sites for new birding destinations. Bird photographers can be more persistent in their quest for pictures and the disturbance levels caused by this form of birding, which can also employ playback, could be considered higher than simple bird-watching. However, we have never observed activities such as feeding of birds or removal of vegetation removing activity in association with photography (Francis pers. obs.).

Playback of previously recorded songs and calls is commonly used by birdwatchers to draw out a species of particular interest. This technique is often reported to have been used in successful sightings of *Larvivora ruficeps*. The effects of playback on breeding birds are not fully understood. A study of the effects of playback on two Southern American species found that the birds increased vocalisations after playback, which is likely to have reduced the ability of the birds to participate in their normal daily patterns of feeding and routine behaviour. However, this report also acknowledges that the effects of playback differ between species (Berton et al. 2013). Responses to our own use of playback to detect *Larvivora ruficeps* most often resulted in a singing response from a hidden perch; the bird then usually moved closer to the source of playback. However, we often lost contact with the singing bird after one or two bursts of responsive song. Compared to other species this response to playback could be described as medium (Francis pers. obs.). We never observed lengthy bouts of noisy, agitated behaviour on an open perch (which would be considered a high response level, likely to result in decreased fitness to the animal). With repeated exposure to simulated playback, individuals of certain species are reported to ignore and show habituation towards playback (Berton et al. 2013). Our impression is that L. ruficeps exhibits such habituation.

Although there is no proof that playback has a harmful effect on *Larvivora ruficeps*, the fact that the bird shows a response, even if considered medium, shows that the practice can distract the birds from their normal behaviour patterns. This can only be interpreted as an extra stress for the species and is something that should be avoided. As such we recommend that playback for *Larvivora ruficeps* is stopped. Park authorities could assist by erecting signage to request visiting birders to refrain from this practise.

6 Cage Bird Trade

Male *Larvivora ruficeps*, being highly attractive and rare, could be considered an attractive target for trappers. In China, the capture of wild birds as cage specimens is illegal, but nets and traps are openly sold in shops and over the internet (Francis pers. obs.). We have also observed organized bird catching where a group of people equipped with walkie-talkies work as a team (Zeidler pers. obs.). At the Chengdu bird-market we have noted numerous examples of many species that obviously

originate from the wild, including Siberian Rubythroat, *Calliope calliope*, a migrant songbird, whose main Sichuan breeding distribution lies in North Sichuan and borders the Jiuzhaigou area (Francis & Zeidler pers. obs). Any bird trapping in this area could be considered a risk to *Larvivora ruficeps*, while trapping south of breeding areas and SE Asia of course constitutes a danger to passage and wintering birds.

7 Predator Pressure

During May 2015 SF witnessed a male *Larvivora ruficeps* being killed by a Least Weasel *Mustela nivalis*. Although extremely difficult to estimate the threat posed by predators it is interesting to note, that during peak prey/breeding years, that coincide with population peaks of small rodents, *Mustela nivalis* populations can increase up to 10-fold, with these densities lasting six to 18 months (McDonald et al. 2016). For a low-density species, like *Larvivora ruficeps*, a high density of predators, which will also prey on eggs and nestlings must pose a problem and could affect local population numbers and be a more serious factor when populations were already at an extremely low level.

Conservation Measures

1 national conservation measures - currently *Larvivora ruficeps* receives no special protecting from Chinese wildlife protection laws (China.org.cn. 2017). Giving the species increased official protection would not only enhance an ability to combat direct persecution and trapping, but also legally compel development projects in potential breeding areas to take special note of this species in the required development impact studies.

2 local conservation measures

If new populations of the bird are found the following measures could be considered -

Birdwatching, Bird-photography and Playback Disturbance - responsible attitudes from visitors to breeding sites. Playback should be minimised or stopped, while access into breeding areas should not add stress or disturbance to the birds. Responsible attitudes regarding birding also include keeping exact site details hidden from unwanted parties such as professional bird trappers.

Improved Local Monitoring and Wardening – new breeding sites warrant monitoring and extra protection.

Studies on Habitat Management – the discovery of new populations should necessitate the need for more detailed habitat study, both to better understand breeding requirements but also explore the feasibility of future habitat management programs.

Studies Regarding Population Bottlenecks During Winter/Passage Periods

If robust new populations are found, a study, that used new miniaturized GPS tracking technology (Hallworth & Marra 2015), could be invaluable in discovering migratory routes and wintering grounds, which could be used to investigate possible population bottlenecks outside the breeding-grounds

An evaluation of the remote audio survey method for finding *Larvivora ruficeps*

We consider that the remote audio survey was an appropriate method to use to ascertain whether or not *Larvivora ruficeps* was present in the survey area. Because of the difficulties associated with locating this bird, chiefly access to sites and skulking behaviour combined with a lack of active, expert ornithologist in the region. We recommend this survey method for future efforts. The fact we found 32 species using remote recording, and that six of these, all birds with loud characteristic vocalizations, were not found during walking visits to the sites, indicates this method is equally valuable for finding other loud singing/calling species that have characteristic vocalizations.

Regarding *Larvivora ruficeps* there are circumstances where this method could be particularly advantageous.

- When expert ornithologists are not available, recorders can be placed and collected by non-expert field assistants and analysed afterwards by experts. Ecological niche modelling suggests large areas of potential habitat, but coverage of that area is difficult for the few ornithologists/birdwatchers that regularly work/visit in the region. With many of these areas already included in large reserves designated to Giant Panda protection it could be feasible to train park staff in the use of remote recorders. Many of these reserves are already using camera traps so the concept of remote recording equipment should be easy to introduce.
- Potential new *Larvivora ruficeps* sites could be physically difficult to access not only due to terrain but, because they lie in areas on national nature reserve that have strict access policy. Using local field assistants that are non-expert in ornithology but have access and are expert in local terrain and conditions, would give greater survey scope.
- The method is well suited to being used with other technologies. GPS and Satellite imagery technology can be employed when instructing field assistants where to set recording equipment. Sound recognition technology can be used in the analysis of data.

There also several disadvantages to the method.

- The static nature of the survey method which cannot cover the same area of survey area as an experienced ornithologist on foot.
- The method relies solely on audio contact, which is difficult when identifying species with indistinct or quiet calls. In the case of *Larvivora ruficeps* female and immature birds will not be identified using this method. However, most contacts are first made through hearing male vocalizations, with females/immatures being rarely seen and their vocalizations never described or recorded.
- Estimating population density requires physical presence. Audio recordings can only give an indication if more than one bird is singing at the same time.
- Susceptibility of recording quality to interference from rain, running-water, wind, moving vegetation or other forms of unwanted noise.
- Susceptibility of equipment to technical problems
- Expense of equipment. There are few voice recorders of the necessary quality and technical specifications that can be used for remote recording. Dedicated recording equipment, with better protection, more battery power and greater technical sophistication are now reaching the market but comes at a higher cost than the simple voice recorder type setup as used by this survey.
- The workload to analyse recording, even when using software, can be time consuming. Although not utilised in this survey, automatic analysis software is available. Using this

programming will cut down further on time needed to analyse tapes, but the cost of software is high and requires a new level of expert technical ability.

Conclusion

The survey team successfully managed to set up remote audio survey equipment during late May, early June 2017 in an area of Baihe National Nature reserve where *Larvivora ruficeps* had been caught and released on June 25, 2015. After five days the equipment was recovered, yielding 580 minutes of recording on which 32 species were identified, but with no trace of *Larvivora ruficeps*. The survey team concluded that remote recording is a suitable method for searching for *Larvivora ruficeps* when expert field workers are unavailable and search areas have restricted or difficult access.

We also suggest that more work is needed to understand the reasons for decline and new conservation should be implemented.

We would like to thank the following for their help in assisting us in this project. AEC Ltd. for sponsoring this project. The oriental Bird Club for their support. Ren Hong and Chen Yiwen (Mianyang Birdwatching Club) as our two untiring volunteers who helped with all aspects of our field survey. The Sichuan forestry department wildlife management office and Baihe nature reserve management office for their cooperation and assistance in allowing us to survey at Baihe. We also got invaluable assistance and information from Adam Walleyn, Phillip Edwards, Per Alstrom, Chris Gooddie and Andy Mears.

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