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欧美陆地鸟类监测的历史、现状与我国的对策

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摘要: 鸟类是生物多样性评估与监测, 以及生态环境影响评价的重要指标。有关鸟类种类组成、数量与分布动态的长期监测工作在欧美地区已有100多年的历史。本文在总结欧美陆地鸟类监测历史与现状的基础上, 着重介绍了英国繁殖鸟类调查(the Breeding Bird Survey, BBS)、北美繁殖鸟类调查(the North American Breeding Bird Survey, BBS)和圣诞鸟类调查(the Christmas Bird Count, CBC)等重要的陆地鸟类长期监测计划。同时, 本文在分析中国鸟类调查和现状的基础上, 参照英国BBS计划的调查设计与野外方法, 提出了中国BBS(the Chinese Breeding Bird Survey, Chinese BBS)计划的具体建议: (1)以国家相关部门为实施主体、然后逐渐向以非政府组织(non-government organization, NGO)为主体过渡, 并以学术团体为技术依托, 组织全国鸟类学工作者、观鸟爱好者和志愿者参与野外调查工作; (2)根据各地观鸟志愿者的数量采用分层随机抽样(stratified random sampling)的取样策略选取调查样方, 并结合样线法(line transects)和样点法(point transects)进行鸟类调查; (3)组建中国BBS信息共享平台, 要求鸟类调查者按照统一的数据格式将调查结果在线输入平台之中; (4)相关部门和学术团体积极推动各地观鸟组织的发展, 充分利用志愿者力量实施中国BBS计划。

关键词: 陆地鸟类监测, 重要监测计划案例, 中国BBS计划

History, status of monitoring land birds in Europe and America and countermeasures of China

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Abstract: Because birds are important indicators of biodiversity, and useful for Ecological Impact Assessment (EcIA), scientists have monitored the abundance, richness and distribution of bird species for >100 years throughout the world. In this paper, we reviewed the history and status of land bird monitoring, particularly some well-known long-term monitoring programs such as the Breeding Bird Survey (BBS) in the UK, and the Breeding Bird Survey (BBS) and Christmas Bird Count (CBC) in North America. We also evaluated the status of large-scale bird monitoring programs in China, and propose a monitoring program called the Chinese Breeding Bird Survey (Chinese BBS) based on methodology of BBS in the UK. We suggest the following: (1) the Chinese BBS could initially be administered by relevant government departments with support from academia, with responsibility gradually transitioned to non-government organizations to implement the monitoring scheme and organize professionals, amateurs and volunteers to conduct field surveys; (2) survey squares could be randomly selected after stratification by volunteer density, and surveyed for birds using line and point transect surveys; (3) the results of all bird surveys should be recorded using a standard data format and could be edited and submitted via the Internet through a system named the Chinese BBS information sharing platform; (4) relevant governmental departments and academic organizations should actively promote the development of local bird watching societies, and implement the Chinese BBS with support from volunteer surveyors.

Key words: monitoring land birds, cases of bird monitoring schemes, the Chinese Breeding Bird Survey

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鸟类因具有分布广泛、种类多样以及易于识别等特点(Gregory *et al*., 2003), 是研究最多和调查最为频繁的动物类群之一(Wiens, 1989; Gibbons & Gregory, 2006), 也是一类对栖息地改变和环境变化反应极为敏感的动物(Morrision & Meslow, 1983; Fuller *et al*., 1995; Eeva *et al*., 1998; Hutto, 1998; Krebs *et al*., 1999; Both *et al*., 2010)。鸟类物种的组成、数量、多样性和群落等特征可直接反映栖息地的适宜性、生态系统健康与生物多样性状况、人类活动对生态系统的干扰程度、土地利用和景观改变对生态系统影响程度, 以及区域生态环境的质量(Furness & Greenwood, 1993; Nally, 1997; Bibby, 1999; Canterbury *et al*., 2000; Gregory *et al*., 2003; Jorgensen *et al*., 2005)等。因此, 鸟类又是生物多样性监测和生态环境影响评价(EcIA)的重要指标(Treweek, 1999; Bibby *et al*., 2000; Gregory *et al*., 2003)。

有关鸟类种类组成、数量与分布调查及其动态的长期监测工作在欧美地区已有100多年的历史, 先后实施了许多具有国际性影响的长期监测计划(Bart, 2005; Gregory *et al*., 2005; Sauer *et al*., 2008)。这些计划的主要目的是在大尺度上了解鸟类物种多样性、种群分布与数量动态, 分析鸟类与栖息地的关系和估算鸟类多样性与数量的变化趋势, 为研究和保护鸟类及其栖息地提供数据, 并在鸟类受胁等级的划分、保护措施的制定等方面发挥了重要的作用(Brown *et al*., 2001; Williams *et al*., 2002; U.S. Fish and Wildlife Service, 2004)。在中国, 鸟类生态学研究起步较晚(郑光美, 1981), 虽然近几十年来中国学者在鸟类学领域开展了大量的研究工作, 但却缺乏对某一对象进行长期的监测与研究(丁平, 2002), 有关鸟类种类组成与数量的监测工作亦开展不多, 更缺乏长期的大尺度的陆地鸟类监测工作。本文在总结欧美陆地鸟类监测的历史与现状的基础上, 着重介绍英国繁殖鸟类调查(the Breeding Bird Survey, BBS)、北美繁殖鸟类调查(the North American Breeding Bird Survey, BBS)和圣诞鸟类调查(the Christmas Bird Count, CBC)等重要监测计划的具体实施方案, 分析我国陆地鸟类监测现状与存在的问题, 并提出我国开展陆地鸟类监测工作的对策与建议, 以促进我国实施大尺度的鸟类长期监测计划。

1 欧美陆地鸟类监测历史与现状

19世纪以前许多北美人乐于参加传统的圣诞狩猎活动。至19世纪末, 美国鸟类学家Frank M. Chapman提出了“在每年圣诞节期间人们应以计数鸟类的数量来代替猎杀鸟类”的建议, 并于1900年圣诞节开始了世界最早的鸟类监测计划, 即圣诞鸟类调查(CBC), 该计划至今已不间断地持续了100多年(Butcher, 1990; Dunn *et al*., 2005; LeBaron, 2009)。

到了20世纪中叶, 人们逐渐意识到了环境变化对生物的影响, 诸如农田生境的退化、河流湖泊的水质恶化和有毒杀虫剂的危害(Dubos, 1964), 以及广泛使用DDT所产生的残留农药在生物体内富集后对整个生物链的影响(Zaret & Paine, 1973)等。虽然当时已有研究表明杀虫剂可导致一些鸟类的死亡, 但却无法确定杀虫剂是否会在大尺度上影响鸟类种群数量(George & Stickel, 1949; Genelly & Rudd, 1956; Hickey & Hunt, 1960; Hunt, 1960; Wurster *et al*., 1965; Keith, 1966)。据此, 英国于1962年由BTO(British Trust for Ornithology)负责启动了首个具有统一标准、大规模的陆生鸟类监测计划——常见鸟类调查(the Common Birds Census, CBC), 旨在通过长期监测鸟类数量来反映环境质量的变化(Marchant *et al*., 1990)。该计划被由BTO、JNCC (Joint Nature Conservation Committee)和RSPB(the Royal Society for the Protection of Birds)联合负责的、始于1994年的繁殖鸟类调查(BBS)计划逐步取代, 并于2000年结束。

继英国CBC计划之后, 美国帕图克森特野生动物研究中心(Patuxent Wildlife Research Center)和加拿大国家野生动物研究中心(National Wildlife Research Center)于1966年合作启动了北美繁殖鸟类调查(BBS)计划, 该计划是一个长期的、大尺度的、多国合作的鸟类监测项目, 主要跟踪调查北美繁殖鸟类种群的数量状态和变化趋势(Sauer *et al*., 2008)。

随着20世纪60年代英国CBC计划和北美BBS计划的实施, 瑞典、芬兰和丹麦等欧洲国家亦相继开始实施一些全国性陆地鸟类监测计划(表1), 至2007年共有35个欧洲国家开展了50多个鸟类监测项目(Klvaňová & Voříšek, 2007)。在此基础上, 2002年1月EBCC(the European Bird Census Council)启动了包含欧洲主要繁殖鸟类监测项目的泛欧洲常见鸟

类监测计划(Pan-European Common Bird Monitoring Scheme, PECBMS)。该计划旨在联合欧洲所有的鸟类学家来共同关注鸟类种群的数量和分布区域, 并以常见鸟类为指示物种进行繁殖期的鸟类数量监测, 以此反映欧洲自然环境的变化。目前, 已有37个国家或地区加入PECBMS计划。

在澳大利亚, 1989年RAOU(the Royal Australasian Ornithologists Union)启动了澳大利亚鸟类调查计划(the Australian Bird Count, ABC)(Loyn, 1986; Clarke *et al*., 1999)。除了长期监测鸟类数量动态的项目之外, 美国IBP(the Institute for Bird Populations)于1989年启动了北美鸟类繁殖力和存活力的监测项目(the North American Monitoring Avian Productivity and Survivorship Program, MAPS), 目前该计划在美国和加拿大已经建有近450个监测站, 每年持续开展雾网(mist-netting)标记(DeSante & Kaschube, 2009), 旨在获得并分享鸟类种群数量的变化趋势和有关繁殖能力与存活力方面的数据, 为决策者提供资料并确定需要保护的鸟类。

由此可见, 目前在全球范围内已有众多的陆地鸟类监测项目, 其监测范围大小不一, 监测时间各有长短。不过这些已经开展的陆地鸟类长期监测项目主要集中在北美和欧洲。此外, 在北美和欧洲还有不少相对较小尺度(跨州或省)的监测项目, 如始于1992年的意大利伦巴第地区常见繁殖鸟类调查(Common breeding bird count in Lombardy)(Bani *et al.*, 2009), 始于1993年的美国五大湖区鸣禽数量监测(Monitoring songbird populations in the Great

表1　部分正在欧洲实施的陆地鸟类监测计划
Table 1　Some ongoing schemes of monitoring land birds in Europe

国家 Country	项目名称 Scheme name	起始年份 Start	调查方法 Method	参考文献 Reference
芬兰 Finland	芬兰繁殖鸟类年度监测 Annual monitoring of breeding birds in Finland	1975	P & L	Väisänen, 2006
瑞典 Sweden	瑞典繁殖鸟类调查 Swedish Breeding Bird Survey	1975	P	Ottvall *et al.*, 2008
丹麦 Denmark	繁殖与越冬鸟的样点法普查 Point count census of breeding and wintering birds	1976	P	Heldbjerg & Eskildsen, 2010
捷克 Czech Republic	繁殖鸟类普查计划 Breeding Bird Census Programme	1981	P	Reif *et al.*, 2006
爱沙尼亚 Estonia	样点法普查计划 Point census project	1983	P	Leito & Kuresoo, 2004
荷兰 Netherlands	常见繁殖鸟类调查计划 Common breeding species project	1984	T	van Dijk *et al.*, 2010
法国 France	常见鸟类调查 Temporal Survey of Common Birds	1989	P	Jiguet, 2009
德国 Germany	德国鸟类学家联合会常见繁殖鸟类监测计划 Dachverband Deutscher Avifaunisten Monitoring programm Häufige Brutvögel	1989	P, L & T	Mitschke *et al.*, 2005
比利时 Belgium	瓦隆尼亚常见繁殖鸟类调查 Common Breeding Birds Survey in Wallonia	1990	P	Paquet *et al.*, 2010
立陶宛 Lithuania	立陶宛繁殖鸟类监测计划 Lithuanian Breeding Bird Monitoring Scheme	1991	P	Kurlavicius, 2004
英国 United Kingdom	繁殖鸟类调查 Breeding Bird Survey	1994	L	Risely *et al.*, 2010
挪威 Norway	挪威繁殖鸟类普查 Norwegian Breeding Bird Census	1995	P	Husby, 2003
西班牙 Spain	常见繁殖鸟类监测计划 Common Breeding Bird Monitoring Scheme	1996	P	Escandell, 2006
奥地利 Austria	奥地利繁殖鸟类调查 Monitoring der Brutvögel Österreichs	1998	P	Teufelbauer, 2010
爱尔兰 Ireland	乡村鸟类调查 Countryside Bird Survey	1998	L	Coombes *et al.*, 2009
匈牙利 Hungary	常见鸟类监测 Monitoring of our common birds	1999	P	Szép & Gibbons, 2000
瑞士 Switzerland	繁殖鸟类数量监测 Monitoring of abundance breeding birds	1999	T	Kéry & Schmid, 2004
意大利 Italy	意大利鸟类监测 Monitoraggio Italiano Ornitologico	2000	P	Fornasari & de Carli, 2002
波兰 Poland	常见繁殖鸟类监测计划 Common Breeding Bird Monitoring Scheme	2000	L	Chylarecki & Jawińska, 2007
保加利亚 Bulgaria	常见鸟类监测计划 Common Bird Monitoring Scheme	2004	L	Spasov, 2008
葡萄牙 Portugal	常见鸟类普查 Common Bird Census	2004	P	Hilton *et al.*, 2006

P: 样点法; L: 样线法; T: 标图法
P, Point transects; L, Line transects; T, Territory mapping

Lakes Region)(Howe *et al.*, 1997), 始于2000年的科罗拉多鸟类监测(Monitoring Colorado's Birds)(Leukering *et al.*, 2000), 以及2003年开始的内华达鸟类调查(the Nevada Bird Count)(http://www.gbbo.org/projects_nbc.html)等等。

2 重要案例

在全球鸟类监测项目中, 圣诞鸟类调查已有百年历史, 调查区域涉及整个美洲大陆。在国际上具有较大影响力的英国和北美的繁殖鸟类调查均是始于20世纪60年代, 各自形成了相对成熟的监测方案。

2.1 英国繁殖鸟类调查(BBS)计划

1962年英国启动了常见鸟类调查(CBC)监测项目, 该项目要求志愿者在鸟类繁殖期内按照标准化的标图法(territory mapping)(Kendeigh, 1944)在预先选定的样方中开展调查。由于该项目是由观鸟志愿者自由选择(free choice)调查样方, 导致了调查区域主要集中在居住点的周围, 因此无法包含英国的大部分生境。同时, 由于志愿者人数的不足和缺少后续数据的处理等问题又限制了该项目的实施和扩展(Noble, 2008)。基于此, BTO、JNCC和RSPB在1992年和1993年联合开展了野外试点工作(Baillie & Marchant, 1992; Greenwood *et al.*, 1995), 通过比较样点法和标图法(Gregory & Baillie, 1994)、样线法和样点法的差别(Gregory & Baillie, 2004), 以及不同的取样策略(Gregory & Baillie, 1994, 2004), 确定采用分层随机抽样的取样策略, 采用样线法和样点法进行调查, 并最终于1994年启动了英国繁殖鸟类调查(BBS)计划(Gregory *et al.*, 1999)。经过6年的发展, 繁殖鸟类调查的设计与方法不断完善, 除了能够合理地估计农田和灌木生境中鸟类的变化趋势外, 还可以对生活在城市和山地中的鸟类进行变化趋势估计(Noble, 2008)。于是, BBS计划逐渐替代了CBC项目, 最终使实施了近40年的CBC于2000年结束。

BBS计划按照地方行政区划将英国分成83个地区, 依照不同地区观鸟志愿者的人数进行抽样, 总共选取了1,565个1 km × 1 km的调查样方, 然后安排志愿者到指定的样方中开展鸟类调查(Gregory *et al.*, 1996)。志愿者每年开展3次野外调查。第一次调查时需要用生境代码(Crick, 1992)详细记录样方中的不同生境, 并标记调查路线, 然后在繁殖季节的前半季(4月初到5月中旬)和后半季(5月中旬到6月底)分别开展第二次和第三次鸟类调查。具体调查方法是: 志愿者在每个样方中选取两条平行的长度为1 km的调查路线, 每条路线均匀分割成5段, 在每小段路线中各自记录听到或见到的鸟类和所处的生境(图1), 并分别记录距样线25 m内、25–100 m和100 m以外3个距离区带内的种类与数量(http://www.bto.org/volunteer-surveys/bbs/taking-part/download-forms-instructions), 以便进行鸟类发现概率分析和鸟类密度估算(Buckland *et al.*, 1993; Bibby *et al.*, 2000)。每次调查的时间从早晨6点至7点之间开始, 每条样线的调查时间一般在90 min左右。

同时, 英国BBS计划网站(http://www.bto.org/volunteer-surveys/bbs/latest-results)会每星期更新调查范围、鸟类分布区域和相对数量以及调查报告等相关数据, 定期发布的BBS年度报告会对当年和总

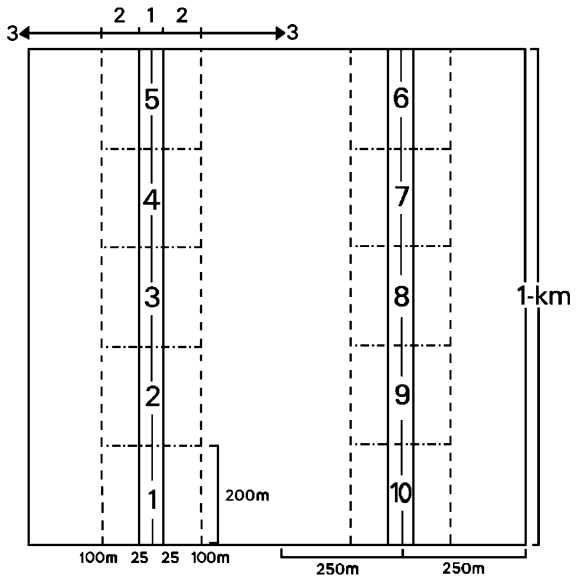

图1 繁殖鸟类调查的理想路线示意图: 每个1 km^{2}调查样方包含两条平行的南北或东西走向的长度为1 km的调查样线。两条样线相隔500 m, 离边界250 m。每条样线分割成200 m长的5段, 以1–10进行标记。在每段路线中志愿者按照三个距离区带记录鸟类及其生境。

Fig. 1 Diagram of 'ideal' BBS route: each square should contain two parallel lines, north-south or east-west, each 1 km long. Transect lines should be roughly 500 m apart and 250 m from the edge of the square. Each transect line should be divided into five equal sections 200 m in length, numbered 1–10. Volunteers should record birds and their habitats in three distance bands. (Breeding Bird Survey, 2011)

的鸟类数量变化趋势予以总结和分析(Risely *et al*., 2009; Risely *et al*., 2010)。人们又进一步开发了TRIM(Trends and Indices for Monitoring data)软件, 以便对缺失数值的数据进行时序分析(the analysis of time series) (Pannekoek & van Strien, 1996), 并对英国繁殖鸟类调查的监测设计、取样策略和调查方法等一系列方法学上的问题予以详细概括(Gregory, 2000)。

随着该计划实施, 参加鸟类调查的志愿者和调查样方数亦不断增加。目前, 每年有3,000多名志愿者参加BBS计划的鸟类调查工作, 调查样方数达到3,500个左右。例如, 2009年, BBS计划共调查了3,243个样方, 记录到217种鸟类(Risely *et al*., 2010)。该计划的实施为研究鸟类数量和种群趋势分析等科学问题提供了大量的基础数据。

2.2　北美繁殖鸟类调查(BBS)计划与圣诞鸟类调查(CBC)计划

北美BBS计划于1966年启动。该计划组织志愿者在每年鸟类繁殖高峰期, 沿着公路开展鸟类调查。每条样线长39.43 km(24.5英里), 每隔805 m(0.5英里)设置1个记录点。在每个记录点, 调查者在3 min内按照样点法记录距调查者402 m(0.25英里)范围内的所有听到或者看到的鸟类个体。每次调查从太阳升起的1.5 h后开始, 持续记录5 h后结束(http://www.pwrc.usgs.gov/bbs/)。到目前为止, BBS计划在北美大陆已有4,100多条调查样线, 记录了400多种鸟类。调查得到的所有原始数据和超过420种鸟类的趋势估计等资料都可以从BBS网站下载(http:// www.pwrc.usgs.gov/bbs/dataentry/)。

圣诞鸟类调查于1900年启动, 至今已有110年。该计划在进行鸟类调查时, 需要调查人员在圣诞节前后数周内(一般从12月14日到翌年1月5日)的某一天调查一个直径为24.14 km(15英里)的圆形区域内的所有鸟类(Dunn *et al*., 2005)。在每一个调查区域内, 组织至少10个志愿者分成若干小组, 沿着预设的路线进行鸟类数量调查。该计划自实施以来, 已从最初的25个调查区域, 增加至2008年的2,124个, 并有超过5,000个志愿者参与此计划的野外调查工作(LeBaron, 2009)。目前, 北美CBC计划的调查区域已覆盖美国、加拿大、墨西哥、巴拿马, 以及哥伦比亚、哥斯达黎加和巴西等越来越多的美洲国家。

3　中国陆地鸟类监测现状与建议

综上所述, 大尺度的鸟类种类与数量动态监测是了解人类活动对生物多样性和生境影响及其动态变化的重要手段。欧美地区许多大尺度鸟类监测计划已经开展, 其取样策略、调查方法和数据管理与分析等方面都已逐步完善(Gregory, 2000; Bart, 2005; Voříšek *et al*., 2008), 但由于中国鸟类学研究起步较晚(郑光美, 1981, 1995), 并受人力和财力限制等诸多因素的影响, 使得中国至今未能实施任何大尺度的陆地鸟类监测计划。

1996–2000年期间, 我国在全国范围内开展了陆生野生动物资源调查, 亦制定了《全国陆生野生动物资源调查与监测技术规程》。但该调查存在着设计与方法选用不合理、调查目标与方法选用不衔接、只关注保护和受胁物种、调查目标设定上只关注资源量、各门类与物种间的调查方法和时间与季节的不协调、技术力量与资金不足, 以及缺乏长期监测计划与实施能力等一系列问题, 使得我国在进行全国范围内的陆生野生动物资源调查过程中, 亦未能实施大尺度的长期鸟类监测计划。目前, 新一轮的全国陆生野生动物资源调查项目即将全面展开。为了有效推进我国陆地鸟类监测计划, 笔者依据国际各类陆地鸟类种类与数量监测计划的成功经验, 特提出以下建议:

(1)国家相关部门应在关注保护和受胁物种, 开展陆生野生动物资源调查的基础上, 关注常见鸟类的调查与监测, 积极组织专家制定出符合我国实际的中国繁殖鸟类监测计划, 即中国BBS(Chinese BBS)计划, 以及相应的监测技术标准。虽然国际上的长期鸟类监测项目一般由相关的NGO(如英国的BTO)负责项目的实施和经费的筹集, 但基于我国各类与鸟类相关的NGO发展之现状, 我国应以行政主管部门为主体、以中国动物学会鸟类学分会等学术团体与机构为技术依托, 组织与协调全国的鸟类学工作者、观鸟爱好者和志愿者共同参与, 实施中国BBS计划。经不断完善后, 相关的NGO逐渐过渡为监测计划的主体, 组织和协调整个计划的实施。

(2)制定合理的取样策略, 选用可行的调查方法。取样策略和野外调查方法是陆地鸟类调查与监测计划技术规范的核心, 它们将会对调查数据的科学性和最终结果的可靠性等产生直接影响。英国

CBC计划让志愿者自由选取调查样方使得调查区域主要集中在英国南部, 导致调查结果产生较大的偏差。我国是一个生境类型多样的国家, 专业技术人员和观鸟爱好者的数量相对较少且分布不均。因此, 建议采用英国BBS计划的取样策略, 依照各个省(或地区)的观鸟志愿者人数进行分层随机抽样获取一定数量的样方, 结合样线法和样点法进行样方内的鸟类调查。

(3)统一数据格式, 组建信息共享平台。北美地区目前鸟类调查项目众多, 其取样策略和调查方法以及关注的鸟类物种也不尽相同, 相互之间缺乏统一的标准, 使这些项目的数据和后续结果无法共享(Bart, 2005)。随着信息化时代的来临, 网络共享平台已在鸟类监测计划的数据管理、分析和共享中扮演着越来越重要的角色。例如, 英国BBS网站在2003年开通以后, 极大地方便了志愿者在线提交和浏览调查记录结果, 便于向公众公布所有鸟类物种在不同尺度上的数量以及分布情况(Noble, 2008)。因此, 在实施中国BBS计划开展大尺度鸟类监测工作之前, 我们应该统一鸟类记录表格, 编制统一的鸟类代码和生境代码, 保证在后期的数据共享中能够整合。在此基础上, 进一步以相关专业机构为依托, 构建中国BBS信息共享平台。

(4)充分利用志愿者的力量, 实施中国BBS计划。纵观国际各类鸟类监测计划的实施状况可知, 众多志愿者的参与是大尺度鸟类监测项目完成的前提, 也使这些项目具有公民科研(citizen science)的性质。由于中国幅员辽阔、地貌多变, 仅仅依靠我国的专业鸟类研究人员, 难以有效实施全国性的长期鸟类监测计划。随着我国经济和社会的不断发展, 国内的观鸟爱好者数量亦不断增加, 各地纷纷成立各种类型的观鸟协会。因此, 各相关部门、学术团体和鸟类学工作者应关心和积极推动各地各类的观鸟组织与社团的发展, 进一步壮大观鸟爱好者的队伍。在此基础上, 以中国BBS计划及其监测技术标准为指导, 组织专家对志愿者进行适当培训, 能够让志愿者在完成鸟类调查之后按照统一的数据格式在信息共享平台上提交调查所得的数据, 以逐步推进中国BBS计划的实施。

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