Chapter 17
Networking Networks for Global Bat Conservation

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Abstract Conservation networks link diverse actors, either individuals or groups, across space and time. Such networks build social capital, enhance coordination, and lead to effective conservation action. Bat conservation can benefit from network approaches because the taxonomic and ecological diversity of bats, coupled with the complexity of the threats they face, necessitates a wide range of expert knowledge to effect conservation. Moreover, many species and issues transcend political boundaries, so conservation frequently requires or benefits from international cooperation. In response, several regional bat conservation networks have arisen in recent years, and we suggest that, with the globalization of threats to

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bats, there is now a need for a global network to strengthen bat conservation and provide a unified voice for advocacy. To retain regional autonomy and identity, we advocate a global network of the regional networks and develop a roadmap toward such a meta-network using a social network framework. We first review the structure and function of existing networks and then suggest ways in which existing networks might be strengthened. We then discuss how regional gaps in global coverage might best be filled, before suggesting ways in which regional networks might be linked for global coverage.

17.1 Introduction

Individuals have formed groups to address conservation issues for decades, but with the application of network theory to social settings, we can now gain insights on the consequence of the structure of conservation-oriented groups for group function. Networks comprise nodes that are linked together by some form of interaction. In social networks, nodes (or actors) are typically individuals, but they may also be groups or entities in their own right, linked by relationships that typically reflect socially oriented values such as friendship, reputation, altruism, and reciprocity (Fig. 17.1).

Conservation networks link actors involved in conservation activities across space (Guerrero et al. 2013). A network may be specifically formed to address a management objective, or arise organically and informally through stakeholder interactions. Interest in network approaches to conservation and natural resource governance (e.g., Bodin and Prell 2011) has been precipitated by the growing realization that top-down centralized approaches often fail to engage stakeholders, are rarely adaptive to local conditions, and as a consequence often fail to achieve sustainable conservation outputs (Bodin and Crona 2009). Regardless of the specific issue, conservation networks have three implicit objectives: (i) The network builds *social capital* [information, resources, knowledge, connections held by the group (Putnam 2000) or individual actors (Portes 1998)] (Newman and Dale 2007); (ii) the network strengthens relationships among activities in a system such that their common effectiveness is enhanced (*coordination*—Hessels 2013); and (iii) that the increase in social capital and coordination will have *agency* (Newman and Dale

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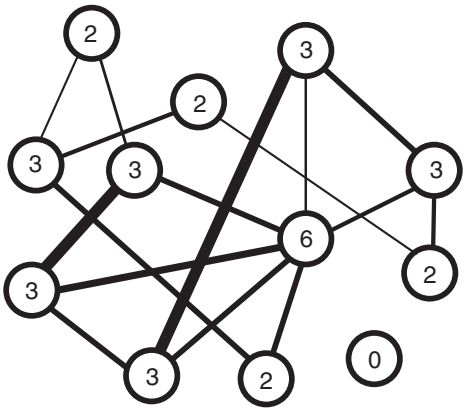

Fig. 17.1 A simple social network. *Circles* are nodes (or actors) connected to one another by links (*straight lines*), also called vectors. Links may be bi- or unidirectional and can be weighted by the strength of the connection between nodes, depicted here by link thickness. Bidirectional links may differ in strength (weight) with direction, for example, if a local coordinator in a bat conservation network commonly sends more information out than she receives, but this has been omitted for clarity. The number of links connected to a node is the degree centrality, shown here within each node. The mean degree for this network is 2.67, and the network density is 0.24 (16/66)

2007), i.e., ability of a group to turn social capital derived from the network into conservation action.

Bat conservation may be facilitated by network approaches for several reasons. First, conservation networks can be particularly effective in dealing with issues operating at multiple spatial and temporal scales and thereby preventing mismatches between the scale at which conservation actions are undertaken and that of the problem (Guerrero et al. 2013). Bat conservation is susceptible to scale mismatches in both space and time. From a geographical perspective, coordinated effort across political boundaries may be required to ensure species' protection across their entire range and to manage migratory species. The Agreement on the Conservation of Populations of European Bats (UNEP EUROBATS), which came into force in 1994, was set up under the Convention on the Conservation of Migratory Species of Wild Animals (CMS), precisely for these reasons. Thirty-five of the 63 range states have acceded to the Agreement, which aims to protect all 52 species of European bats. In the Paleotropics, larger Pteropodidae are known to move across borders [e.g., *Eidolon helvum* (Richter and Cumming 2008), *Pteropus* spp. (Epstein et al. 2009; Breed et al. 2010)], while the continuous north–south latitudinal orientation of the Americas has promoted seasonal migration across borders in several genera (Popa-Lisseanu and Voigt 2009). Stable taxonomy is essential for conservation (Tsang et al. 2015) and similarly may require international cooperation to resolve taxonomic conundrums and test systematic hypotheses of taxa distributed across multiple countries (e.g., Ith et al. 2011). Commercial trade in *Pteropus* spp. for human consumption and traditional medicine has imperiled

many species, particularly in the Pacific Islands and western Indian Ocean Islands (Mickleburgh et al. 2009; Mildenstein et al. 2016). Although one *Acerodon* and 10 species of *Pteropus* are listed under Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the remainder together with *Acerodon* spp. on Appendix II (June 2014), illegal trade will likely continue without coordinated international enforcement among parties.

From a temporal standpoint, because bats are long-lived (Wilkinson and South 2002) decades of observations/monitoring may be required to detect population numbers responding to disturbance or management (Meyer et al. 2010). Moreover, long-term efforts deploying standardized methods across funding cycles and staff turnover require substantial training and coordination. The UK's National Bat Monitoring Programme was established in 1996, but it took a further 15 years of work before statistically robust population trends could be estimated, and then for "only" 10/11 of the UK's 17 breeding species (Barlow et al. 2015). The enormous citizen science effort is spearheaded and coordinated by the Bat Conservation Trust (BCT), a network of 100+ local bat groups. In addition, long-term social or political change may be needed to address particular threats to bats, particularly if the threat is embedded in cultural practices or superstitious beliefs (Kingston 2016).

Second, the social capital and coordination brought by a network approach are important because bats are so diverse taxonomically and ecologically that few practitioners can hold knowledge of more than a handful of species; most researchers are taxonomically or geographically limited. Similarly, varied skill sets are required to garner the basic knowledge that underpins conservation efforts (e.g., taxonomy, ecology, acoustics, genetics and phylogenetics, population monitoring, disease ecology, outreach/engagement, policy), and many issues require an integrative approach to conservation action. Finally, bat research expertise is patchily distributed in many parts of the world, residing in particular institutes within countries, or absent entirely from some countries. Connecting experts through a network accelerates both knowledge transfer among them and the development of capacity in underrepresented areas.

Given the potential for networks to coordinate and strengthen bat conservation, it is not surprising that several bat networks have evolved over the last 25 years. The purpose of this chapter is to review the structure and function of existing bat conservation networks and to discuss the ways in which application of social network theory might strengthen existing networks, facilitate the establishment of new networks, and ultimately guide efforts to link regional networks into a global network of networks.

17.2 Existing Bat Conservation Networks

We focus our review on networks that have conservation as a primary mission and that encompass two or more countries, namely Agreement on the Conservation of Populations of European Bats (UNEP EUROBATS); the Australasian Bat

Society (ABS); Bat Conservation Africa (BCA); BatLife Europe; BCT; Chiroptera Conservation and Information Network of South Asia (CCINSA); North American Bat Conservation Alliance (NABCA); Red Latinoamericana para la Conservación de los Murciélagos (Latin American Bat Conservation Network) (RELCOM); and Southeast Asian Bat Conservation Research Unit (SEABCRU) (Table 17.1,

Table 17.1 Summary information for existing bat conservation networks

Name (acronym)	Agreement on the Conservation of Populations of European Bats (UNEP EUROBATS)
Web presence	Web site: http://www.eurobats.org
Founded	1994
Geographical scope	63 range states (countries) of Europe, North Africa, and the Middle East
Structure	An agreement to which range states (countries) accede and thereby becoming parties. Working group substructure
Membership	35 range states have acceded of a possible 63
Communication	Electronic newsletter, Web presence, annual Meeting of the Advisory Committee (AC), four-yearly Meeting of the Parties to the Agreement. Inter-sessional working groups report to AC, resulting documents published/available on Website
Leadership	EUROBATS is now part of the United Nations Environment Programme and is administered by an executive secretary, with a small administrative staff. An Advisory Committee (AC) comprising invited representatives from range state government departments, Statutory Nature Conservation Organizations (SNCOs), NGOs, and observers meets annually to prepare resolutions for adoption by parties to the Agreement (the signatory governments) who meet every four years
Funding	Member states pay an annual subscription. EUROBATS established the separately funded European Projects Initiative to provide grants of up to 10,000 Euros
Mission and objectives	(1) Exchange information and coordinate international research and monitoring initiatives; (2) arrange the Meetings of the Parties and the Advisory and Standing Committee Meetings; (3) stimulate proposals for improving the effectiveness of the Agreement and attract more countries to participate in and join the Agreement; (4) stimulate public awareness of the threats to European bat species and what can be done at all levels to prevent their numbers dwindling further
Primary activities	(1) The fifteen intersessional working groups produce authoritative reports which help to inform conservation practice. (2) The annual Meetings of the Advisory Committee, in addition to providing valuable opportunities for exchanging ideas about best practice in bat conservation, produce resolutions which are presented to and generally adopted by the four-yearly Meeting of the Parties. An example is the resolution on rabies, the full text of which appears on the Web site, which urged signatories to the Agreement which had not already done so, to introduce surveillance programs. That was successful and several more range states introduced such programs. (3) European Bat Night is an annual awareness-raising activity. (4) The Year of the Bat 2011–2012 was introduced initially as a European Initiative but quickly went global

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Table 17.1 (continued)

Name (acronym)	Agreement on the Conservation of Populations of European Bats (UNEP EUROBATS)
Major successes	The commitment of 35 European governments to conserve bat populations
Name (acronym)	Australasian Bat Society, Inc (ABS)
Web presence	Web site: http://ausbats.org.au/. Facebook: Australasian Bat Society, e-mail Discussion List, Twitter, YouTube uploads
Founded	1992 (origins 1964)
Geographical scope	Australasia: Australia, New Zealand, Melanesia
Structure	A conservation society with an elected executive team, plus various subcommittees and formalized positions that are created as required
Membership	Researchers, environmental consultants, wildlife rehabilitators, advocates, land managers, naturalists, and educators c. 350 members
Communication	Biennial conference, biannual newsletter, Web presence, quarterly executive meeting, and e-mails (online)
Leadership	Executive committee elected by membership for 2-years term. Comprise President and 2 VPs, Secretary, Treasurer, Editor, Membership Officer. Advisory "extended executive" of past office bearers and helpers. Informal positions—public officer, bat night coordinator, communications officer, social media officer, sponsorship officer, conservation officer, media spokesperson
Funding	Membership subscriptions, conference registrations and sponsorship, advertising in newsletter, account interest, donations, fundraising events
Mission and objectives	*Mission* "To promote the conservation of all populations of all species of bats in Australasia." *Objectives* Encourage membership, disseminate information and outreach materials, advocate for bat conservation and management by advising decision makers, encourage bat research, fund raising, organize biennial conference, build relations and work with other organizations, promote ethical and humane practices in study of bats, support carer and rehabilitation organizations, maintain a public fund for donations
Primary activities	Biennial research conference and workshops, liaising with Local and State Government on issues of bat management and conservation (e.g., flying fox dispersals, bats in mines and bridges, threatened species), produce fact sheets and position statements about bat–human conflict issues (e.g., shooting as control method for flying foxes), media statements on selected issues, survey standards, assist all levels of Government with their information and policy documents, community education events ("Bat Nights" talks and walks)
Major successes	Input to Government policy—Guidance Notes, Action Plans, Conservation Status listings, threatened species survey guidelines. 16 well-attended biennial conferences. 42 editions of newsletter since 1993, plus other similar periodicals since 1964, integration of wildlife carers, significant promotion of bats to the public
Name (acronym)	BatLife Europe
Web presence	Web site: http://batlife-europe.info. Facebook: BatLifeEurope
Founded	2011

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Table 17.1 (continued)

Name (acronym)	BatLife Europe
Geographical scope	Europe and North Africa
Structure	Country-based network comprising national conservation NGOs ("partner organizations"), usually 1 per country. 33 partners from 30 countries (2013)
Membership	NGOs involved in bat conservation, but not necessarily exclusively so. Membership to NGOs open
Communication	Newsletter, Web presence, triennial conference (European Bat Research Symposium). Trustees meet up to 6× per year online
Leadership	Board of 14 trustees nominated and elected by partner organizations every three years at a meeting of partners at the European Bat Research Symposium. The Board is run by the Chair, with support from the Vice Chair, Secretary, and Treasurer
Funding	Partner NGOs pay an annual subscription or are sponsored by another member. Small grants
Mission and objectives	To promote the conservation of all wild bat species and their habitats throughout Europe, for the benefit of the public. Objectives focus on the following: (1) communication and knowledge sharing; (2) identifying priorities for action; (3) developing projects; and (4) building capacity and international support
Primary activities	Member of the European Habitats Forum seeking to influence European environmental policies, active within the Eurobats Agreement. Disseminates knowledge and experience to build capacity across network (workshops planned). Working on development of a European biodiversity indicator based on bat hibernation surveillance data
Major successes	Bringing together 33 NGO's to form the network. Capacity building survey completed to guide development actions. Contributed to the Pan European Indicator and the European Union Bat Action Plan

Name (acronym)	Bat Conservation Africa (BCA)
Web presence	Web site: http://www.batconafrica.net. Facebook: Bat Conservation Africa Google Listserv: batconafrica@googlegroups.com
Founded	2013
Geographical scope	Africa and the island nations of the western Indian Ocean
Structure	Organized around six regions (southern, eastern, central, western, northern Africa, and western Indian Ocean Islands)
Membership	Individuals joining the list serve, c. 80 members from 25 countries
Communication	List serve and e-mail
Leadership	Steering Committee of representatives from each region, led by a Chair and Vice Chair selected by the Steering Committee. External Advisory Committee to be established
Funding	
Mission and objectives	*Vision* Bats and humans live in harmony in Africa. *Mission* To create a platform for the promotion of bat conservation in Africa. *Objectives* (1) Establish a platform for information sharing; (2) capacity building-skills transfer, education and training, leadership, resources; (3) identify and promote regional conservation priorities; and (4) identify and respond to knowledge gaps on African bats

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Table 17.1 (continued)

Name (acronym)	Bat Conservation Africa (BCA)
Primary activities	Current emphasis on establishing network operations and lines of communication. Future emphasis on meeting objectives with targeted activities
Major successes	

Name (acronym)	Bat Conservation Trust (BCT)
Web presence	Web site: www.bats.org.uk. Facebook: Bat Conservation Trust. Twitter @_BCT_, LinkedIn Forum
Founded	1990
Geographical scope	England, Wales, Scotland, Northern Ireland (UK)
Structure	Networks c. 100 local Bat Groups
Membership	5600 members including members of the public, volunteers, ecologists and environmental consultants, government workers, academics and teachers
Communication	Newsletters (adult and youth), monthly e-bulletins (general, bat workers, National Monitoring Programme), Web presence, annual national conferences, and separate annual conferences/forums in Scotland and Wales. Regional meetings biennially
Leadership	BCT is a fully constituted NGO and registered charity and must conform to the regulations of the Charity Commissioners in England and Wales and the Office of the Scottish Charity Regulator in Scotland. It is governed by a board of 12 trustees with elected officers. The board appoint the CEO. There are presently 30–35 staff
Funding	Donors, government conservation agencies, charitable trusts and foundations, Heritage Lottery Fund, contracts for service provision (e.g., National Bat Helpline), fees for conferences and training, membership fees, donations from public and major donors
Mission and objectives	*Vision* A world where bats and people thrive together in harmony. *Mission* To secure the future of bats in a changing world. Key objectives that lead work conducted—*Discover* To establish the capacity of the landscape to support viable populations of bats. *Act* To secure and enhance bat populations to the full capacity of the landscape. *Inspire* To win the level of support required to achieve and maintain these bat populations
Primary activities	Monitoring bats, conservation research, landscapes for bats, buildings, development and planning, biodiversity policy and lobbying, training and best practice for professionals, bat crime investigations, education and engagement
Major successes	Establishing and growing the National Bat Monitoring Programme (trends for 10 of UK's 17 breeding species). Lead on Biodiversity Action Plans for bats, which led to targeted advice for buildings industry and woodland managers, and establishment of bat crime investigations, and a training program for professionals whose work affects bats. Public education effectively changed people's attitudes to bats in UK

Name (acronym)	Chiroptera Conservation and Information Network of South Asia (CCINSA)
Web presence	Web page: www.zooreach.org/Networks/Chiroptera/Chiroptera.html

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Table 17.1 (continued)

Name (acronym)	Chiroptera Conservation and Information Network of South Asia (CCINSA)
Founded	1999
Geographical scope	South Asia (Bangladesh, Bhutan, India, Nepal, Maldives, Pakistan, Sri Lanka and Afghanistan)
Structure	None
Membership	Academic, government, NGO, teachers, volunteers c. 270 members
Communication	Newsletter
Leadership	Founded and run by Sally Walker with help from staff and President invited by her
Funding	Support for workshops from Zoo community, plus other small grants
Mission and objectives	*Mission* To encourage and promote the study of bats of South Asia, by organizing and running a network of bat specialists, and to provide them useful services. *Objectives* (1) To maintain a check list and database of bats; (2) implement a program of bat research training workshops; (3) develop and disseminate outreach materials; and (4) lobbying for the protection of bats
Primary activities	Organizing and conducting workshops on techniques for studying bats, lobbying for specific causes by contacting appropriate governmental departments
Major successes	Development of bat conservation community in S Asia, 9 workshops with 251 participants. Established Pterocount, a program using volunteers to monitor local populations of *Pteropus giganteus*. Successful public education program and dissemination of outreach materials. Successfully lobbied to get two threatened bats moved from Schedule V ("vermin") to Schedule I (absolute protection) of the Indian Wildlife Protection Act 1972

Name (acronym)	North American Bat Conservation Alliance (NABCA)
Web presence	Facebook: North American Bat Conservation Alliance
Founded	1997 as North American Bat Conservation Partnership, 2008 as Alliance, relaunched 2013
Geographical scope	Canada, USA, Mexico
Structure	A federation of working groups and organizations in North America
Membership	Working groups and organizations involved in bat conservation. Membership to working groups open. c. 500 individuals
Communication	Annual open meeting at varied national or international professional meetings (2014 onward), tied biennially to North American Society for Bat Research meeting. Monthly conference calls among organizing committee. List serves with quarterly summaries (planned)
Leadership	Organizing committee comprising representatives form member organizations and working groups. Leadership to rotate between USA, Canada, Mexico
Funding	
Mission and objectives	To promote the conservation of bats in North America by facilitating collaboration, coordinating priorities, and elevating awareness, for the benefits of bats, people, and their ecosystems

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Table 17.1 (continued)

Name (acronym)	North American Bat Conservation Alliance (NABCA)
Primary activities	Facilitating communication among bat working groups across North America, developing conservation priorities, and assisting the bat community in addressing important issues impacting the conservation of North American bats
Major successes	List of conservation priorities completed. Trilateral agreement to promote cooperation in the conservation of bat populations in North America. Letter of Intent signed by representatives of Environment Canada, secretariat of the Environment and Natural Resources for the United Mexican States, and the Fish and Wildlife Service of the USA, April 2015

Name (acronym)	Red Latinoamericana para la Conservación de los Murciélagos [Latin American Bat Conservation Network) (RELCOM)]
Web presence	Web site: http://www.relcomlatinoamerica.net/. Blog: http://reddemurcielagos.blogspot.com/. Facebook: Relcom Murciélagos. iNaturalist: (http://www.inaturalist.org/projects/murcielagos-de-latinoamerica-y-el-caribe): Groups: Yahoo RELCOM. Twitter: @Relcom
Founded	2007
Geographical scope	Latin America and the Caribbean
Structure	Country-based network constituted by local Programs for Bat Conservation (PCMs), one program per country. 5 countries at foundation, 22 countries currently
Membership	1 PCM per country, but PCM membership open to all interested in bat welfare, large academic membership. c. 800 people
Communication	Quarterly newsletter, Web presence, biennial conference (since 2014), subregional initiatives (e.g., Central and South America)
Leadership	Acting General Coordinator (AGC) elected by 51 % majority of voting members, one from each PCM, during General Assembly. Serves 3 years. AGC appoints a board of directors with individual responsibilities for research, conservation, and education. Board also includes Elected GC and Past GC. Governed by Bylaws approved by General Assembly
Funding	Donors support General Assembly. PCM's generate local funding, apply for national and international academic and conservation grants, sell merchandizing and have membership contributions
Mission and objectives	Guarantee the persistence of healthy bat species and viable populations in Latin America and that in all the countries their importance is acknowledged and recognized. *Research* Promote and stimulate the generation of scientific knowledge that contributes to the conservation of bats and their habitats. *Education and public outreach* Spread the knowledge about bats over the civil society and involve local people in their conservation. *Conservation* Promote the implementation of specific actions and policies aimed at preserving the species and bat populations in Latin America
Primary activities	Promotion and designation of Important Bat Conservation Areas/ Sites. Conservation research projects. Task force for rapid response to problems associated with vampire bats and rabies. Public outreach supported by traveling education kit. Capacity building within and outside PCMs

(continued)

Table 17.1 (continued)

Name (acronym)	Red Latinoamericana para la Conservación de los Murciélagos [Latin American Bat Conservation Network) (RELCOM)]
Major successes	Creation and consolidation of Important Bat Conservation Areas/ Sites. Publication of action plans for threatened species. Delisting of *Leptonycteris yerbabuenae* reflects the success of conservation action by one of RELCOM associates from Mexico (PCMM)
Further reading	Aguirre et al. (2014)
Name (acronym)	Southeast Asian Bat Conservation Research Unit (SEABCRU)
Web presence	Web site: http://www.seabcru.org. Facebook: Southeast Asian Bat Conservation Research Unit (SEABCRU)
Founded	2007
Geographical scope	SE Asia: Brunei, Cambodia, East Timor, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, Singapore, Vietnam
Structure	Organized around four conservation priorities—flying foxes, cave bats, forest bats, and taxonomy and systematics
Membership	Open to all interested in SE Asian bats, core membership comprises those with research background c. 400
Communication	Web site, Facebook, conferences, workshops
Leadership	Led by Principal Investigator while supported by NSF, with Steering Committee comprising experts in the priority research areas (2–3 per priority) from SE Asia, USA, UK. Steering Committee supported by student teams from USA and SE Asia (3–4 per priority)
Funding	Established with funds from BAT Biodiversity Partnership. 5-years grant from US's National Science Foundation (NSF) as a Research Coordination Network (2011–2016)
Mission and objectives	*Mission* To provide an organizational framework to coordinate and implement research, capacity building, and outreach to promote the conservation of Southeast Asia's diverse but threatened bat fauna. *Objectives* under NSF funding: (1) Effect a regional assessment of the distribution, abundance, and status of SE Asian bats through the implementation of research activities centered on the four priority areas. The SEABCRU network will develop standardized research protocols for each priority and train Southeast Asian bat researchers in the protocols through a series of workshops. (2) Recruit students and researchers to the SEABCRU, engage them in the research priorities, promote effective international communication, and stimulate collaboration
Primary activities	Conferences and expert workshops to develop protocols, training workshops to build capacity across the region. Establish a regional database for bat locality data. Online community of practice
Major successes	Protocols for research rolling out in 2015. 3 international conferences organized, international workshops in Thailand (2012), Cambodia (2013), Myanmar (2014), Vietnam (2014)
Further reading	Kingston (2010), Kingston et al. (2012)

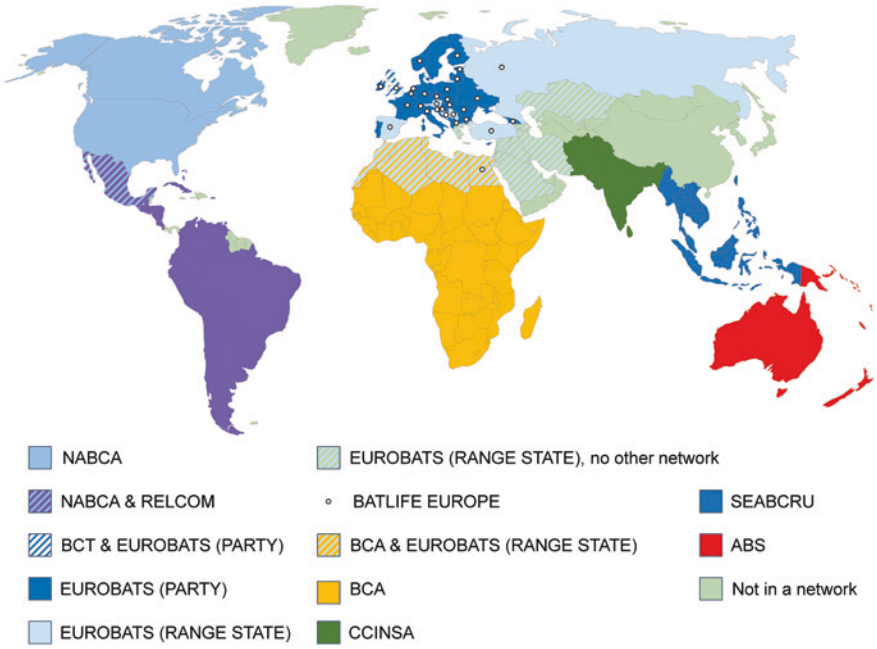

Fig. 17.2 Map of the world with coverage provided by existing bat conservation networks. Countries that are not within a network are filled with *light pink*. Note that some networks require active membership of nations, so countries may fall within the geographic scope of a network but not be members (RELCOM, EUROBATS, BatLife Europe). For networks based on individual membership, geographic scope is illustrated (*BCA*, *CCINSA*, *SEABCRU*, *ABS*). Network acronyms as in Table 17.1

Fig. 17.2). We recognize that there are a growing number of very active national networks (e.g., Asian Bat Research Institute, Bat Association of Taiwan, Bat Study and Conservation Group of Japan, and Indian Bat Conservation Research Unit), as well as NGOs such as Bat Conservation International (BCI) and the Lubee Bat Conservancy, discussed in Racey (2013). The IUCN Bat Specialist Group has a global network structure, but its primary role is to provide member expertise to the IUCN in support of Red List assessments and the development of Action Plans (e.g., Mickleburgh et al. 1992; Hutson et al. 2001). In addition, the North American Society for Bat Research (NASBR) is a large and active network, but the Society's mission is the promotion and development of the scientific study of bats, which it achieves by organizing an annual symposium. Although scientific study extends to conservation and public education, and the society puts forth resolutions on conservation issues, conservation is not the primary focus of the network, so is not included in this review. Together, our focal eight conservation networks unite bat researchers and conservation practitioners in over 130 countries, but major gaps persist and geographical coverage within networks is heterogeneous. Despite active national groups in Japan and Taiwan, as a region East Asia

lacks coverage, as does Central Asia, the Middle East (although Israel, Jordan, Lebanon, Syria, and Saudi Arabia are included as range states within EUROBATS and BatLife Europe), and much of the Russian Federation.

17.2.1 Commonalities of Existing Networks

17.2.1.1 Origins and Activities

Most of the networks were founded as a response to the prevalence and intensity of threats to bat populations, lack of scientific knowledge about bats to support conservation action and changes to public policy, and to combat the contribution of public antipathy or ignorance to bat conservation issues. The common overarching goal in all cases is to halt declines and support sustainable populations. To achieve this goal, common foci or organizational themes are research, education/outreach, and conservation. In regions with few bat researchers, or high variance in expertise, research also encompasses building local academic and sometimes volunteer capacity to implement research, typically through workshops and development and sharing of guidance documents (e.g., CCINSA, RELCOM, SEABCRU, BatLife Europe, EUROBATS).

Most networks see themselves as providing a regional organizational framework, guiding or coordinating local activities, and facilitating transboundary communication and capacity building. They aim to realize broader-scale impacts and identify priorities for action at larger scales (NABCA, SEABCRU, RELCOM, BatLife Europe, EUROBATS). Several networks are also instigating, or already implementing, region-wide initiatives, with particular focus on surveying and monitoring populations (BCT, NABCA, RELCOM, SEABCRU, BatLife Europe), data collation and storage (SEABCRU, BatLife Europe, BCT), and evaluation and priority-setting of species, habitats, and threats (all).

Several networks play a direct role in policy development and implementation. In some cases, individuals or groups representing the network act as advisors to governments, in others the network directly lobbies decision makers. Because of its conspicuous foundation in published science and other scientific activities, the ABS has had a strong advisory role at all levels of Government in Australia, having major input into guidance notes (the information used to assess major development proposals by Government), producing action plans and associated recommendations for Conservation status listing, and survey guidelines for threatened listed species, and making submissions to parliamentary inquiries. As a member of the Wildlife and Countryside Link, BCT regularly contributes to joint responses on bat-relevant issues to government bodies, while EUROBATS is a network of parties to an agreement directly influencing conservation policy, as it pertains to bats, in member states. Networks may also take a more direct lobbying approach. CCINSA has been working for years to move India's fruit bats from Schedule V of the Wildlife Act of India 1972, which defines them as vermin

that can be exterminated without legal penalty. Two threatened species were afforded protection (moved to Schedule I), but the influence of the agricultural lobby has kept the remaining 12 species on Schedule V (Singaravelan et al. 2009). RELCOM has been lobbying for the creation and acquisition of legal status of Areas and Sites of Importance for the Conservation of Bats across Latin America (see Sect. 17.4.1) and promoting the implementation of bat conservation action plans.

17.2.1.2 Structure and Membership

Most of the networks exhibit substructure. In many cases, independent subgroups hold membership to the network. These are national Bat Conservation Programs (PCMs) in RELCOM, national conservation NGOs in BatLife Europe, range states in EUROBATS, local bat groups in BCT, and regional working groups in NABCA. Thematic structure is seen in some networks. SEABCRU is organized around four conservation priorities; the ABS has subcommittees addressing flying fox issues, outreach and education, and a small-grants program; EUROBATS has intersessional working groups, reporting on key conservation issues (15 currently); and RELCOM is implementing key strategies organized by subregion (e.g., Central and South America). Individual membership is varied, whereas some networks formed around a core of bat researchers in academic settings (SEABCRU, RELCOM), others have greater representation of members from NGOs (BatLife Europe), Statutory Nature Conservation Organizations/Agencies (SNCOs) and government departments (NABCA, EUROBATS), volunteer members of the public (BCT), or a combination (ABS, BCA). As networks mature, membership tends to diversify. The ABS was founded by bat researchers as a scientific society in 1992 (with an informal origin associated with a research newsletter launched in 1964), but now includes members from universities, government, other conservation societies, and private industry.

17.2.1.3 Challenges to Network Sustainability

By far the greatest challenge to network scope and sustainability is funding. Outside Europe, the networks do not have a paid staff or executive (with the exception of a small staff in CCINSA) and are run by volunteers. While volunteer origins and membership often confer network strength (Bodin and Crona 2009), time constraints can slow or limit responses to new challenges. Moreover, although several networks have a core of conservation researchers that remains relatively stable, as network activities can to some extent be integrated with their research agenda, there may be high turnover of volunteers involved with local activities (outreach programs, surveys etc.). Maintaining or rebuilding capacity because of volunteer turnover is a challenge, e.g., for PCMs within RELCOM.

Generally, it is a lot easier to attract funding for specific projects and programs than for staff or volunteer compensation, but these projects may be short term and tied to specific areas. Conservation solutions that require long-term monitoring with standardized methodologies (mandatory for statistical inference of success or failure of interventions) often lack "innovation appeal" to referees and funding organizations. Access to core or unrestricted funding which can be used for key strategic work, or to maintain basic network administration, is hard to secure. BCT has managed to grow its unrestricted income through donations, membership, legacies, and community fundraising, with some success, but this takes time and investment, and can be hard to maintain during periods of economic downturn. Ironically, while lack of protective legislation hampers conservation progress for some networks, protective legislation can lead to negative attitudes toward bats in other areas, particularly during recessions when protection of species can be seen as a barrier to economic growth. In addition, perceived "exaggerated" bat protection efforts can lead to reluctance among citizens to admit to the occurrence of bats in their property at all, for fear of losing partial control over their property.

In a social network, links between actors are almost entirely based on forms of communication, so mechanisms for communication (from face-to-face to online contact) are critical for the success of a network, particularly when members are geographically dispersed. All the bat conservation networks have a Web presence for interaction and/or issue newsletters, and many have regular face-to-face meetings, but gaps in communication can cause network stress, particular when node diversity is high (i.e., members come from many different backgrounds and perspectives). Effective communication is critical if network members differ in their position on a key issue. For example, tensions between the core actors in BCT and supporters and volunteers in 2006 over BCT's stance on a government study of rabies in bats generated very strong concerns (Racey et al. 2013). This led to a review and new model of working with volunteers (partner and network agreements, regular meetings and communication) which proved very beneficial.

17.3 What We Can Learn from Theories of Network Structure and Function

17.3.1 Network Structure and Function

Network functioning describes the process by which certain network conditions lead to various network-level outcomes (Provan and Kenis 2008). Network structure influences individual and group agency, that is, the ability of a group to turn social capital derived from the network into conservation action at the network level. Network structure can be thought of as a map of the relationships (links) between the nodes (actors) in the network. Not all actors are connected to each other. Degree centrality measures the number of links an actor has, and

betweenness centrality describes the extent to which an actor links actors that are otherwise disconnected (Burt 1992). The distribution of degree and betweenness centrality across the network is used to characterize network-level characteristics such as network density (number of existing ties divided by the number of possible ties—a measure of degree) and network centrality (variability in degree among network members) (Wasserman and Faust 1994). In general, a network with high density (one with many highly connected actors) (e.g., Fig. 17.3a) facilitates rapid transfer of knowledge and development of trust, is resilient to the loss of individual actors, and promotes collective action (Bodin and Crona 2009). High link density would therefore seem to be a desirable network characteristic. However, there can be trade-offs. Very high link density can lead to network homogenization and homophily. In a homogenized network, all nodes share similar knowledge and perspectives, which limits responses to novel problems, decreasing network resilience. Homophily describes the tendency for people to interact with individuals with characteristics similar to themselves, whether by preference or restricted opportunities (McPherson and Smith-Lovin 1987) and can lead to reluctance to interact with dissimilar others, promoting a "them versus us" environment (Newman and Dale 2005, 2007). Homophily can also restrict individual freedom (Portes 1998) and discourage dissenting opinions (Newman and Dale 2007). Homophily consequently hinders innovation by cutting off actors from needed information and imposing social norms that discourage innovation and inhibit links to dissimilar others (bridging ties).

More typically, the degree of individual actors varies quite widely. Centralized networks in which a few individuals are highly connected (Fig. 17.3b) similarly have benefits and costs. Central actors can prioritize and coordinate activities resulting in effective collective action (Sandström and Carlsson 2008), but this is most effective if problems are relatively simple and short-term. Long-term planning and more complex solutions require a more decentralized structure to access different knowledge and expertise more readily (Bodin and Crona 2009). Moreover, high network centrality can leave the network vulnerable to the removal or dysfunctionality of a few central actors, and to asymmetries of influence and power (Ernstson et al. 2008).

Betweenness (linking disconnected actors), also described as bridging (bridging links and bridging actors), is important in several regards. First, bridging links reduce the path lengths (shortest distance between actors) and network diameter (longest distance) and create "small world" networks (Watts 2003) that can lead to the rapid dissemination and penetration of ideas across the network. Second, bridging actors can connect disparate subgroups. The extent to which a network comprises cohesive subgroups is referred to as network cohesion or modularity (Bodin and Crona 2009) (Fig. 17.3d). Subgroups may hold different sets of knowledge and skills that can be vital to the resolution of a complex problem, but this expertise must be integrated across the network through bridging links. If subgroups are poorly connected (Fig. 17.3c), they can tend internally toward homophily and homogenization (Bodin and Crona 2009).

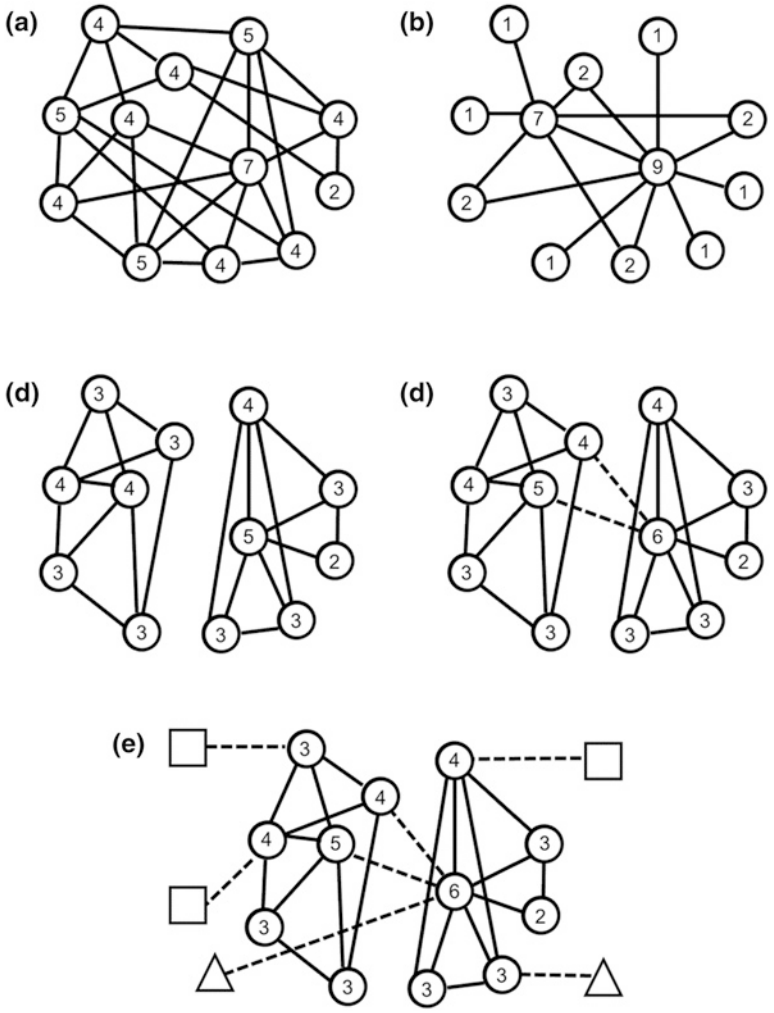

Fig. 17.3 Archetypal network configurations of the social network presented in Fig. 17.1. **a** A highly connected network, with no clear modularity (subgroups) (mean degree 4.33, network density 0.38). **b** A highly centralized network, in which two actors who are highly connected reducing mean degree (2.50) and network density (0.23). **c** Extreme modularity in which the network divided into two isolated subgroups. The subgroups are highly connected or cohesive (mean degree 3.33 and density 0.67). **d**. Network with high modularity with two distinguishable, cohesive subgroups, connected by bridging links (*dashed lines*). **e** Network with high modularity but connected subgroups (**d**) with peripheral ties to actors outside the network (*open squares* and *triangles*)

Just as the distribution of links between actors can vary across the network, the links themselves may vary both qualitatively (type of link) and quantitatively (strength). Links can be a form of communication, a collaboration, an agreement, knowledge, or data transfer. The strength of the link can be suggested by simple frequency counts (number of new joint conservation projects started), or more holistically as suggested by Granovetter (1973): "The strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, and intimacy (mutual confiding), and the reciprocal services which characterize the tie" (p. 1361). Actors linked by strong (or bonding) ties are more likely to influence one another, promoting mutual learning and sharing of resources but at the price of information redundancy and social "imprisonment" (Borgatti and Foster 2003). Weak or "bridging" ties promote the sharing of diverse information as they are usually between dissimilar others. On one hand, this promotes network resilience and adaptability to change, but on the other hand, these links may be broken more easily.

17.3.2 Structural Characteristics of Effective Conservation Networks: Within Subgroup Cohesion, Across Subgroup Collaboration, Bridging Actors, and Peripheral Actors

Given the trade-offs between network characteristics outlined above, is there such a thing as an "ideal" network structure for effective conservation? Recent reviews (Vance-Borland and Holley 2011; Mills et al. 2014) suggest that polycentric networks in which multiple, heterogeneous subgroups are linked by bridging ties maintain the greatest diversity of response options. Each subgroup has high within-group cohesion so is characterized by dense linkages (high degree centrality, strong or bonding ties) among people sharing specific knowledge that work together productively—enhancing knowledge development (Bodin et al. 2006; Bodin and Crona 2009). Within the network as a whole, there are multiple subgroups, which differ in the knowledge areas and expertise (subgroup diversity—Newman and Dale 2007), developing the diversity of knowledge held by the network as a whole (Bodin et al. 2006; Ernstson et al. 2008; Bodin and Crona 2009; Sandström and Rova 2010). Such functional diversity enhances network adaptability and resilience (Newman and Dale 2007; Mills et al. 2014), cultivates creativity (Aslan et al. 2014) and obviates internal turf battles in large networks (Reuf et al. 2003). Critical to network success are bridging relationships (actors with high betweenness centrality) among the diverse subgroups to promote sharing of expert knowledge and counter tendencies toward subgroup homophily. Network sustainability and adaptability are further enhanced if there are connections to actors outside the network (peripheral actors) who hold specialized knowledge, skills, or resources. Put simply, we can identify four network characteristics

indicative of success—within subgroup cohesion, across subgroup collaboration, availability of bridging actors, and inclusion of peripheral actors (Fig. 17.3e).

Network structure tends to evolve through time naturally as the goals of actors change, or the success of actors leads to greater engagement and linking. Structure and transitions can and often should also be managed more actively. For example, while diverse, polycentric networks may be a valid end-goal structure, centralized networks with a few highly motivated actors already connected to many others are good for the initial phase of forming groups (Olsson et al. 2004; Crona and Bodin 2006), and several of the bat networks began with a handful of well-connected actors (ABS, BCT, SEABCRU, and RELCOM). Once the network is more established, managed transitions can increase modularity and long-term decentralization. Moreover, during periods of stability, actors should be provided with opportunities to develop new relational ties with others, which can then be drawn upon in times of change (Olsson et al. 2006). Ideally, rather than simply increasing connectivity among all network members, inspection of network maps and data can be used to implement "network weaving"—the strategic development of new relationships among actors for their mutual benefit and to enhance overall network agency or response to a specific challenge (e.g., a new threat to bats) (Vance-Borland and Holley 2011).

17.4 Toward a Global Network of Networks

17.4.1 Do We Need a Global Network?

A global network of networks can certainly build social capital among bat researchers and conservationists, and facilitate knowledge transfer and capacity building. Moreover, the existing networks are diverse, collectively holding knowledge and skills that range from taxonomy to advocacy. Connectivity among networks could rapidly increase functional diversity, resilience, and adaptability of both individual networks and a global network of networks. It could also provide a platform to develop bridging ties to peripheral actors with greater expertise and skills in key areas, notably lobbying and environmental education. Such a meta-network could also provide a venue for discussion of issues at the global level and for explicit requests for assistance with critical issues. This assistance could be in terms of technical or strategic advice, or collaborative projects that combine resources for the common goal. But is there a need for global agency? We suggest that there are several sets of circumstances in which a global network might facilitate conservation efforts.

First, some issues are genuinely of global concern or can benefit from prioritization efforts at the global scale. For example, habitat loss is a global issue, and the use of standardized, objective criteria to identify critical biodiversity areas worldwide can galvanize and support protection efforts, and provide a basis for monitoring. The Important Bird Areas (IBAs) Program, initiated by BirdLife

International over 30 years ago, now comprises a network of over 10,000 IBAs and has had a major impact on the development of protected areas worldwide to ensure sustainable bird populations (BirdLife International 2008). RELCOM recently launched a similar program for bats in Latin America—Areas and Sites of Importance for the Conservation of Bats (Areas or Sitios para la Conservación (AICOMs/SICOMs) (Aguirre and Barquez 2013) and to date have identified 60 Areas and Sites, including 17 binational AICOMs. A coordinated initiative by a global network to develop this program worldwide could reap similar benefits for bat diversity, particularly if the network develops mechanisms to support and monitor protection of the sites after designation. Similarly, global priority-setting at the species level requires coordinated effort. While this remains the remit of the IUCN, problems arise integrating national evaluations with the global effort. Although the IUCN provides guidelines for the application of Red List criteria at regional and national levels (IUCN 2012), the guidelines and criteria are arguably difficult to apply where data are sparse, as is the case for many bat species. This has led to a proliferation of different national methods, even within regions [e.g., Aguirre et al. 2009—Bolivia, Sánchez et al. 2007—Mexico, US Endangered Species Act (ESA 1973, as amended)], which are difficult to integrate within and across regions. A global network could discuss and develop common criteria to establish the conservation status of bats at local and national scales, and provide a clearer link or integration to the global IUCN Red List assessments.

Second, several conservation issues that originated in certain areas are now "going global"—knowledge gained by regional networks could be vital for rapid responses in other parts of the world. For example, the impact of wind energy installations on bat populations has hitherto been of most concern and best studied in North America and Europe (Arnett et al. 2015). However, 103 countries used wind power on a commercial basis in 2013, with the most dynamic markets with highest growth rates in Latin America, eastern Europe, and for the first time Africa (WWEA 2014), drawing many networks into the development of guidelines to minimize bat fatalities. A global network allows for the rapid synthesis and dissemination of expertise and advocacy materials (e.g., white papers/position statements/research summaries of mitigation approaches) to support efforts in areas lacking direct experience of an issue. Similar issues are being (or could be) realized across multiple regions or globally include the role of bats as reservoir hosts in zoonotic infectious diseases (Schneeberger and Voigt 2016), white-nose syndrome (Frick et al. 2015), and hunting of bats (Mildenstein et al. 2016).

Third, a global network secures the diversity of expertise to respond to future threats. It is noteworthy that some of the biggest threats facing bats today were unimagined less than 20 years ago, with no mention in edited volumes (e.g., Kunz and Racey 1998) or action plans (Mickleburgh et al. 1992; Hutson et al. 2001) of mortality at wind installations, white-nose syndrome, or the role of bats in emerging infectious diseases (EIDs) and the attendant consequences for public and government perceptions of bats. We do not know what new threats to bats might emerge in the coming decades, nor whence they might originate. A global network would facilitate coordinated responses and support for regional issues.

Finally, a global network would provide a means for current and emergent critical issues to become widely known and, critically, could act as a single voice to promote bat conservation through global positions on recurrent, widespread issues such as wind installations, habitat loss and the protection of critical sites, EIDs. A unified voice and global position could also be key in local or national issues where governments, resilient to the dogged efforts of the local group, might be swayed by unified international scrutiny or outrage. Many of the regional networks have faced such challenges. For example, in Australia, the ABS is in urgent need of support to keep up with the number and scale of political issues and administrative actions surrounding flying foxes, and it is conceivable that unified global advocacy might have prompted earlier, precautionary, action as the Christmas Island Pipistrelle (*Pipistrellus murrayi*) declined to (presumed) extinction. Some suggestion that international opinion can influence local decisions comes from Mauritius. In 2006, the prime minister of Mauritius was heavily lobbied by British conservationists to void a cull of *Pteropus niger*, planned to placate fruit farmers. The lobbyists' influence is uncertain as the cull went ahead, *but* its success was limited by existing, *observed*, legislation precluding the discharge of firearms after dark.

We believe a global network can play a key role in bat conservation in the coming decades. However, it must retain the personality of each regional network and promote local bat conservation. Based on the effectiveness of polycentric diverse networks outlined above (Sect. 17.3.2), we envisage a global network as a meta-network of regional networks (Table 17.1) linked by bridging ties among members to generate an emergent, but decentralized global network of networks. To reach this end requires that existing regional networks be supported and strengthened, the establishment of new networks in areas of the world currently not covered, and the development of bridging links across regional networks to provide global coverage.

17.4.2 Strengthening Existing Networks

From our review of characteristics of successful conservation networks (Sect. 17.3.2), existing networks might consider activities that increase the number and strength of links among its actors. This increases mean degree, with redundancy improving resilience to member loss (Folke et al. 2005), and greater connectivity facilitating knowledge transfer. Face-to-face events (conferences, workshops, etc.) as well as online social networks (e.g., Facebook) provide for bidirectional communication among actors and an increase in connectivity through establishment and strengthening of social bonds. Although online social ties are often weak (Burke et al. 2010), they may nevertheless cultivate and crystallize otherwise ephemeral relationships established face-to-face (Ellison et al. 2007; Lewis and West 2009).

While organizations may not be in the position to conduct a full social network analysis to guide explicit network weaving (as advocated by Prell et al. 2008, 2009), development can still be strategic. Identifying and connecting or

developing "missing nodes" is an important aspect of network strengthening—are there individuals, themes, perspectives, knowledge, and countries missing from the network? Do actors exist but are not connected, or does the network need to encourage the development of new capacity?

Establishing connections to existing actors not currently in a network increases network diversity and hence adaptability, which in turn is central to maintaining social capital (Newman and Dale 2007). In Southeast Asia, Myanmar has had an active bat research community for at least a decade, but for political reasons it has been difficult to connect it to the rest of the SEABCRU, a situation that the SEABCRU has actively sought to rectify with a workshop in 2014, now that political landscape has changed. From a knowledge perspective, early in SEABCRU development it became clear that the network lacked expertise in disease ecology, despite the fact that Southeast Asia is an emerging disease hotspot (Jones et al. 2008), and actively recruited an actor from Ecohealth Alliance to fill that expertise gap. As a network grows, actors with specific management skills needed to run the network may need to be recruited. BCT actively headhunted to achieve a skill mix for the board of trustees that included strategy, organizational development, funding, marketing, legal, financial, HR, bat research, and conservation as well as volunteers perspectives.

In many cases, actors or nodes may not currently exist. Lack of expertise and capacity was one of the driving motivations behind the establishment of CCINSA, a network that has focused much of its efforts on training workshops. The role that this can play in establishing new nodes is illustrated by the growth of activities in Nepal, following a CCINSA workshop in 2007. Participants went on to establish two organizations involved in bat conservation—Small Mammal Conservation and Research Foundation (2009) and Natural Resources Research and Conservation Centre (2010). RELCOM began with representatives from five countries (Brazil, Bolivia, Costa Rica, Guatemala, and Mexico) and grew network membership by actively recruiting key bat conservationists and researchers from across Latin America. In countries lacking expertise (e.g., in Central America), senior leaders from RELCOM actively built capacity through courses and workshops and identified local members needed to fill the gaps in region-wide representation. This approach grew RELCOM from five to 22 countries in just five years, and most of the remaining gaps are being filled by organizations actively petitioning to join.

The SEABCRU five-year plan allocated year three for the identification and filling of gaps in the SEABCRU network. In accord with the SEABCRU's thematic approach, gaps were defined as areas lacking expertise in, but facing, one or more of the four major threats. Activities center on fostering capacity to fill these gaps. These include a flying fox workshop in Cambodia (2013) to train biodiversity researchers in monitoring protocols, dietary studies, bat–farmer conflict resolution, and disease ecology, and a similar workshop focused on cave bat conservation in southern Vietnam (2014).

Filling in network gaps that lack existing actors can be challenging, and several networks have encountered difficulties, despite having identified clear targets. Efforts have generally been hampered by lack of funds to support foundational

events (e.g., workshops), lack of suitable liaisons in the target area that can anchor events, and political constraints. Political constraints may be current (countries restricting international relations because of war or ideology), or historical. As an example of the latter, the majority of countries in Central and South America are now members of RELCOM, but the Guianas of northeastern South America have greater, recent European affiliations (comprising French Guiana, an overseas department of France), Guyana (British Guiana until independence in 1966), and Surinam (part of Dutch Guiana until 1975). These countries support high bat diversity, face similar conservation challenges to the rest of the continent, and lack local research capacity, but colonial and immigration history have limited their integration with Latin America, and hence with RELCOM.

Established networks should also work to develop links to other conservation stakeholders (Mills et al. 2014—scale-crossing to peripheral actors; Fig. 17.3e). Obvious "peripheral actors" include those engaged in similar issues (e.g., raptor fatalities at wind installations) or habitats (e.g., RAMSAR wetland groups). Perhaps, the most intuitive and common peripheral actors for bat conservation networks are cave groups. Cave groups have contributed to bat surveys from the Philippines to the USA. The Australian Speleological Federation played a major role in gathering bat knowledge in Australia in the late 1950s, and the legacy of this interaction is embodied in the ABS constitution, which seeks "to establish and maintain links, and work cooperatively, with other organizations within and outside Australia which share similar aims and objectives to the Society." More recently, the ABS became part of the Places You Love alliance of more than 40 green groups in response to pressure to weaken Australian environmental laws and has increased interaction with other smaller bat conservation and wildlife rehabilitation groups in Australia. Similarly, BatLife Europe works with "collaborating organizations," such as local NGOs, museums, and companies, to exchange information and participate in activities.

Networks should be cognizant that, as discussed above, the most effective network structure may change through time. As the network becomes more established and grows, knowledge and responsiveness can be enhanced by transitioning from a centralized structure (Fig. 17.3b) to one with greater modularity (Fig. 17.3d). RELCOM is actively transitioning to a more modular structure through the establishment of subregional groups (Central and South America), while maintaining the strong bonds already established. This structure allows the network to respond more effectively to the issues in each subregion. For example, Central America is in need of greater capacity building, as local PCMs are comprised of very young researchers, whereas expertise is more established in South America. The network is further subdividing South America into the Andes, Amazon, Southern Cone, and Caribbean to reflect the dominant conservation issues: wind turbines and habitat fragmentation in the Andes; habitat destruction in Amazonia; wind turbines in the Southern Cone; and bat migration and roost loss associated with hurricanes in the Caribbean.

As described above (Sect. 17.2.1), most of the bat conservation networks are already modular, comprising subgroups defined geographically or thematically.

Geographical subgroups are likely to be more cohesive initially (as actors within them know each other), but may tend toward homophily over time. In some cases, there may not be sufficient actors to make up a geographic subunit, as was the case with the SEABCRU at its foundation. Thematic groups promote functional diversity of the network as a whole, but it may take time for trust and strong bonds to develop within them. Ultimately, a mix of both is desirable, with members from geographical groups sitting on different thematic teams. This "jigsaw" strategy (Aronson and Patnoe 2011) promotes cooperative learning as expert knowledge developed in thematic groups is returned to the geographical groups. Currently, EUROBATS includes elements of this strategy with intersessional working group members drawn from member states. This strategy also ensures a variety of weak (bridging) and strong (bonding) ties among more actors, and explicit network weaving (Prell et al. 2008, 2009).

Network centrality is further decreased if the leadership structure transitions to a rotational one with elected officers serving for specified terms, as several of the networks do (e.g., RELCOM, ABS, BCA). Rotational leadership also avoids cliques and encourages different viewpoints. Conversely, failure to decentralize leaves the network vulnerable to loss of central actors, homophily, and poor long-term recruitment. Networks should also maintain ongoing recruitment programs to replace people, who leave, and maintain network heterogeneity (Newman and Dale 2007).

17.4.3 Filling Regional Gaps—Establishing New Networks

Major regional gaps include East Asia (covering China, Japan, North Korea, South Korea, Mongolia), Central Asia (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Afghanistan), the Middle East (18 countries), and the Russian Federation (Fig. 17.2).

The first question, rather similar to that when filling in gaps in existing networks, is to determine whether expertise (possible actors/nodes) already exists and just needs connecting in these regions, or if the area is completely lacking expertise. In East Asia, there are several active national groups, namely the Asian Bat Research Institute, Bat Study and Conservation Group of Japan, and the Bat Association of Taiwan, as well as individual actors in Mongolia and China, which could be the kernels of a regional network. Similarly, the EUROBAT range state members Israel, Jordan, Lebanon, Syria, and Saudi Arabia could serve as nodes in establishing a Middle East network.

A limited number of actors (be they individuals or national groups) should not hinder the development of a network, provided of course the actors can commit to the venture. Rather, based on the general principle that founding networks are most likely to succeed if they are fairly centralized (Olsson et al. 2004; Crona and Bodin 2006), the best approach at foundation is to identify a few actors in the region that are well connected with others (high betweenness), which could be brought together

to establish or strengthen links needed to form a network. If a handful of central actors are already connected this is ideal, otherwise it is *essential* to spend time building trust and fostering interpersonal relationships (and skills) before getting into issues (Newman and Dale 2007; Cheruvelil et al. 2014). Many of the existing networks (e.g., BCT, RELCOM, SEABCRU) started with a small group of people that were already connected with strong bonds (positive interactions going back many years). In several cases, the group already had the characteristics of a network (social capital, coordination) with agency directed at a specific task. In the UK, BCT evolved from the Mammal Society Bat Group. In Australia, the ABS was preceded by the Australian Bat Banding Scheme (1960), and a collective effort to produce the first bat identification guide. Core members of what was to become the SEABCRU first came together to organize the 1st SE Asian International Bat Conference (2007). Similarly, RELCOM was created by five existing Bat Conservation Programs during the 15th International Bat Research Conference in Mérida, México (2007). Because these actors also had high betweenness (lots of links to others), they were then able to pull in diverse people to build the network. Conversely, networks may struggle to persist beyond foundation if the founding actors do not have or develop strong ties to one another and/or have low betweenness (few links to others).

The diversity of actors involved during network formation should also be considered. High diversity of members can avoid structural homophily (Prell et al. 2008; Cheruvelil et al. 2014), but there must be sufficient commonality of perspectives and expectations among members to provide cohesive network objectives and to develop and strengthen links. Diversity of actors in terms of age, career stage, and nationality has generally proven productive, and although new networks might begin with a fairly centralized structure, thought can still be given to internal structure and subgroups with inclusion of actors with diverse expertise (e.g., SEABCRU steering committee included specialists in each of the four priority research areas) or from different nationalities (e.g., RELCOM). However, communication (and hence link strength) can falter during network formation when actors come from different institutional backgrounds and hence mandates (e.g., academic, non-governmental, governmental, consultancy). In essence, social capital builds more readily when actors are diverse, but not so diverse that agendas and modes of communication differ. As the network matures, it becomes easier to integrate and capitalize on different perspectives. Whereas several of the younger networks largely comprise members with similar backgrounds (e.g., SEABCRU, RELCOM—academic, NABCA working groups drawn from government agencies, NGOs), older networks, such as the ABS, have broader membership that include representation in universities, government, other conservation societies, and private industry.

Early development of a network's mission and objectives can help establish network identity and guide membership decisions and help actors clarify what it means to be part of the network versus an independent researcher, conservationist, or NGO. Moreover, actors that are expected to play a role in the network need to be included or consulted during the establishment process. Given that most actors in bat conservation networks are volunteers, networks will be more sustainable if actors are not only committed to the overall goals of the network but also see

increases in personal social capital that lead to tangible benefits. Identifying objectives that contribute to the core network mission requires collective input, but benefit actors directly can be invaluable. Benefits may accrue to the subgroup (e.g., NGO, PCM), but also to the individual in the form of publications, research proposals, or databases that facilitate their own research or applied conservation objective. For example, the SEABCRU explicitly identified publications that met the network's objectives by synthesizing regional conservation knowledge (Abdul-Aziz et al. 2016; Mildenstein et al. 2016) or resolving multi-national taxonomic concerns (e.g., Ith et al. 2011), and is currently developing a regional echolocation call library for acoustic surveying and monitoring of bat diversity in anthropogenic landscapes. Social capital built through the network can also be mobilized to apply for conservation research funding for collaborative teams from within the network. RELCOM partnered with BCI to offer seed grants for its members, and several PCMs have joined together to conduct research, such as a project on the study of migratory patterns of *Leptonycteris curasoae* (IUCN Red List as Vulnerable), which involves participants from Venezuela, Colombia, Aruba, Bonaire, and Curacao. EUROBATS launched the European Projects Initiatives with maximum grants of 10,000 euros to address urgent site- or species-based conservation issues or to fund training workshops in range states. Priority is given to transboundary projects and those promoting international cooperation between the parties and range states to the Agreement.

Fostering the development of expertise in regions with none, essentially developing sufficient nodes to actually support a network, is a significant challenge. Nonetheless, basic network principles apply, and supporting a few actors who can develop (or have) strong bonds between them and are linked to many others will likely maximize success. Broad initiatives to identify enthusiastic, key actors might target vertebrate biodiversity specialists, as it is relatively easy to transfer bat research techniques and knowledge to bird and small mammal researchers. Interest in bat diversity and conservation in Bangladesh (Group for Conservation and Research on Bats) grew out of projects on bats and EID at veterinary institutes (Nurul Islam pers. comm.), providing another avenue for identifying key actors. Involving interested actors in the activities of existing networks and the global network can expose them to the value of network approaches and suggest organizational modes.

17.4.4 Networking Networks for Global Coverage

Our vision is of a global network resulting from bridging ties across regional networks. As such, it would be a largely decentralized entity, but overseen by a coordinating committee drawn from the member networks. To foster bridging ties and accelerate exchange of best practice, thematic subgroups could be identified (e.g., research, outreach, policy) and populated with members from each network. Working groups, similar to those of EUROBATS, to address specific issues of global or multi-regional concern would further weave the network together. Such a jigsaw approach would additionally disseminate expertise back to the regional networks.

Other approaches to develop and sustain bridging ties are offered by the network literature. “Board interlocks” (Borgatti and Foster 2003) develop ties among organizations through a member of one organization sitting on the governing body of another. With so many regional networks, this might be a little unwieldy, but initial efforts might focus on the thematic subgroups, with members attending events run by other networks. In some cases, members from one network may lead a training event of another. For example, SEABCRU steering committee member Neil Furey was the key resource person for a 2014 CCINSA workshop in Bangladesh.

Joint ventures (e.g., collaborative conservation projects and joint symposia) and inter-organizational alliances provide access to information and knowledge resources that are difficult to obtain by other means and which improve performance and innovation (Borgatti and Foster 2003). Several regional networks encounter the same conservation issue (e.g., EIDs and increased pressure on declining pteropodids from a variety of factors unite BCA, SEABCRU, CCINSA, ABS; hunting of bats for bushmeat and medicine are concerns for BCA, SEABCRU, ABS) and might benefit from joint-venture approaches or alliances to seek funding for research and conservation action. Global initiatives, such as priority-setting of important areas or sites, would likewise foster bridging ties.

The challenges in establishing and maintaining a global network of networks are essentially those of the regional networks, writ large—limitations on time, resources, communication, and trust. To overcome these constraints, the global network must have a clear identity, mission, and objectives agreed upon by all member networks. Given resource limitations, and the many threats to bats that participant networks deal with within their own regions, member networks must see how involvement benefits not only the global mission but their own. Communication is pivotal to all networks, and at the global scale, there are obvious barriers associated with cultural and linguistic differences, sometimes augmented by insular attitudes. Just as important for communication and expectations is the diversity of the networks themselves; establishing bridging links between networks comprising mostly of researchers and conservation practitioners (RELCOM, SEABCRU), and those made up of NGOs (BatLife Europe), for example, require thought and active fostering of trust among actors. Moreover, clear lines of communication must be established between executives/committees representing societies, and among members at the individual level.

17.5 Recommendations

With the globalization of threats to bats, we recommend the following:

1. The development of a global network of bat researchers and conservationists to respond to such threats and to provide a unified voice for advocacy.
2. That the global network be formed as a federation of regional networks, retaining regional autonomy and identity.

3. The establishment of new networks in regional gaps, specifically East Asia, Central Asia, the Middle East, and the Russian Federation.
4. That existing and planned networks consider social network theory and developing and refining their structure. We recommend that:
   (a) at foundation, networks adopt a centralized structure based around a few well-connected actors;
   (b) as the network matures:
      (i) actively transition to a structure comprising multiple, heterogeneous subgroups differing in knowledge areas and expertise;
      (ii) fill gaps in knowledge, expertise, or geography by developing links with new actors;
      (iii) increase overall membership diversity; and
      (iv) develop ties to peripheral actors with overlapping conservation interests.

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