S11-2   The utility of hotspot identification for forest management: cracids as bioindicators

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Abstract   Diverse species of large forest-dwelling vertebrates can serve as bio-indicators of forest quality. In the Neotropics, forest-dwelling game mammals have often been used as the model because their presence/absence can identify forest integrity and sustainability of game harvest together. Species such as ateline primates are often the first to disappear when forest is degraded and population harvest is beyond sustainable limits. In South America, one of the few groups of birds that can also serve in this way is the family Cracidae. This is especially true for curassows and guans, which are typically associated with pristine forest, and also provide a highly preferred source of protein for rural hunters and Amerindians. Determining where these species reach peak diversity in sympatry (i.e. hotspots) is a means of identifying and prioritizing regional forest conservation. In this study, I identify cracid hotspots by comparing equal blocks of regional map quadrats. The location of these hotspots is then compared with current regions identified in the Cracid Action Plan of Birdlife International and FAO. Hotspot analysis is a contemporary paradigm in modern conservation biology because of its usefulness in determining priorities for regional forest conservation.

Key words   Cracidae, Hotspot analysis, Primary forest, Priority regions

1   Introduction

Neotropical game mammals that are terrestrial are often used as bio-indicators of forest quality and sustainability of harvest (Bodmer, 1997). Such species, all vulnerable to local extinction by forest destruction and non-sustainable harvesting, include the ateline primates (spider and woolly monkeys) and the bird families Psophiidae (trumpeters) and Cracidae (Brooks, 2001). The latter group, the cracids, are the most threatened family of birds in the Americas, and include 12 species of chachalacas (*Ortalis*), 24 species of guans (15 in the genus *Penelope* and the remainder in five other genera) and 14 species of curassows in four genera (Brooks and Strahl, 2000).

Most cracids depend on undisturbed, often primary, forest. In this category are four species (34%) of chachalacas, eight (54%) of *Penelope* guans, five (45%) of other guans, and all curassows (100%), totalling 31 species (62%) of cracids. Other cracids, however, can use secondary habitat, including eight species (66%) of chachalacas, seven (46%) of *Penelope* guans, and four (55%) of other species of guans, totalling 19 species (38%) of cracids (Appendix 1). Even so, most cracids, especially curassows, are associated with and dependent on pristine habitat. These species, moreover, have been much used as a traditional source of preferred protein (Brooks, 1999). Consequently, half of the 50 species are threatened or endangered.

The objective of this study, then, was to assess the utility of cracid hotspots for determining priorities for forest conservation in the Neotropics. Hotspot analysis is a procedure for identifying and prioritizing regional habitat conservation by comparing species richness among equal blocks of regional map quadrats (Mittermeier et al., 1998).

2   Methods

I compared equal blocks of regional map quadrats to identify hotspots of species richness at 6 group levels: 1) chachalacas, 2) *Penelope* guans, 3) other guans, 4) curassows, 5) all cracids, and 6) cracids dependent upon undisturbed forest. I then compared the resulting hotspot locations with regional priorities for forest conservation in the Cracid Action Plan (Brooks and Strahl, 2000), and assessments of globally threatened birds (Birdlife International, 2000) and threatened and degraded forests (FAO, 2000).

3   Results

Diversity for the groups of *Penelope* guans, all cracids, and cracids dependent upon undisturbed forest reached peak species richness in the region of southwestern Colombia and Ecuador.

Chachalacas were the only group with a hotspot in Central America, in the region of the southern Mexican isthmus. The "other guans" group peaked in southeastern Peru, where Andean and Amazonian forests interface. Curassows reached peak diversity in western Amazonia, a somewhat surprising result in light of the greater uniformity of habitat in the Amazon basin than on the slopes of the Andes.

Table 1 Conservation priorities, by nation, for the Cracid Action Plan (Brooks and Strahl, 2000), Birdlife International (2000) and FAO (2000)

Rank	CAP	BL	FAO (2000)		
			Total forest cover (ha)	Forest cover loss 1999–2000 (ha/yr)	Forest cover change 1999–2000 (%/yr)
1	Brazil	Brazil	Peru (65 215 364)	Mexico (–630 574)	El Salvador (–4.6)
2	Colombia	Colombia	Mexico (55 205 278)	Argentina (–285 111)	Belize (–2.3)
3	Peru	Peru	Bolivia (53 068 062)	Peru (–268 794)	Guatemala (–1.7)
4	Mexico	Mexico	Colombia (49 601 300)	Venezuela (–217 539)	Panama (–1.6)
5	Bolivia	ND	Venezuela (49 506 000)	Colombia (–190 470)	Ecuador (–1.2)
6	Ecuador	ND	Argentina (34 648 222)	Bolivia (–161 075)	Mexico (–1.1)

CAP = Cracid Action Plan, BL = Birdlife International, FAO = Food and Agricultural Organization

Table 2 Regional priorities for CSG (Brooks and Strahl, 2000) and Birdlife International (2000) = BL

Rank	CSG	BL
1	Santa Marta mountains, Colombia	Atlantic forest
2	Colombian Pacific and Andean slopes	northern Colombian Andes
3	northern Andean foothills and cloud forest (Venezuela–Bolivia)	no data
4	Mexican highlands and cloud forest	no data

4 Discussion

Southwestern Colombia and Ecuador harbor the highest diversity of forest-dependent cracids, a region that was also the primary hotspot for other groups, including *Penelope* guans and all cracids. Comparative data from the Cracid Action Plan (Brooks and Strahl, 2000; Birdlife International, 2000; FAO, 2000) are provided in Tables 1 and 2. Rankings by Brooks and Strahl (2000) and Birdlife International (2000) place southwestern Colombia only second for both county and region (Table 3). Brooks and Strahl (2000) also ranked Ecuador second regionally and sixth by country (Table 3). Birdlife International (2000) did not in-

clude Ecuador at all, and their criteria only ranked two regional priorities and four country priorities (Table 3). FAO (2000) ranked Colombia within the top five countries for categories of both total forest cover and forest cover loss, and placed Ecuador fifth for percentage of forest cover change (Table 3).

Cracid hotspots of secondary importance include the southern Mexican isthmus (chachalacas), southeastern Peru (other guans), and western Amazonia (curassows). Here conservational priorities in Brooks and Strahl (2000), Birdlife International (2000) and FAO (2000) are more appropriate. Brazil, Peru and Mexico (Table 1) were all ranked high in priority by Brooks and Strahl (2000) and Birdlife International (2000). Peru and Mexico are ranked highest by FAO (2000) for total forest cover and loss, and Mexico sixth for forest cover change (Table 1). It should be noted, moreover, that the smaller countries have suffered higher proportions of forest destruction by virtue of their smaller relative size.

Thus, cracid diversity hotspots are linked generally to prioritized regional and geopolitical units for conservation, and consequently could serve as good bio-indicators for forest management. Moreover, while the hotspots are not necessarily concordant with the highest ranks of conservation need according to other criteria, they are still important indicators for forest management involving a suite of factors.

Table 3 Ranked comparison of southwestern Colombia/Ecuador hotspots with other regional priorities

Criteria	SW Colombia	Ecuador
CAP — Country	2	6
CAP — Region	2	2
BL — Country	2	ND
BL — Region	2	ND
FAO — total forest cover	4	ND
FAO — forest cover change	5	ND
FAO — % forest cover lost	ND	5

CAP = Cracid Action Plan, BL = Birdlife International, FAO = Food and Agricultural Organization

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Appendix 1

Habitat type required by cracids

(a) Species of cracids dependent upon undisturbed habitat:

1. Chachalacas: *Ortalis erythroptera*, *O. wagleri*, *O. poliocephala*, *O. superciliaris*

2. *Penelope* guans: *Penelope barbata*, *P. ortoni*, *P. dabbenei*, *P. purpurascens*, *P. albipennis*, *P. pileata*, *P. ochrogaster*, *P. jacucaca*

3. Other guans: *Pipile cujubi*, *P. jacutinga*, *Chamaepetes unicolor*, *Penelopina*, *Oreophasis*

4. All curassows: *Nothocrax*, *Mitu tomentosa*, *M. salvini*, *M. tuberosa*, *M. mitu*, *Pauxi pauxi*, *P. unicornis*, *Crax rubra*, *C. alberti*, *C. daubentoni*, *C. alector*, *C. globulosa*, *C. fasciolata*, *C. blumenbachii*

(b) Species of cracids that can use secondary habitat:

1. Chachalacas: *Ortalis vetula*, *O. cinereiceps*, *O. garrula*, *O. ruficauda*, *O. canicollis*, *O. leucogastra*, *O. guttata*, *O. motmot*

2. *Penelope* guans: *Penelope argyrotis*, *P. montagnii*, *P. marail*, *P. superciliaris*, *P. perspicax*, *P. jacquacu*, *P. obscura*

3. Other guans: *Pipile pipile*, *P. cumanensis*, *Aburria*, *Chamaepetes goudotii*