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Comparing Perspectives of Participants and Outside Commentators on Habitat Conservation Plans

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Abstract

Habitat Conservation Plans (HCPs) have become the primary mechanism by which the Endangered Species Act (ESA) is implemented on private land. Due to the dramatic increase in the number and size of plans, numerous scientists, conservation organizations, and other outside commentators have evaluated the HCP program. These reviews share several common themes including concern over HCP data adequacy and regulatory assurances as well as recommendations to increase participation and independent scientific review during HCP development. This paper briefly reviews these common themes and then analyzes interview responses from 121 participants of 31 plans in light of these issues. In general, participants' concerns and recommendations were different from those of outside reviewers. Participants generally felt that the data used in plans were adequate or more than adequate for the decisions that were made and they did not recommend using independent review to improve data quality. The most frequent problems and recommendations identified by participants involved political, economic, social, and logistical issues, rather than scientific issues. Participants' most common concern was the duration of time required to develop a plan. Regulatory assurances were the most frequent motivating factor named by HCP applicants. Because of the complexity of HCP processes, recommendations aimed at improving the conservation value of HCPs are more likely to be adopted and implemented if they are bundled with mechanistic proposals for how these changes can be effectively integrated into complex, expensive, and lengthy processes.

Comparación de Perspectivas de Participantes y Críticos Externos en Planes para la Conservación de Hábitats

Resumen

Los Planes para la Conservación de Hábitats (HCPs por sus siglas en inglés) han llegado a ser el principal mecanismo por medio del cual el Acta de Especies en Peligro de Extinción (ESA por sus siglas en inglés) es implementada en propiedad privada. Debido al incremento dramático en el número y tamaño de estos planes, un número significativo de científicos, organizaciones conservacionistas y otros críticos externos han evaluado el programa de HCPs. Estas evaluaciones comparten algunos temas en común que incluyen la preocupación acerca de la adecuación de los datos y aseveraciones regulatorias de los HCPs, así como también recomendaciones para incrementar la participación y revisión científica independiente durante el desarrollo de los HCPs. Este artículo revisa en forma breve estos temas que las evaluaciones tienen en común y en base a estos asuntos analiza las respuestas de 121 participantes en 31 planes. En general, las preocupaciones y recomendaciones de los participantes fueron diferentes de las mencionadas por los críticos externos. Los participantes generalmente expresaron que los datos usados en los planes fueron adecuados o más que adecuados para las decisiones que fueron hechas y no recomendaron usar una revisión independiente para mejorar la calidad de los datos. Los problemas y recomendaciones identificados más frecuentemente por los participantes son de naturaleza política, económica, social y logística, y no de índole científica. La preocupación más común de los partipantes fue la duración del tiempo requerido para desarrollar un plan. Las garantías regulatorias fueron el factor motivador nombrado más frecuentemente por los solicitantes de HCP. Debido a la complejidad de los procesos en HCPs, es más probable que las recomendaciones que tienen como meta el mejoramiento del valor para la conservación de HCPs sean adoptadas e implementadas, si estas recomendaciones están acompañadas de propuestas con metas bien definidas de cómo estos cambios pueden ser efectivamente integrados a procesos complejos, costosos y largos.

Une Comparaison des Perspectives des Participants et des Commentateurs Externes sur les Plans de Conservation

Résumé

Les plans de conservation sont devenus le mécanisme le plus important pour la mise en œuvre de l'acte américain sur les espèces en voie de disparition (le ESA) sur la propriété privée. En raison de l'augmentation dramatique du nombre et de la taille des plans, de nombreux scientifiques, organisations de conservation, et d'autres critiques indépendants ont évalué la méthodologie de ces plans de conservation. Ces revues ont produit plusieurs recommandations en commun focalisées sur la qualité de la science des plans, leur participation de façon indépendante, et la politique de 'Aucunes Surprises.' Cet article passe en revue brièvement ces recommandations et analyse des réponses d'entrevue de 121 participants des 31 plans en considération de ces thèmes. En général, les préoccupations et les recommandations des participants étaient différents de ceux des critiques externes. Les participants ont généralement estimé que les données utilisées dans les plans de conservation étaient satisfaisantes ou plus que satisfaisantes pour les décisions qui ont été faites et n'ont pas recommandé d'employer une évaluation indépendante pour améliorer la qualité de données. Les problèmes et les recommandations le plus fréquemment identifié par les participants impliquaient les issues politiques, économiques, sociaux et logistiques, plutôt que les issues scientifiques. La préoccupation la plus importante des participants était la durée du temps requise pour développer un plan de conservation. Les assurances de normalisation étaient le facteur de motivation le plus fréquemment identifié par des requérants des plans de conservation. En raison de la complexité du processus des plans, les recommandations visées à l'amélioration de la valeur conservatrice des plans seront plus probablement adoptées et mises en oeuvre si elles sont empaquetées avec des propositions et objectifs bien définis sur la façon dont ces changements peuvent être efficacement intégrés dans des processus complexes, chers, et prolongés.

Introduction

Habitat Conservation Plans (HCPs) have become the primary mechanism for resolving conflicts between non-federal land use and the Endangered Species Act (ESA). In exchange for implementing conservation measures outlined in the HCP, a landowner receives an Incidental Take Permit (ITP), authorizing the conversion or modification of endangered species' habitat. Due to their growing prominence, spatial scale, and number, HCPs have received considerable scrutiny from outside commentators. These reviews have produced numerous recommendations aimed at improving the science, conservation value, and level of participation of HCPs. This paper seeks to complement these efforts by analyzing the results of an interview-based study of HCP participants conducted by the National Center for Environmental Decision-making Research (NCEDR). Using a subset of questions from that study, we summarize general feedback and specific perspectives on data adequacy, scientific review, and other factors influencing the incorporation of science and conservation into HCPs. Through this analysis we compare and contrast the recommendations and concerns of outside commentators with those of HCP participants. We also discuss how a better understanding of participant perspectives can help policy makers and participating scientists improve the conservation value of HCPs.

Recent assessments and commentaries have focused on the quality of science in HCPs, the effect of plans on endangered species, and the degree of outside participation in planning processes (Shilling 1997; Kareiva 1999; Hood 1998; Smallwood et al. 1999; Harding et al. 2001). These studies aim to provide an objective review of HCPs and have thus been primarily based on the opinions and analyses of independent researchers. We distilled the following critiques and major recommendations emerging from these studies regarding science and conservation within HCPs:

1.Science and data adequacy. HCPs should be based on high-quality scientific data and analyses (Noss et al. 1997; Shilling 1997; Kareiva 1999; Smallwood et al. 1999; Harding et al. 2001; Thomas 2001a). HCPs have often relied upon science that is incomplete or inadequate (Bingham and Noon 1997; Hall 1997; Mueller 1997; Shilling 1997; Hood 1998; Smallwood et al. 1999; National Audubon Society 2003) or not sufficiently quantitative (James 1999); often HCPs do effectively utilize the available data, but these data may not be sufficient to predict the consequences of management actions (Kareiva 1999; Harding et al. 2001).

2.Independent participation/review. HCP processes should be open to participation by outside interests (Cullinan 1997; Kostyack 1997a; Aengst et al. 1998; Hood 1998) and include species experts (Harding et al. 2001). Independent scientists should "peer review" large HCPs or participate in a meaningful way throughout the planning process (Hosack et al. 1997; Noss et al. 1997; Shilling 1997; James 1999; Kareiva 1999; Thomas 2001a).

3.Uncertainty and regulatory assurances. Regulatory assurances, or "No Surprises," were created to encourage landowners to participate in HCPs by reducing planning uncertainty. Under "No Surprises" landowners are not accountable for any additional mitigation beyond that which is outlined in the original plan. Scientists feel that these regulatory assurances pose some risk to species and must be designed to allow adaptive management (Kareiva 1999). Although several commentators voice opposition to "No Surprises" (Mueller 1997; Shilling 1997), many scientists and environmentalists experienced with HCPs acknowledge that some form of regulatory assurances are necessary to encourage participation from landowners (Dwyer et al. 1995; Kostyack 1997b; Noss et al. 1997; O'Connell & Johnson 1997).

In this paper, we analyze the responses of HCP participants in light of these recommendations. Although the agencies that oversee HCPs - the U.S.

Fish and Wildlife Service (FWS) and the National Marine Fisheries Service (NMFS) - have responded to outside critiques with policy changes (e.g., the "Five Point Policy Guidance," released in 2000 as an addendum to the HCP Handbook), they have also responded to participant concerns and complaints (Aengst et al. 1998).

HCPs are simultaneously scientific, legal, and political agreements negotiated by agency staff, landowners, consultants, and representatives of industry and environmental constituencies. Ultimately, these individuals make the final decisions regarding scientific content, conservation and participation within the complex negotiating and decision-making process of plan development. For these reasons, recommendations to change HCP policy are more likely to be implemented, both in policy and practice, if they are developed with a thorough understanding of current processes and are sensitive to the experiences of HCP participants. This paper seeks to shed light on these processes and experiences. Our intended audience includes those working to improve HCPs at the policy level as well as conservation scientists working directly within HCP processes.

Methods

We used the interview responses from a 1998 NCEDR study (Bidwell et al. 1999; Ostermeier et al. 2000) that investigated the decision-making processes in HCP development. The study focused on 31 HCPs or related plans and included, at a minimum, interviews with the landowner developing the HCP (the permittee) and the Agency staff person responsible for negotiations. For larger, more complex plans, additional participants were interviewed, including representatives of industry and environmental groups, consultants, and state-agency staff. A questionnaire of primarily open-ended questions was administered over the telephone. Bidwell et al. (1999) and Ostermeier et al. (2000) provide additional information about the NCEDR study methods. Ostermeier et al. (2000) provide a list of plans used in the NCEDR study. The list of plans, along with plan summaries, can also be found at http://www.ncedr.org/casestudies/summaries.htm. The questionnaire can be found at http://www.ncedr.org/casestudies/protocol.htm.

Using a sub-set of questions from the NCEDR study, we analyzed the responses of 121 participants in HCP (or related plan) processes in light of the aforementioned concerns and recommendations of outside reviewers. Where possible, we stratified responses based on participant type: agency (includes primarily FWS, but also NMFS and state agency staff), permittee, consultant (generally hired by the permittee to develop the plan), representatives of environmental groups (local and national) and industry/agriculture groups (e.g., Farm Bureau, oil company, real estate). Industry representatives were distinct from the permittee but were involved with plan development (e.g., on a Steering Committee). For some analyses, permittees were divided into those representing public entities (e.g., a county) and private companies (e.g., a timber company).

Because participants were asked to qualitatively describe their opinion of data adequacy, we broadly classified their responses into three categories: good, adequate, and inadequate. Responses using positive words such as "great" or "more than adequate" were categorized as good. Responses that used neutral language and words such as "adequate" or "sufficient" without negative or positive qualification were grouped as adequate. Responses that used negative language such as "insufficient" or "lacking" were classified as inadequate. It is worthwhile to note that "data adequacy" in this context is simply a participant's perception of the quality of the data used in the plan, not a quantitative analysis of the data by the interviewee or any outside reviewer.

Results

Interviewees described diverse objectives for participating in HCP pro-

cesses. Agency staff emphasized protection of the species, with 77% citing conservation or recovery of the species as an objective for the plan. (It should be noted here that this does not necessarily mean that 23% of agency staff do not think that conservation is important, simply that they mentioned other objectives when asked; this caveat holds for other questions and other participant types). Environmentalists also overwhelmingly cited conservation or recovery (85%), while industry representatives emphasized economic activity (77%). The most common objectives of public permittees were receiving a permit to facilitate economic activity, followed by conservation and streamlining the ESA process. Private permittees mentioned conservation less frequently (21%) and all mentioned the need to conduct economic activity.

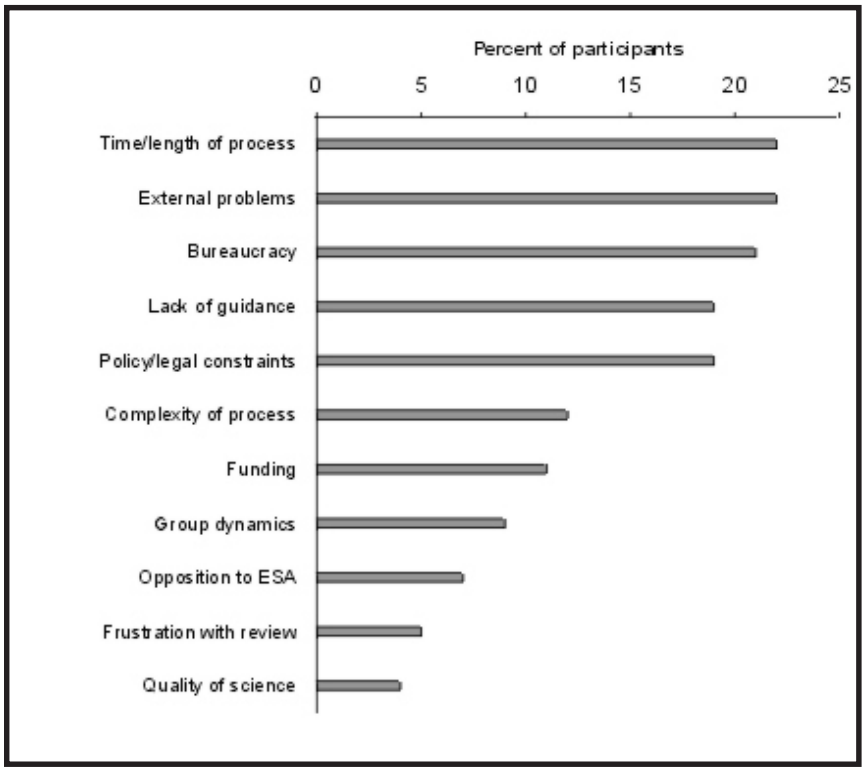

Figure 1. Participants reported the major problems they encountered while developing an HCP. Participants could report more than one problem and, thus, bars sum to more than 100%.

Participants reported that the most common problems during the HCP process were the duration of the planning process, external problems such as politics and public opinion, agency bureaucracies, lack of guidance, and policy and/or legal constraints (Figure 1). As a sub-group, permittees felt that lack of guidance (35%), agency bureaucracy (30%), and the duration of the process (30%) were the most significant problems. Alternatively agency staff felt that policy or legal constraints (26%) and external problems (23%) were the biggest issues. Agency staff also cited the length of the process and agency bureaucracy (21% each) as problems they experienced during plan development.

When asked how to improve HCPs, participants focused primarily on improving planning and decision-making processes (Figure 2). This general response category includes specific recommendations such as offering training for participants, using a facilitator, and ensuring that the actual decision makers were present during negotiations.

Three-quarters of the interviewees reported that collaborating on an HCP improved subsequent working relationships between the participants. Less than 10% indicated that relationships worsened, and many of these were from the same plan.

Below, participant responses are reviewed in light of outside reviewers' main concerns:

1.Science and data adequacy. Interviewees generally perceived the data to be adequate or more than adequate for the decisions that needed to be made (Figure 3); only 10% of all respondents characterized the data as inadequate. Additionally, interviewees rarely reported that data adequacy was a problem (Figure 1). In fact, among problems cited more than once, concern over the science, data, or scientific review was the issue least frequently reported by interviewees (4%).

2.Independent participation/review. Only one interviewee reported that independent review had been used to resolve disputes over data adequacy, and no interviewee mentioned lack of outside review as being a problem encountered during the HCP process. Additionally, only 6% of interviewees recommended independent review as a way to improve HCPs (Figure 2).

More participants recommended including all the stakeholders (19%) than limiting participation (<2%).

3.Uncertainty and regulatory assurances. The most frequently cited factor influencing permittees to apply for an ITP was regulatory certainty, with 63% of HCP permittees mentioning "No Surprises," "regulatory certainty" or "certainty." Other motivating factors included the need to conduct an economic activity (31%), avoiding liability (19%), and conservation (10%).

Discussion

Overall, the recommendations and concerns of HCP participants differ from those of outside commentators. While outside commentators have emphasized data adequacy, independent participation and concern over "No Surprises," participants focused primarily on challenges within the planning process.

Independent reviewers commonly identified data adequacy as a major problem with HCPs. However, most participants, including environmentalists, felt that the data were adequate or more than adequate for the decisions that were made. Participants in this study were more concerned with the social, political, and logistical dimensions of fashioning an HCP than with issues of data adequacy. Due to these constraints and the desire to achieve consensus, participants may have been willing to accept a lower threshold of data quantity and quality than that expected by academic scientists. Further, participants likely view data adequacy through several filters, including their training, ideology, and objectives for the plan. Finally, participants often came to understand and trust each other during the process, which may have increased participants' confidence in data provided by other members of the group.

Interviewees provided little evidence that meaningful outside review had been used to guide decisions, and, generally, participants did not advocate for more review. This may be the result of widespread satisfaction with data adequacy, common concerns about the length of time required to craft an HCP, or frustration with the existing review and approval process conducted by FWS and/or NMFS (collectively, the 'Services') (Ostermeir et al. 2000).

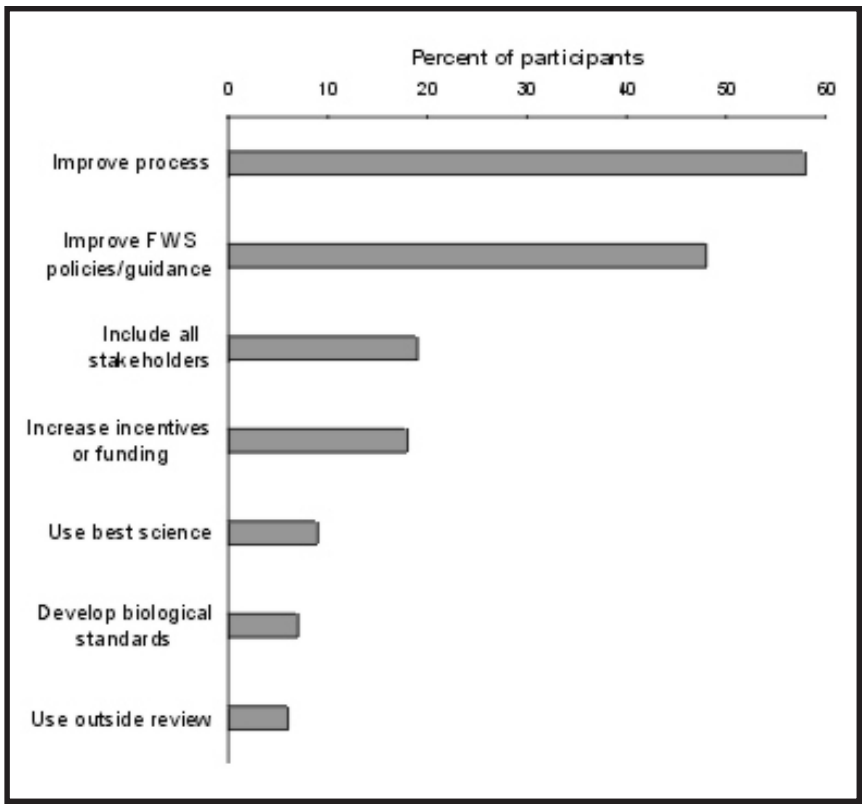

Figure 2. Recommendations made by participants to improve HCPs. Participants could report more than one recommendation and, thus, bars sum to more than 100%.

Expanding participation to include external scientists or conservation groups can significantly increase the time and cost of developing a plan (Ostermeier et al. 2000). This study and others (Lin 1996) have found that participants' primary frustrations with HCPs are the time and cost necessary to complete the process. These results emphasize that one of the great continuing challenges to increasing the role of independent scientists will be designing effective mechanisms for integrating expanded participation into already complex, long, and expensive processes.

Numerous commentators have suggested that regulatory assurances are necessary to encourage landowner participation in HCPs (Thornton 1997; O'Connell and Johnson 1997; Noss et al.

1997; Loew 2000), and this study supports that assertion. Two-thirds of HCP permittees listed certainty or regulatory assurances as influencing their decision to enter the HCP process. Because of the importance of assurances to landowner participation, reconciling "No Surprises" with effective conservation of dynamic ecosystems means balancing meaningful adaptive management with regulatory assurances (Thomas 2001b). Innovative, flexible legal agreements and effective scientific models and monitoring programs will be necessary to achieve this balance.

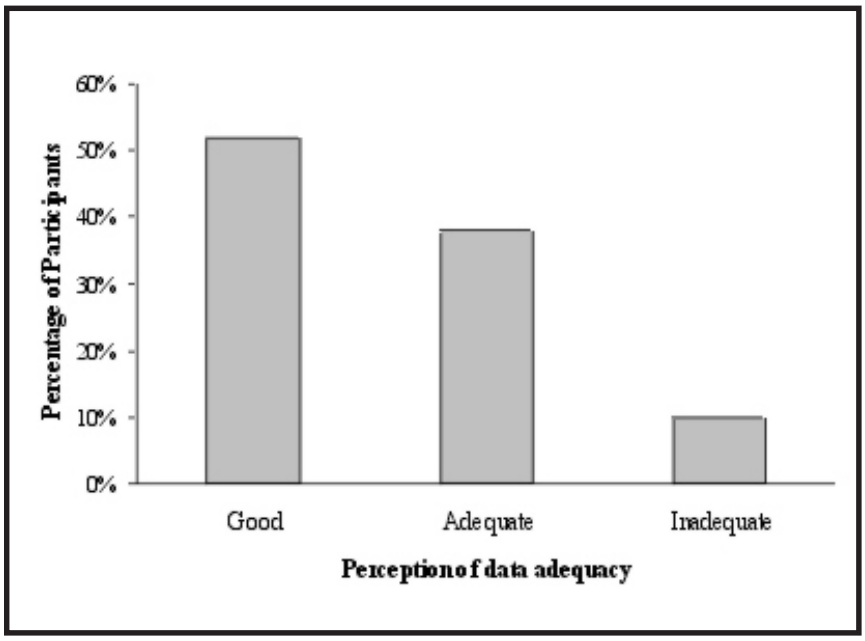

Figure 3. Participants' perceptions of plan data adequacy. Participants were asked, 'How adequate were the data for the decisions that needed to be made?' We categorized their responses as 'good,' 'adequate,' or 'inadequate' depending on whether they used positive, neutral, or negative language to describe data adequacy.

Recommendations

*Focus on process***.** Recommendations to improve HCPs, such as incorporating more data or expanding scientific review, should focus not only on improved *outcomes,* but also on the *processes* necessary to achieve these outcomes. Without an effective process, scientific review is unlikely to be productive (Brosnan 2000), and even a comprehensive research program may fail to influence decisions (Price 1993). The importance and utility of process-based recommendations are emphasized by the fact that a majority of participant recommendations focused on process improvements, such as the organization of sub-committees, changes to the review process, and funding mechanisms. However, most outside commentators propose changes to HCP policy without considering how these changes can be implemented within complex planning processes. In this respect, Aengst et al. (1998) provide a notable exception with process-oriented recommendations to enhance public participation in HCPs.

For example, many outside commentators have recently recommended integrating independent scientific guidance throughout an HCP process rather than a review of the final product (Hosack et al. 1997; Noss et al. 1997; Thomas 2001a). This recommendation recognizes that decisions, once negotiated, are generally difficult to modify (Aengst et al. 1998). Thus, this is a first step toward coupling recommendations to change outcomes (e.g., expanded independent scientific input) with an awareness of the complex processes in which the desired outcomes must occur. However, advocating for changes to the timing of review is only part of the solution. Participants frequently expressed frustration with existing review processes, feeling that they were lengthy and uncoordinated. Therefore, efforts to expand the contribution of independent scientists should be part of a larger strategy to create a coordinated, comprehensive, and efficient platform for scientific review and guidance, encompassing independent contributors, state agencies, the Services and other internal participants. Further, because high-quality scientific guidance will generally require compensation (Noss et al. 1997; Brosnan 2000) these reforms may also require new or innovative sources of funding.

Prioritization. HCP science operates within a complex arena of legal standards, logistical timelines, and political, social, and economic constraints. Although scientists should focus primarily on science, they should not proceed as if the other constraints do not exist. Thus, the ability to prioritize is one of the most important skills that scientists can offer an HCP process. For example, given the temporal and finan-

cial constraints, HCPs would greatly benefit from scientific guidance that prioritizes which questions require new data collection or analysis and which can be addressed through professional judgment. Scientists should also use their experience and expertise to help make clear the relative benefits of investing limited dollars in upfront research, land acquisition, or establishing a fund for long-term monitoring and adaptive management.

Communication. Most HCP participants were satisfied with data adequacy and generally felt that logistic and economic issues posed greater challenges than data adequacy. Although HCPs must function on several levels, to fulfill their touted role of contributing to species conservation, they must be grounded in scientific principles, including an understanding of cumulative effects, the limitations of available data and models, and the uncertainty inherent in many restoration and mitigation strategies. Conveying the importance of these and other concepts to an audience with diverse educational backgrounds, objectives, and filters for evaluating science requires considerable communications skills. This is particularly true when participants are focused on the political and economic constraints bounding the negotiations. While effectively communicating scientific concepts and the importance of strong scientific underpinnings to a lay audience is a challenge, it is one that conservation scientists are uniquely equipped to address.

Coordination. The skills described above – communication, prioritization, and working with an awareness of other constraints – may be bolstered by integrating practitioners, in addition to academic scientists, into review processes (Fleishman 2001) and by utilizing a science manager**.** A science manager is responsible for coordinating communication between scientists and decision makers and other HCP participants, and helping scientists effectively prioritize the questions and issues that are most needed.

*Good science and participation not a panacea***.** Participant responses provided ample evidence that HCP decisions are often driven by political and economic factors. The inclusion of extensive data, scientific review, and outside participation cannot guarantee that HCPs will ultimately contain effective conservation measures. Illustrating the potential disconnect between scientific input and conservation outcome, several environmentalists interviewed about plans with a scientific advisory committee said they felt positively about the data but had concerns about the conservation value of the ultimate plan. One environmentalist stated that "the big decisions… were based on politics," and another attributed a plan's conservation deficiencies to a "lack of political power." These anecdotes illustrate the fact that good science alone will not necessarily result in strong conservation. Ultimately, decisions made within HCPs reflect political power and tradeoffs between various values and priorities (Policansky 1998; Song and M'Gonigle 2000). These factors will tend to influence conservation outcomes more than the data contained within the plan and, therefore, it cannot be assumed that efforts to improve the science of HCPs will automatically improve their conservation value.

Conclusion

Habitat Conservation Plans have been promoted as an effective tool for resolving endangered-species disputes on non-Federal land. Although outside commentators have suggested numerous changes to HCP policy, most agree that HCPs provide a necessary mechanism for flexibility and compromise and, in some cases, provide the only source of funding for critical management actions (Beatley 1994). Participants expressed many frustrations with the process, but they too generally felt that HCPs provide a necessary and important tool. Although many participants (including agency staff) were frustrated with the bureaucracy and lack of guidance from FWS and NMFS, they often added that the Services' implementation of the HCP pro-

gram was improving considerably through time. Thus, the basic foundation of the HCP program appears to be capable of achieving its promise of providing negotiated, compromise solutions that benefit both landowners and endangered species.

The extent to which this program actually does provide these dual benefits will depend on the political will to ensure meaningful conservation outcomes (Beatley 1994) and the continued fine-tuning of planning processes. Both independent commentators and HCP participants have much to contribute to this process of improvement. Recommendations for improving the conservation value of HCPs should be grounded in an understanding of current practices and the experiences of HCP participants. To be most effective, these recommendations should be bundled with mechanistic solutions to facilitate their integration into complex processes that are often money-limited, lengthy, and politically charged. The NCEDR interview-based study provides a promising start to the examination of the structures and processes that can either promote or hinder effective plan outcomes. Further research and analysis should be focused on evaluating HCP processes and structures and extending the lessons learned to current and future HCP practitioners.

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Literature Cited

Aengst, P., J. Anderson, J. Chamberlin, Grunewald, S. Loucks, and E. Wheatley. 1998. Balancing public trust and private interest: an investigation of public participation in habitat conservation planning. School of Natural Resources and the Environment. University of Michigan, Ann Arbor.

Beatley, T. 1994. Habitat conservation planning: endangered species and urban growth. University of Texas Press, Austin, TX.

Bidwell, D., D. Ostermeier, and S. Schexnayder. 1999. Process components in developing Habitat Conservation Plans. Endangered Species Update **16**:90-95.

Bingham, B. B., and B. R. Noon. 1997. Mitigation of habitat "take": application to habitat conservation planning. Conservation Biology **11**:127-139.

Brosnan, D. M. 2000. Can peer review help resolve natural resource conflicts? Issues in Science and Technology **16**:32.

Cullinan, T. 1997. Habitat Conservation Plans in industrial forests of the Pacific Northwest: mitigation and public participation. Endangered Species Update **14**:29-31.

Dwyer, L. E., D. D. Murphy, S. P. Johnson, and M. A. O'Connell. 1995. Avoiding the trainwreck: observations from the frontlines of natural communities conservation planning in southern California. Endangered Species Update **12**:5-7.

Fleishman, E. 2001. Moving scientific review beyond academia. Conservation Biology **15**:547-549.

Hall, D. A. 1997. Using habitat conservation plans to implement the Endangered Species Act in Pacific Coast forests: common problems and promising precedents. Environmental Law **27**:803-844.

Harding, E. K., E. E. Crone, B. D. Elderd, J. M. Hoekstra, A. J. McKerrow, J. D. Perrine, J. Regetz, L. J. Rissler, A. G. Stanley, E. L. Walters, and NCEAS Habitat Conservation Plan Working Group. 2001. The scientific foundations of Habitat Conservation Plans: a quantitative assessment. Conservation Biology **15**:488-500.

Hood, L. 1998. Frayed safety nets: conservation planning under the Endangered Species Act. Defenders of Wildlife, Washington, D. C.

Hosack, D. A., L. Hood, and M. P. Senatore. 1997. Expanding the participation of academic scientists in the HCP planning process. Endangered Species Update **14**:60-62.

James, F. C. 1999. Lessons learned from a study of habitat conservation planning. BioScience **49**:871-874.

Kareiva, P. 1999. Using science in Habitat Conservation Plans. Santa Barbara, CA: National Center for Ecological Analysis and Synthesis, and Washington (DC): American Institute for Biological Sciences, Santa Barbara, CA.

Kostyack, J. 1997a. Habitat conservation planning: time to give conservationists and other concerned citizens a seat at the table. Endangerd Species Update **14**:51-55.

Kostyack, J. 1997b. Reshaping Habitat Conservation Plans for species recovery: an introduction to a series of articles on Habitat Conservation Plans. Environmental Law **27**:742-765.

Lin, A. C. 1996. Participant's experiences with Habitat Conservation Plans and suggestions for streamlining the process. Ecology Law Quarterly **23**:369-446.

Loew, B. 2000. Multiple species habitat conservation planning: goals and strategies of local governments. Environmental Management **26**:S15-S21.

Mueller, T. 1997. The failed promise of habitat conservation planning. Linkages Fall 1997:7-8.

National Audubon Society. Report of the National Audubon Society Task Force on Habitat Conservation Plans. <http://www.audubon.org/campaign/esa/task_force.html> (March 29, 2003).

Noss, R. F., M. A. O'Connell, and D. D. Murphy 1997. The science of conser-

vation planning: habitat conservation under the Endangered Species Act. Island Press, Washington, D. C.
O'Connell, M. A., and S. P. Johnson. 1997. Improving habitat conservation planning: the California natural community conservation model. Endangered Species Update **14**:1-3.
Ostermeier, D., D. Bidwell, and S. Schexnayder. 2000. Habitat conservation planning: current processes and tomorrow's challenges. Environmental Practice **2**:166-175.
Policansky, D. 1998. Science and decision making for water resources. Ecological Applications **8**:610-618.
Price, M. V. 1993. Involving academics in endangered-species conservation: lessons from the Stephen's kangaroo rat Habitat Conservation Plan. Pages 21 to 25 in J. E. Keeley, editor. Interface between ecology and land development in California. Southern California Academy of Sciences, Los Angeles.
Shilling, F. 1997. Do Habitat Conservation Plans protect endangered species? Science **276**:1662-1663.
Smallwood, K. S., J. Beyea, and M. L. Morrison. 1999. Using the best scientific data for endangered species conservation. Environmental Management **24**:421-435.
Song, S. J., and R. M. M'Gonigle. 2000. Science, power, and system dynamics: the political economy of conservation biology. Conservation Biology **15**:980-989.
Thomas, G. A. 2001a. Where property rights and biodiversity converge II: the role of science. Endangered Species Update **18**(1):6-13.
Thomas, G. A. 2001b. Where property rights and biodiversity converge III: incorporating adaptive management and the precautionary principle into HCP design. Endangered Species Update **18**(2):32-40.
Thornton, R. D. 1997. The No Surprises policy is essential to attract private dollars for the protection of biodiversity. Endangered Species Update **14**:65-66.

Unethical Use of Rare and Threatened Plant and Animal Products in the Aroma Industry

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Abstract
Despite the existence of commodity shortages in the aroma industry, production and marketing strategies that are sustainable in the long-term are driven more by consumers and organizations concerned about conservation than by raw material producers and resellers. The poverty in which many indigenous peoples are submerged increases the unsustainable use of natural materials. This phenomenon is exacerbated by the unwillingness of large companies to pay fair and equitable prices to these peoples when searching and later making profit of active ingredients found in places such as the rainforest. The author argues for a more ethical and responsible use of raw materials in the aroma industry. He also describes the origin, use and status of important animal and plant aromatic items.

Uso no Etico de Productos Animales y Vegetales Raros y en Peligro de Extinción en la Industria de Compuestos Aromáticos

Resumen

A pesar de la existencia de problemas de abasto de algunos productos en la industria de compuestos aromáticos, las estrategias de producción y mercado sustentables a largo plazo son impulsadas más por consumidores y organizaciones preocupados en la conservación que por los productores y revendedores de materias primas. La pobreza en la cual muchos pueblos indígenas están inmersos incrementa el uso insostenible de materiales naturales. Este fenómeno se empeora por la indisponibilidad de las grandes compañías para pagar precios justos establecidos en términos de equidad a estas comunidades por la búsqueda de ingredientes activos que se encuentran en lugares tales como la selva tropical y por la posterior ganancia económica por el uso de estos mismos productos. El autor argumenta en favor de un uso mas ético y responsable de materias primas en la industria de compuestos aromáticos. También describe el origen, uso y estatus de algunos artículos aromáticos de origen animal y vegetal importantes.

Utilisation sans Scrupules des Produits de Plantes et Animaux Rares et Menacés dans l'Industrie Aromatique

Résumé

Malgré la manque des denrées dans l'industrie aromatique, les stratégies de production et de vente qui sont durables dans le long terme sont conduites plus par des consommateurs et des organisations intéressées par la conservation que par des producteurs et des revendeurs des matériaux primaires. La pauvreté de beaucoup de peuples indigènes augmente l'utilisation non-durable des matériaux naturels. Ce phénomène est aggravé par la réticence des grandes compagnies de payer des prix raisonnables et équitables à ces peuples pour la recherche et plus tard pour les bénéfices des substances actives trouvés dans les endroits tels que les forêts humides. L'auteur plaide pour un usage plus moral et plus responsable des matériaux primaires dans l'industrie aromatique. Également, il décrit l'origine, l'utilisation et le statut des articles aromatiques des plantes et animaux importants.

Introduction

The essential oil and aromatic raw materials industry is failing to self-police itself with respect to conserving threatened plant and animal species. Commodity shortages and higher unit prices for certain items signal ever-increasing supply problems. Green policies and any semblance of ecological awareness with respect to these commodities often seem to originate more from the attitudes of consumers than via the raw materials producer and reseller, in spite of the existent national and international laws restricting or forbidding trade in certain threatened species. It seems that some traders will only stop marketing these valuable commodities when prosecuted, legally prevented, shamed or pressurized into adopting more ecologically sound practices.

The World Conservation Union has now classified 11,167 creatures and 5714 plants as facing extinction (IUCN 2003). It is calculated that loss of species is currently running up to 1000 times its natural rate, thus it seems surely time to examine measures to help conservation strategies for the planet (New Scientist 2002). With this in mind, the October 2002 meeting of the United Nations Convention on Trade in Endangered Species voted in favor of protection of a further number of species, thus there is hope of tough international legislation to preserve biodiversity (New Scientist 2002).

There is a "non-human"-centered argument in environmental ethics, which states that an individual species has an absolute right to exist. Introducing human's interests into the picture complicates the issue, especially where products from threatened species have associated uses as commodities, at which point ideological principles are sometimes overturned (Benson 2000). For example, the 1973 Endangered Species Act in the United States, which is based on the assumption that each life form may prove valuable in non-predictable ways, and that each species is entitled to exist for its own sake, was initially welcomed by a majority of the public, but was later challenged by many people, when the habitat of a single unique species was seen to "get in the way" of major industrial development, affecting jobs and livelihoods, and maybe even affecting the way people might vote (Chadwick 1995). As another example, Pakenham (2002) devoted a complete chapter to the case of the eucalyptus forests in Australia. These forests contained enormous *Eucalyptus regnans* trees 350-400 feet high, a wonder in themselves! However, the cutting down of state-owned eucalyptus forests in the Yarra range north of Melbourne has monetarily benefited Australian taxpayers. It is hard to see that conservation can be perceived as effective and ongoing, when governments adopt such policies of such negative ecological value.

Biodiversity Conservation, indigenous peoples and the aroma industry

Slash and burn was practiced for hundreds of years in the tropics in a process of cultivation and fallow rotation (and sometimes management succession) without a great impact in the rainforest (Brookfield and Padoch 1994; Tomich et al. 1998). However, population growth and pressure from big corporations have decreased the amount of land available, and the fallow period has shortened with the subsequent degradation of the land (Tomich et al. 1998). The intensification of slash and burn practices lead to desertification, and agriculture and housing needs intrude more and more on former forest areas. Slash and burn policies of migrating agricultural practices may affect the pH of the soil, change the viable seed count and soil microflora, damage the root matt structure, and may lead to the degradation of forest areas. Indeed the poverty of the indigenous peoples can make huge demands on the forest reserves, and this effect may be comparable or larger than the effects of logging or other destructive forces.

Another cause of the extinction of species is the gathering of threatened organisms. One of the arguments for non-interventionist policies relates to

a fundamental right of peoples to use plants and herbs for religious, medicinal or ritual use. In fact, endemic peoples can easily view the imposition of ecologically reasoned restrictions on these practices as a form of Western scientific imperialism. I am sympathetic to this viewpoint, and would always seek to prevent the more serious threat of commercial exploitation rather than interfere with a more "legitimate" ethnic use, provided that this use does not continue to seriously endanger the species in question, for instance, by the use of sustainable practices to ensure the long-term preservation of natural resources. Sustainable forest development is defined by the International Tropical Timber Organization as "the process of managing permanent forest land to achieve one or more specific objects of management with regard to the production of a continuous flow of desired forest products and services without undue reduction in its inherent values and future productivity, and without undue desirable effects on the physical and social environment" (Mankin 1998).

But despite the fact that the need for as sustainable management is recognized, indigenous peoples generally gain absolutely nothing from large companies searching for new pharmaceuticals, active ingredients for cosmetics and drugs (e.g., curare and quinine), and agrochemicals in environments such as the rainforest (Prance 1998). No establishment mechanisms exist to reward local communities for the conservation of diversity, and the growth of forest conservation schemes has historically shown scant regard for the ways of indigenous peoples.

It is not all doom and gloom however. Panaia et al. (2000) report that one single plant of the critically endangered *Symonanthus bancroftii* plant was discovered in Ardath in Western Australia, and a recovery program using *in vitro* micropropagation techniques was started via the resources of Department of Conservation and Land Management (CALM) and the Botanic Gardens and Parks Authority of Western Australia. The plant has now a less precarious outlook, illustrating the role of tissue culture, one of the ex-situ measures proving useful in conserving rare and threatened species.

Ethno-botany is now such a buzzword across the cosmetic world, thus it is hard to find out if there is any effective monitoring for the majority of these raw materials, and from personal experience, complete ignorance of the conservation status of these commodities items would seem to be the norm amongst the majority of technical staff of many leading cosmetic companies. However, charges of bioethnic plundering in exotic materials for cosmetics generally are offset by the fact that indigenous peoples may gain monetarily from these exploits. For example, the trend towards exotic botanical extracts as actives in cosmetic products is a major development and has spawned some interesting associations, such as those between the French Conservatory of Specialized Botanical Collections and producing companies in Madagascar and Brazil. Unfortunately, it is possible that extensive usage of these exotic ingredients may further damage the fragile ecosystems from whence they came. What action can we in the aroma world take to contribute to conserving biological diversity? One possible way is not to formulate with, or trade in commodities which origin is a threatened species, until we are far surer that truly sustainable production methods are in place. Dialogue to discuss how this might be done, the drawbacks of imposed monoculture on cleared forestland, and policies which contribute to species succession is welcomed. Some of these exploited aromatic items are listed below, although the list is far from being comprehensive.

Animal Products

1. Civet. Civet products were used in less enlightened times in perfumery for their animalic notes, finding use in orientals, heavy florals and chypres. Civet paste is obtained from squeezing or scraping the anal glands of the African civet cat *Civetticus civetta* (sometimes

classified as *Viverra civetta),* the Indian civet *Viverra zibetha* (from India, Indonesia and Malaysia), the Lesser Indian civet (also known as the Chinese civet) *Viverricula indica* (East and South China) and other civet species. *C. civetta*, *V. zibetha* and *V. indica* are listed under Appendix III of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (CITES 2003).

De-Sheng (1986) wrote a review article of the civet cat and presented detailed GC-Mass Spectrometery data on the composition of steam micro-distillation-extraction volatiles from civet secretions obtained from the Chinese civet *V. indica*. Yingkang (1991) described civet paste collection from Hangzou Zoological Garden in China and estimated an annual production of 12 kg of civet paste per year from a one-hectare civet farm operated by the zoo. Farms also operate in Ethiopia, Kenya, Congo, Guinea, Senegal and India. Petitdidier (1986) glowingly reported on a visit to Addis Abbaba Research Institute, which controlled the civet quality output from 105 Ethiopian farms. A similar kind of article would be hard to find these days, reflecting how attitudes have changed.

2. Musk. Musk grains and pods are obtained from the preputial glands of the musk deer (*Moschus* spp). Geist (1999) argues that these timid creatures are really tragulids, the similarity to deer only occurring by convergent evolution. A principle difference is that tragulids have fewer exocrine glands than "real" deer. Examples of musk deer species include *Moschus berezovskii* found in Southern China and Northern Vietnam, *M. chrysoagaster* found in India, and *M. moschiferus* found in China, Mongolia, Himalayas and Korea. *Moschus* spp populations of Afghanistan, Bhutan, India, Myanmar, Nepal and Pakistan are listed under Appendix I of CITES, while other populations are included in Appendix II (CITES 2003).

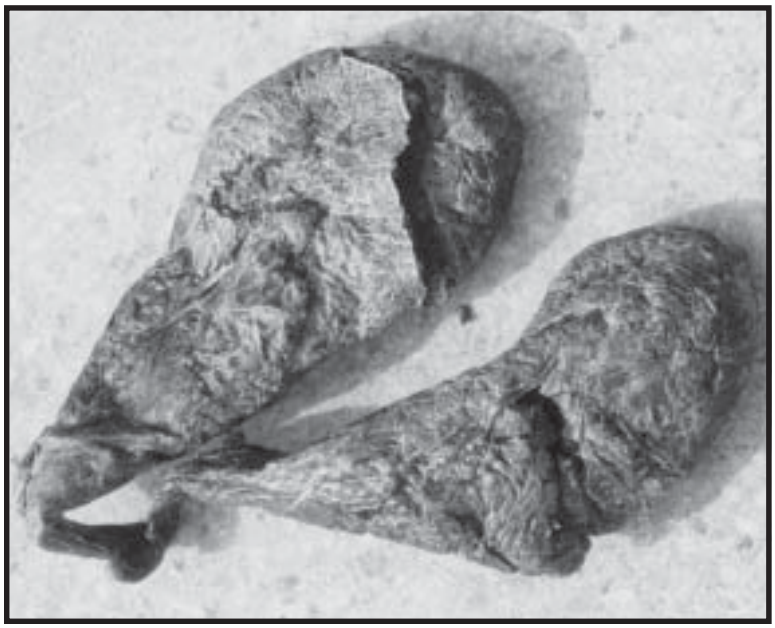
Animal musks have had a long history of use in perfumery. Zhong and Hui (1996) reported that China formerly had 90% of the world "musk deer resources," but that deer populations was reduced from 2.5 million on the 1960s to 100,000 in 1996. Green (1986; 1989) and Wemmer (1998), noted that the economic viability of musk harvesting from either free-range or captive musk deer has not been evaluated. Only small amounts of musk are nowadays used in perfumery - the largest consumers of musk products being China (where various musk qualities are used in traditional medicine) and Japan. Moria (1992) reported that musk is no longer an ingredient of modern Japanese incense.

Traditional musk qualities used in perfumery included: a) musk Tonquin from *M. moschiferus* deer in Tibet and China; b) musk cabardine from cabardine deer *M. sibiricus* and *M. altaicus;* c) musk Yunnan of different physical appearance from Tonquin; d) musk Bengal (maybe also known assam musk), usually regarded as inferior; e) musk Siberian from the Shansi mountain regions; and f) musk of boukharie.

3. Ambergris. Ambergris is a pathological exudate from the sperm whale *Physeter macrocephalus* and only occurs in approximately 1% of the population. The disease is caused by exposure to sunlight and seawater producing this formerly used perfumery material. *Physeter* spp, amongst other whales, are listed under Appendix I of CITES (CITES 2003). Rice (2002) of the National Maritime Mammal Laboratory, Seattle, pointed out, that contrary to the widely held belief that harvesting of ambergris masses did not pose threat to whale viability because they may be found floating in the sea or washed up on shores, ambergris is hardly ever found on beaches but is mainly recovered from whale carcasses.

4. Castoreum. Castoreum qualities are ethylic extracts of the accumulated dried material collected via secretory glands in the abdominal pouch of the Siberian beaver *Castor fiber* and the Canadian beaver *C. canadensis* living in Alaska, Canada and Siberia. Russian

and Canadian commercial products were available in former times (e.g., from the Hudson Bay Company), and at the present time castoreum products are still available from internet traders and certain perfumery companies (e.g., some in France). Castoreum was once used in perfumery to give leathery animal notes to chypres and to other perfumes. In spite of progress in understanding the chemical composition of castoreum, no synthetic replacement or reconstitution comes close to reproducing the in-perfume effects produced by the authentic material.



Castoreum spp glands.
Photograph by Tony Burfield.

5. Muskrat. Although the species is not threatened, products such as musk zibata were formerly produced from the muskrat *Ondatra zibethicus*, which lives on the Louisiana marshlands. Hall (1981) reported that in North America muskrat pelts are the most valuable fur pelts in the trapping trade. The perfumery use of muskrat products would nowadays be regarded as non-ethical.

There are other "animal" products that are not similarly universally regarded as unethical commodities (e.g., beeswax absolute obtained via alcoholic extract of beeswax). The official line is that respectable international perfumery companies do not trade in animal raw materials, as the trade is regarded as unethical, if not actually illegal under CITES agreements. It does not take the trainee in perfumery too long to realize that certain identifiable perfumery companies do not adhere to these criteria, although they risk the attentions of environmentalists and animal welfare groups who might vigorously pursue these miscreants.

An interesting development is the reported banning of the import by the Chinese government on March 2002 of products from Europe (that includes members and non-members of the European Union), Japan and Oman, containing or suspected of containing animal derivatives (Parfums Cosmétiques Actualités 2002). It will be interesting to see if the ban just applies to some cosmetic materials - including fragrance ingredients - or also applies to musk and other ingredients imported for use in traditional Chinese medicines.

Plant Products

1. Orchid oils. The three commercially cultivated species of the vanilla plant, *Vanilla planifolia* (Bourbon or Indonesian vanilla), *V. tahitensis* (Tahitian vanilla), and *V. pompona* Schneide (Guadeloupe vanilla; vanillons; W. Indian vanilla) are not included in this category. Orchids are already sufficiently rare in many European countries to have protected status, and the family *Orchidaceae* is listed under Appendix II of CITES and Annex B of Regulation (EC) 338/97 (CITES 2003). Some examples of threatened species still use are the ladies slipper *Cypripedium parviflorum* var. *pubescens*, which is used in herbal medicine and is listed in the British Herbal Pharmacopoeia 1983, and *Ophyris insectifera* used in "salep" for Turkish delight and ice cream. McGriffin (2000) proposed self-regulatory initiatives to refrain from trading in wild-harvested ladies slipper. He suggested that these initiatives should be put into practice by the herbal industry, all American Herbal Products Association members, and all other individuals and businesses in the horticultural and herb trade.

Many natural perfumes produced

by many orchid species are currently being researched by leading perfumery companies (Kaiser 1993). Pain (2001) described the plant hunting for new perfumes including orchid perfumes in rain forest areas (e.g., Madagascar) by experts from one of the world's largest fragrance companies. Current interest by the media is further reflected in O'Connell's (2001) reporting on the work of Josef Limacher, a perfume hunter working on orchid scents in locations in Brazil. Kaiser (1993) presented an impressive academic account of the chemistry of natural orchid scents from many parts of the world in his fabulously illustrated book. Although the threat of mass exploitation of orchid species is unlikely, close monitoring to protect individual habitats of these beautiful and irreplaceable plants is desirable.

2. Mountain tobacco. Extracts, concretes, essential oils, the dried roots, dried whole plant and dried flowers of *Arnica montana* are commercially offered, in spite of declining plant populations. Due to over-exploitation, *Arnica montana* is listed under Annex D of the CoE Regulations (EC) No. 338/97 and under Annex V(b) of the European Union Habitats, Fauna and Flora Directive (EUO 2003). A rare drug, the tincture of arnica flower oil from the capitula's of *A. montana*, has previously achieved pharmaceutical status in the British Pharmacopoeia Codex of 1949. The herb and its products have similarly been official in many National Pharmacopoeias (e.g., Austria, France, Germany, Switzerland and it is mentioned in the British Herbal Pharmacopoeia of 1983). The market for the dried flowers is believed to be 50 tons per annum and this product is almost totally derived from wild harvesting from Spain and Romania. An excellent review of the status of *A. montana*, including the position with respect both to legal and illegal harvesting in Spain, is described by Lange (1998).

3. Costus. Products such as extracts, concretes, and essential oils are obtained from *Saussurea lappa* (also known as *Saussurea costus*). This species is sometimes mistaken with the herbal plant *Costus speciosus*. *Saussurea lappa* plants, known as kuth in Hindi and in the herb trade, are grown in Kashmir, Sikkim and other areas of the Himalayas, and in southwestern China. The plant has become endangered and export is banned, the species being included in Appendix I of CITES (CITES 2003). *S. lappa*'s qualities are better known in perfumery as costus products (e.g., costus absolute, costus oil). The plant grows wild, mainly in Jammu and Kashmir (specifically in the Kishenganga and Chenab valleys), but is also cultivated in Kashmir and Lahul. Roots of the plant are used in Ayurvedic, Unani, Siddha and Tibetan medicinal systems. The oil was formerly used in high-class perfumery in small quantities to impart animalic and sebaceous notes, and some would say coupled with orris-like effects. Up to 12 tons of raw material per year are exported from northwest districts of India, in spite of their threatened status and not being permitted in perfumes because of problems of dermal sensitization associated with sesquiterpene lactones and other sensitizers in costus products. Incorporation into perfumes is against the International Fragance Research Association standards, unless specific commercial grades offered are shown to be non-sensitizing.

Additional List of Rare and Threatened Species

The following are aroma materials from species that I believe to be rare, very rare or threatened in their natural habitats. Some aromatic raw material users may be anxious that the conservation ideal should ensure that not only the morphologically distinct forms are preserved, but also the conservation of chemotypes is given equal weighting.

1. Rosewood oil. Oil from the wood of *Aniba rosaedora, A. amazonica, A. parviflora* and other *Aniba* species and varieties, is distilled to produce "bois de rose" or rosewood oil. The present production is mainly from Brazil (the

pure oil is only shipped out from Manaus), although formerly was produced also in French Guiana, Surinam and Peru. Time is running out for this important raw material. Replanting deals (i.e. guaranteeing tree replantation with trade purchases) are commendable in some respects, but will make little impact in the short term due to the long maturation period of the trees. There has been some efforts to find possible substitutes for rosewood oil in aromatherapy in order to protect *Aniba* species (Burfield and Sheppard-Hanger 2003). Loss of germ plasm diversity and narrowing of the genetic base is believed to have already occurred through tree over-exploitation to satisfy the demand for essential oil, although efforts to create a germ plasm collection are now afoot. Some encouraging trials for young trees indicate better growth characteristics in cleared areas compared to the relative failure of poly-tunnel trials. The Faculdade de Ciencias Agrarias do Para at Belem, Brazil recently evaluated specific needs for formal cultivation, including the selection of superior germ plasm, economic studies for production of wood and leaf oils, and optimization management regimes for short-rotation harvesting of trunk wood and leaves. Major purchasers of rosewood oil to date are believed to have been local outposts of fragrance sector multinationals, who have taken up to 100 tons per annum of oil since the eighties (the present output is believed to be closer to 30 tons). This is in contrast to the Brazilian situation of the nineteen sixties, where fifty or so Brazilian distilleries provided 500 tons per year of oil (Ohasi et al. 1997).

Peruvian rosewood oil from "sustainably grown" *Ocotea caudata* is also being sold into the essential oils market. The history of exploitation of *Ocotea* species has not been good up to now. The over-exploitation of Brazilian sassafras *O. pretosia* and the valuable South African timber tree *O. bullata* has been such that the latter is a protected species. So much felling of *O. pretosia* in Santa Caterina forests of Brazil has occurred in the last few decades in order to produce Brazilian sassafras oil that now the transport distances to the distillery are relatively great, and the oil is starting to be uneconomic to produce. Since *O. cymbarum* is often confused with *O. pretosia* has also suffered reduction in numbers from indiscriminate felling. Many *Ocotea* species are slow-growing species and may take up to forty years to mature. If exploitation becomes scaled up the future of *O. caudata* may be uncertain, although some oil customers dislike the inferior odor profile (pine-oil disinfectant like) of some batches of the oil, which makes the increase of *O. caudata* exploitation very unlikely.

2. Amyris oil. Although there is no study that corroborates this prediction, I believe that *Amyris balsamifera* is at risk of becoming extinct in its natural habitat, the Caribbean and Gulf of Mexico, in less than ten years due to over-exploitation. The oil is not greatly valued in perfumery but rather has found employment as an extender of other oils, or in cheap soap perfumes.

3. Sandalwood oil. Possibly originally introduced from the Timor islands, the parasitic sandalwood trees *Santalum* species such as *S. freycinetianum* (Lanal sandalwood) and *S. album* (East Indian sandalwood) became endemic to southwest India, often hiding deep in the southern forests. According to Sahni (2000), some species of *Santalum* were perhaps spread there via birds following their establishment by man on the outskirts of forests or nearby villages. Sahni (2000) also estimated that sandalwoods have been indigenous to parts of India for 23 centuries. My best guess is that there are possibly less than 130,000 hectares of *S. album* trees in the whole of India. In Karnataka and Tamil Nadu forests trees grow at elevations of up to 1400 m and there is some evidence that oil formation in the heartwood is optimal where trees are grown at heigths between 600 to 900 m. It is probable that 75% of India's sandalwood output comes from the forests of Karnataka, where extensive replanting trials have been carried out, although the market sourcing for

this commodity may now focus increasingly on Papua New Guinea. Many replantings in other districts of India have produced viable plants, but with no oil content. Rai (1999) described the plantation techniques used for raising sandalwood from seeds, and container raised seedlings. Many attempts have resulted in failure from insufficient knowledge of the host-parasite relationship, or from mismanagement (e.g., deaths by dehydration, animal scavenging, or human-caused destruction). Due to over-exploitation, East Indian and Indonesian oils from *S. album* are not not freely available, although some limited production of East Indian sandalwood is taking place. The market price of East Indian sandalwood at the time of writing is £425 per kilo! The production has partly been in the control of the Madras and Mysore state governments, who have attempted to prevent the unauthorized smuggling of oil. However, illegal sandalwood oil has been commonly offered in the oil dealing trade, and in recent years, the industry has largely turned its back and pretended not to notice the practice, and now we may be paying the price.

Trees are quite susceptible to disease, especially to the mycoplasmal spike disease, which affects the principal forests (see Nayar (1988) for a detailed review of spike disease). Mineral and hydrational requirements are provided by the host, thus spike disease is thought to be aided by the selection of inappropriate hosts for the sandalwood tree. Infected trees will normally die within 3 years.

There is no national or international genetic germ plasm resource or collection of sandalwoods in existence anywhere. Further, full maturity for trees may take 60-80 years. All of these factors coupled with over-exploitation are putting pressure on other *Santalum* species from which replacement sandalwood oils are being produced. For instance, *S. austrocaledonicum* (sandalwood oil vanuata) and *S. yasi* (Fiji, Tonga) have been so exploited, that numbers of these species are down to a few trees. *S. fernandezianum* was exploited since 1624 for its valuable sweet-scented wood, and according to Lucas and Synge (1978) the last specimen of this species was last seen alive by Skottsberg in 1908. The status of tree numbers of *S. insulare* (French Polynesia), *S. macgregorii* (Papua New Guinea), and *S. ellipticum* (Hawaii) also needs monitoring.

Although East Indian sandalwood reached protected species status in 1995, most of the aroma industry trade press has virtually ignored the topic. Soap, Perfumery and Cosmetics (2002) highlighted the research on the Australian sandalwood *S. spicatum* extract by the Institute of the Pharmaceutical Chemistry in Vienna, in conjunction with an Australian sandalwood producer (Mt. Romance). The article is largely devoted to extol the virtues of *S. spicatum* "oil," apparently via felled trees from a 1.6 km^2 area. Unfortunately the article fails distinguish the differences in compositional and odor properties between East Indian sandalwood oil and the Australian sandalwood extract. Webb (2000) described the solvent extract procedure details, which is followed by co-distillation as utilized by Mt. Romance in the preparation of Australian sandalwood extract.

4. Jatamansi oil. Jatamansi oil is extracted from *Nardostachys jatamansi*, which is found in the Eastern Himalayas, Nepal, Bhutan and Sikkim. The once abundant herbal plants described by early botanists (e.g., Gammie 1894) have been virtually stripped from the hillsides by herb gatherers in many places now, so the plant is becoming extremely scarce and the perennial only occurs in a few Himalayan valleys, typically at heights of between 3600-4800 m, or even at higher elevations. Amatya and Sthapit (1994) expressed concern about over-exploitation of the species, calling for increased levels of cultivation. The authors also remarked that although export of the herb itself was not allowed, there is no restriction on exporting oleoresin and essential oil, and the export volumes of these products are often in-

accurately reported, to avoid payment of government tax. The trading of *N. jatamansi* only reflects the high levels of commercial exploitation that still occurs with other Himalayan herbs like *Aconitum ferox*, *Picrorhiza kurrooa* and *Swertia chirata*. Apart from *S. chirata*, these species are disappearing fast. The rhizome from *N. jatamansi* is used in Ayurvedic medicine for the treatment of hysteria and other nervous illnesses. The larger plant *N. grandiflora* which occurs in the same regions that *N. jatamansi* does, achieved CITES Appendix II listing in July 2000, together with *Picrorhiza kurrooa*. *P. kurrooa* is a tonic herb and possibly the most well-recognized Himalayan medicinal herb. It is interesting to note that *N. grandiflora* is said to be often co-gathered with *Valeriana wallichi* according to Traffic International (1999) and that published chemical compositions of essential oils from these two species are similar.

5. Chaulmoogra oils. Chaulmoogra oils are extracted from *Hydnocarpus* species from some regions in India (especially the Western Ghats and Karnataka). Interestingly, chaulmoogra oils are fixed oils, often being solid in temperate European climates, but with a history of being traded by the essential oil industry. Their traditional indigenous medicinal use against leprosy has been largely superseded by modern pharmaceutical drugs. Biswas (1956) noted that species of chaulmoogra were ruthlessly and crudely collected and sold outside Nepal, in addition to other species such as chirata (*Swertia chirata*) and kuth (*Saussurea lappa*). Since then exploitation has further reduced the abundance of the species. Shankar and Majumdar (1997) quoted the Foundation for Revitalization of Local Health Traditions Research Department, which published a first Red Data List of threatened South Indian medicinal plants, in which the status of *H. macrocarpa* was listed as vulnerable. CIMAP (1997) reported that *H. pentadra* is facing genetic erosion and that in general *Hydnocarpus* species are in decline due to habitat destruction.

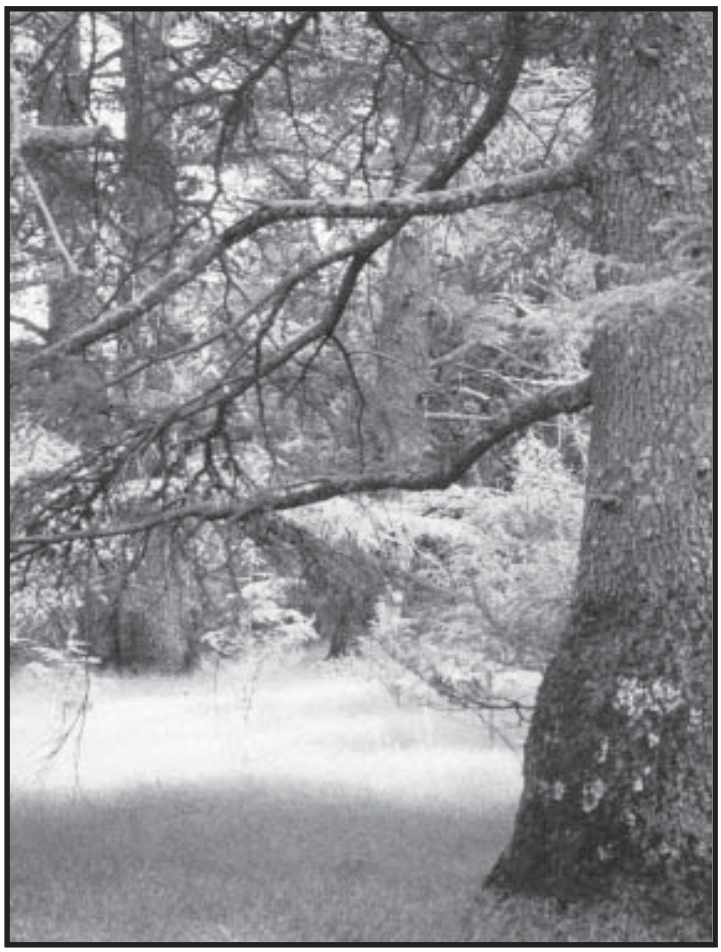
6. Gentian. Many of the 300 or so *Gentiana* species remain very rare or threatened (IUCN 2003). *Gentiana* extracts have traditionally been used in medicines and flavorings, but species such as *G. tibetica* was formerly used in Tibetan medicinal systems, but the species has become so rare that substitutions may have to be made. Kletter and Kriechbaum (2001) note that *G. tibetica* is often confused with *G. crassicaulis* and *G. robusta*, and may be plant gatherers are simply looking in the wrong area for the species. The species may occur in Nepal but is confined to southeast Xizang, Bhutan, Sikkim at heights between 2100 to 4200 m. Kletter and Kriechbaum (2001) further recommended that gathering of all three species should never exceed 50% of the total local population of plants, and should only occur during two years in a row followed by one year without harvest.

G. lutea is listed in the Red Book Data listings for Bosnia, Romania, Portugal, Bulgaria, Albania, Germany, Czech Republic, Ukraine and Poland. It is commonly used as a source material in the preparation of gentian absolute for the perfumery trade, and as a bittering agent in alcoholic beverages, but the more economically important use for the dried roots and rhizome of the plant is to produce bitters to stimulate the digestive system. Lange (1998) estimated the demand for dried roots as being 1500 tons per annum, mainly derived from gathering from the wild in France, Spain, Turkey, Bavaria, Albania and Romania. He also noted that wild harvesting of *G. lutea* in Spain proceeds in contravention of existing legislation.

7. Kenyan cedarwood oil. Known as the East Africa pencil cedar tree, *Juniperus procea* reaches up to 30 m and is found in parts of Ethiopia and central Kenya at 1000 to 3000 m of altitude. An oil traded as Kenyan cedarwood oil was formerly produced from distillation of the chipped wood, and was commercially available as a common perfumery raw material up to the mid-eighties. By 1986, *J. procera* was included in the FAO listing of endan-

gered tree and shrub species and provenances (FAO 1986). Ciesla (2002) discussed reasons for the decline of the species, which include the effect of possible pathogens, drying out of forests and human factors such as heavy overgrazing. The decline lead to the oil production cessation in Africa, and the oil has disappeared from the raw material inventories of perfumery companies. The tree has been introduced into parts of India (the Nilgiris), and waste wood from trees cut down for furniture making may be distilled on a very limited scale to produce oil for local use.

8. Agarwood. Agarwood (also known as aloeswood) is extracted from *Aquilaria* and *Gonystylus* spp. *A. malaccensis* and other *Aquilaria* species grow in Malaysia and Indonesia are becoming rare because of the great demand for infected sections of fragrant wood (agaru), which fetch a great price. *A. crassna* is listed as endangered by the Vietnamese government and *A. malaccensis* is protected under CITES. Agarwood trees are felled indiscriminately by roving teams of agaru hunters who search Southeast Asian territories for this very valuable material, in places in which the species are not known to occur. Exploitation from incense makers and other commercial users threaten the continued future sustainability of *A. agallocha* trees (which some workers regard as synonymous with *A. malaccensis*) from Cambodia, Vietnam and Thailand (Barden et. al. 2003; CITES Newsletter 2000). *A. malaccensis* is mentioned amongst 65 listed Indian medicinal and aromatic plants facing genetic erosion by CIMAP (1997), a list that also includes *Gentiana kurroo*, *Sausaurea costus*, *Hedychium spicatum*, *Nardostaschys grandiflora, Gaultheria procumbens* and *Jurinea dolomiaea.* Agarwood formation is maximal in trees older than 25 years old, peaking in trees older than 50 years, thus even though the Department of Forests in Arunachal Pradesh has developed large *Aquilaria* plantations, these measures may not affect the cutting and illegal exporting of this product. Attempts and trials for artificial resin inducement and biotechnological processes for agaru production are planned to be covered at a First International Agarwood Conference which will take place in Vietnam on November 2003. The objective of this conference is to lay the groundwork for collaborative efforts towards preventing *Aquilaria* trees becoming extinct in the wild.



Cedrus atlantica.
Photograph by Tony Burfield.

Momberg et al. (2000) provided an insight into the social and ethical issues surrounding the bioprospecting "rush" for agaru in the Kayan Mentarang National Park in East Kalimantan, Indonesia. The authors reported for example that the nineties boom in agaru collecting featured non-indigenous teams flying agaru out by aircraft. Eventually government restrictions stopped this activity, unfortunately at the point when the agaru forest re-

serves were exhausted. Inexperienced outside collectors felling every *Aquilaria* tree (instead of just infected trees) have added to a worsening situation.

9. Greater wormwood oil. This product is derived from *Artemisia gracilis*, a now rare European alpine plant growing at elevations of 2400-3500 m. The oil was formerly used as a flavoring ingredient in alcoholic beverages and to produce the alpine liqueur genipy.

10. Anise scented myrtle oil. This oil is traditionally associated with Australia (North East part of New South Wales, specifically the Bellinger and Nambucca valleys). Anise scented myrtle oil is obtained from *Backhousia anisata*, a rare tree that grows up to 25 m, although plants are always smaller in cultivation. Briggs and Leigh (1996) listed *B. anisata* as a rare or threatened plant, with a geographic range in Australia of less than 100 km. More than 1000 trees of the species exist in natural reserves and Briggs and Leigh (1996) consider the species' status as adequate inside the reserves. Annual production of leaf or branch or bark oil production is not known, although is believed to be minute. Some anecdotal reports state that leaf oils produced from the cultivated plants are inferior in odor profile to wild harvested leaves. The spicy leaves have been used in the Australian bush tucker industry.

11. Hinoki wood oil. Since 1982 the Japanese government has protected *Chamaecyparis obtusa* where the oil is extracted from, and has only allowed the use of trees that have died naturally, or which have been recycled from the rebuilding of temples. Therefore the oil is produced from the steam distillation of the chipped wood and sawing wastes of the Hinoki tree legally obtained, and buyers should seek documented proof of legality if buying from a Japanese source. There may now also be some limited Chinese production of this oil.

12. Havozo tree oil. The practice of bark distillation, which produces an oil that smells strongly of aniseed and contains 80-97% methyl chavicol as well as limonene, anethole, and linalol, is threatening the survival of *Ravensara anisata*, the Madagascan tree from which the oil is extracted. There are some signs that this practice is being discouraged and better forestry management are being put into practice (Rasoanaivo 1997).

13. Siam Wood oil. *Fokiena hodginsi*, first reported in 1908 and now becoming very rare, is used to produce this oil. The oil is rarely encountered commercially.

14. Mulanje cedarwood. In 1892, Whyte reported that forest fires were threatening the mulanje cedarwood *Widdringtonia whyte* (Dallimore and Jackson 1966). However, this African species survived in a ten-mile area until it was replanted from Mulanje Mountains Forest Reserve in the 1960s to former Nyasaland, Tanganyika and Kenya. Now over-used as timber, sawdust is collected from timber-yards and distilled to obtain oil for local use.

15. *Origanum* oil. Several individual species of *Origanum* such as *O. barygyli* from Syria and *O. dictamus* and *O. vetter* from Greece are rare or threatened. Several institutions have collected the genetic resources of the genus, which reside in a number of gene banks and private collections across the world.

16. Himalayan cedarwood oil. *Cedrus deodara* grows on the Himalayan slopes of northern India, Afghanistan and Pakistan, at elevations between 1650 and 2400 m, and has extensively been used in India for building, furniture and railway sleepers. Felled trees are floated down the rivers in the Himalayas to the plains. Oil production is down from former levels of 20 tons, to approx 1 ton per year. The species is listed as threatened (Farjon et al. 1993), and according to Sahni (2000) the tree is the remaining habitat for the threatened and spectacular Western tragopan (*Tragopan melanocephalus)* in parts of Kashmir, Himachal Pradesh and Pakistan. The oil is widely used in aromatherapy, but little used in Western perfumery where Virginian cedarwood oil from *Juniperus virginiana* L. is often preferred.

17. *Cedrus atlantica* commodities.

The tree is found at elevations between1400 and 2500 m growing on several types of soil in 133,653 hectares of cedar forest in the Moroccan Middle Atlas, Rif Central, Grand Atlas Oriental and Middle Atlas Oriental mountains (Mardaga 1999). While cedarwood Atlas trees are well conserved in specific protected areas, the ecosystem is very fragile, and often the margins are subject to degradation by erosion, demineralization, dehydration, and desertification, occasionally resulting in areas of complete desolation, in spite of heroic attempts by the Moroccan authorities to maintain the natural habitat. Lawrence (1985) reported that the production of cedarwood Atlas oil was 7 tons, but the availability in recent years has been more limited, probably now to around 1 ton per annum.

18. *Thymus* oil. Of the 350 distinguishable species of *Thymus*, threatened species include *T. moroderi, T. baeticus* and *T. zygis* subsp. *gracilis* (Lange 1998). Although licensed collection may put the brake on international trade on certain *Thymus* traded items, the use of *Thymus* species for essential oil distillation within Spain is not monitored, and so the true situation of the genus is not clearly known (Lange 1998).

19. Buchu oils. *Agathosma betulina and A. crenulata* leaves are steam-distilled to produce the oil. The plants have long been used in traditional South American ethnic medicine, but a major use for the powerful smelling steam-distilled oil is in flavorings and perfumery to produce a fruity berry (especially blackberry) note. Its diminishing presence in the wild has been the subject of several recent articles. For instance, Hoegler (2000) mentioned the poor gathering practices in the face of increased demand that has partially been responsible for the demise of the species, and mentioned the work of Agribusiness in Sustainable African Plant Products (A-SNAPP) which has targeted the plant for sustainable development initiatives. Recently, African farmers demanded price rises of 30% for buchu oil, a move known as "holding the market to ransom" (Parfums Cosmétiques Actualités 2003).

20. Cinnamomum oils. At the time of writing, the Chinese authorities have seemingly introducing a ban on tree-felling of certain species including *Cinnamomum* because of concerns related to climate change. Ho leaf and wood oils from species such as *C. camphora* L. var. *linaloolifera* and *C. camphora* Sieb var. *glavescens* Hayata, are subject to considerable price rises and supply problems. Zhu et al. (1994) had previously warned of potential problems of exhaustion of *Cinnamomum* species reserves in China, as no policy of tree replanting currently existed. The future sustainability of this commodity is unforeseeable at present. Another *Cinnamomum* species, *Cinnamomum tamala,* was listed by CIMAP (1997) as suffering from over-exploitation and habitat destruction in India, such that plant populations are considerably reduced to the point of being "nearly threatened."

Just because some aromatic materials are no longer offered, it does not necessarily mean that they are threatened. Unavailable products could be divided into various groups: a) materials no longer available in former quantity due to lack of demand (e.g., *Backhousia citriodora* oil for many years, after the advent of cheap commercially available synthetic citral, and now enjoying modest comeback due to interest in natural perfumery); b) materials which have slipped from fashionable use, but can be obtained with difficulty (e.g., reseda absolute from *Reseda odorata*, woodruff absolute from *Galium odorata*); c) materials which go short because of huge demand (e.g., vanilla oleoresin from *Vanilla* spp.); and d) materials which become temporarily short due to climatic or political difficulties (e.g., geranium Chinese *Pelargonium graveolens* in 2002).

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Literature Cited

Amatya G. and Sthapit V.M. 1994. A note on *Nardostachys jatamansi.* Journal of Herbs, Spices and Medicinal Plants **2**(2): 19-47.

Barden A., N. A. Anak, T. Mulliken, and M. Song. 2003. Heart of the matter: agarwood use and trade and CITES implementation for *Aquilaria malaccensis*. <http://www.traffic.org/news/agarwood.pdf> (May 20, 2003).

Benson J. 2000. Environmental Ethics. Routledge, London 2000.

Biswas K. 1956. Common Medicinal Plants of Darjeeling and Sikkim Himalaya. Bengal Goverment Press, West Bengal.

Briggs J.D. and J.H. Leigh. 1996. Rare or threatened Australian plants. Fourth editon. CSIRO Publishing, Collingwood, Australia.

Brookfield H. and C. Padoch. 1994. Appreciating agrodiversity: a look at the dynamism and diversity of indigenous farming practices. Environment **36**(5): 6-11,37-45.

Burfield T. and S. Sheppard-Hanger. 2003. Substituting for rosewood: high linalool essential oils. Aromatherapy Today **26:**30-37.

Chadwick D.H. 1995. Dead or alive: the Endangered Species Act. National Geographic **187**(3):2-41.

Ciesla W.M. 2002. Juniper forests: a special challenge for sustainable industry. Forests, Trees and Livelihoods **12**:195-207.

Central Institute of Medicinal and Aromatic Plants (CIMAP). 1997. Indian medicinal plants facing genetic erosion. CIMAP, Lucknow, India.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Official documents: appendices I, II and III. <http://www.cites.org/eng/append/latest_appendices.shtml> (May 28, 2003).

CITES Newsletter. CITES news: plants. <http://www.rbgkew.org.uk/conservation/Issue7English.pdf> (July 7, 2000).

Dallimore W. and A.B. Jackson. Handbook of Coniferae and Ginkgoaceae. Fourth edition (revised by S.G. Harrison). Edward Arnold, London.

De-Sheng D. 1986. Civet cat in China. Perfumer and Flavourist **11**(October/November):97-103.

European Union On-Line (EUO). Annex V: animal and plant species of community interest whose taking in the wild and exploitation may be subject to management measures. <http://europa.eu.int/comm/environment/nature/hab-an5en.htm> (May 20, 2003).

Farjon A., C.N. Page and N. Schellevis.1993. A preliminary world list of threatened conifer taxa. Biodiversity and Conservation **2**:304-326.

Food and Agriculture Organization of the United Nations (FAO). 1986. Databook on endangered tree and shrub species and provenances. FAO, Rome.

Gammie A. 1894. Reports on botanical tour of Sikkim: 1892. Botanical Survey of India **1**(2):1-24.

Geist V. 1999. Deer of the world: their evolution, behaviour and ecology. Stackpole Books, Mechanicsburg.

Green M.B.J. 1986. The distribution, status and conservation of the Himalayan musk deer (*Moschus chrysogaster*). Biological Conservation **35**: 347-375

Green M.B.J. 1989. Musk production from musk deer. Pp 401-409 in R.J. Hudson, K.R. Drew and L.M. Baskin, eds. Wildlife production systems. Cambridge University Press, Cambridge.

Hall E.R. 1981. The mammals of North America Volume II. Second edition. Wiley-Interscience, West Sussex.

Hoegler N. 2000. Plight of buchu underscores the need for international herb development. Herbalgram **50**:16.

International Union for Conservation of Nature and Natural Resources (IUCN). IUCN Red list of threatened species. <http://www.redlist.org/> (May 20, 2003).

Kaiser R. 1993. The Scent of Orchids. Editiones Roche, Basel.

Kletter C. and D. Kriechbaum, eds. 2001. Tibetan Medicinal Plants. Medpharm

Publishers, Stuttgart.
Lange D. 1998. Europe's medicinal and aromatic plants: their use, trade and conservation. Traffic Europe 1998.
Lawrence B.M. 1985. A review of the world production of essential oils (1984). Perfumer and Flavourist **10**:1-16.
Lucas G. and H. Synge. 1978. The IUCN Red Data Book. IUCN, Morges, Switzerland.
Mankin W.E. 1998. Defining sustainable forest management. Tropical Forest Update **8**(3):7.
Mardaga. 1999. Le grand livre de la Foret Morocaine. P. Amardaga, Spimont, Belgium.
McGriffin M. 2000. Self regulatory initiatives by the herb Industry. Herbalgram **48**: 42.
Momberg F., R. Puri, and T. Jessup. 2000. Exploitation of Gaharu, and forest conservation efforts in the Kayan Mentarang National Park, East Kalimantan, Indonesia. In Charles Zerner, ed. People plants and justice: the politics of nature conservation. Columbia University Press, New York.
Moria K. 1992. The book of incense: enjoying traditional art of Japanese scents. Kodansha Internatioanl Limited, Tokyo.
Nayar R. 1988. Cultivation, improvement, exploitation and protection of *Santalum album* L. Advances in Forestry Research in India **2**:117-152.
New Scientist. 2002. The spice of life. New Scientist (Inside Science pullout) **176** (2372) : 1-4.
O'Connell S. 2001. A nose for new aromas. The Times Sept 8, 2001 p10.
Ohashi S.T., R.L. dos Santos, and J.L. Santana. 1997. Brazilian rosewood oil: sustainable production and oil quality management. Perfumer and Flavourist **22**(2): 1-5.
Pakenham T. 2002. Remarkable trees of the world. Weidenfield & Nicolson, London.
Panaia M., T. Senaratna, E. Bunn, K. W. Dixon, and K. Sivasithamparam. 2000. Micropropagation of the critically endangered Western Australian species, *Symonanthus bancroftii* (F. Muell.) L. Haegi (Solananceae). Plant Cell, Tissue and Organ Culture **63**:23-29.
Parfums Cosmétiques Actualités. 2002. Réglementation chinoise: decisions immédiates et drastiques. Parfums Cosmétiques Actualités **165**(June/July):48.
Parfums Cosmétiques Actualités. 2003. Controversy surrounding *Buchu betulina*. Parfums Cosmétiques Actualités **170**(April/May):38.
Petitdidier J-P. 1986. Travelling through civet perfume country. British Society of Perfumers Newsletter page 6.
Pain S. 2001. The perfume hunter. New Scientist April 21, 2001 **2287**:37.
Prance G. 1998. Indigenous non-timber benefits from tropical rain forest. page 36 in F.B. Goldsmith, ed. Tropical rain forest: a wider perspective. Chapman & Hall, London.
Rai S.N. 1999. Nursery and planting techniques of forest trees in tropical Southeast Asia. Punarvasu Publications, Karnataka, India.
Rasoanaivo P. 1997. Ravensara aromatica: a threatened aromatic species of Madagascar. Medicinal Plant Conservation 4:9.
Rice D.W. 2002. Ambergris. Page 20 in W.F. Perrin, B. Würsig and J.G.M. Thewissen, eds. Encyclopedia of marine mammals. Academic Press, San Diego.
Sahni K.C. 2000. The Book of Indian Trees. Second edition. Bombay Natural History Society, Oxford University Press, Oxford.
Shankar D. and B. Majumdar. 1997. Beyond the Biodiversity Convention: the challenge facing the bio-cultural heritage of India's medicinal plants. In G. Bodeker, K.K.S. Bhat, J. Burley, and P. Vantomme, eds. Medicinal plants for conservation and health care. Non-Wood Forest Products Series No.11. Global Initiative for Traditional Systems (GIFTS) of Health and FAO, Rome.
Soap, Perfumery and Cosmetics. 2002. A calming influence. Soap, Perfumery and Cosmetics **75**(10):42-43.
Tomich T.P., M. van Noordwijk, S.A.

Vosti and J. Witcover. 1998. Agricultural development with rainforest conservation: methods for seeking best bet alternatives to slash-and-burn, with application to Brazil and Indonesia. Agricultural Economics **19**: 159-174.

Traffic International. 1999. Implementation of the CITES appendix II listing of jatamansi *Nardostachys grandiflora* and kutki *Picrorhiza kurrooa*: a report of the findings of research conducted by the Traffic Network under contract with the CITES Secretariat. Convention on international trade in endangered species of wild fauna and flora. Tenth meeting of the plants committee. Shepherdstown, U.S. December 2000:11-15.

Webb M.A. 2000. Bush sense: Australian essential oils and aromatic compounds. National Library of Australia, Canberra.

Wemmer C., ed. 1998. Deer: status, survey and conservation action plan. IUCN/SSC Deer Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Yingkang C. 1991. Captive civet cats. Perfumer and Flavourist **16:**15.

Zhong G. and Hui L. 1996. Resettling musk deer: new promise to increase musk output. Perfumer and Flavourist **21**(4):7.

Zhu L., D. Ding and B.M. Lawrence. 1994. The *Cinnamomum* species in China: resources for the present and future. Perfumer and Flavourist **19**(July/Aug): 17-22.

Species at Risk

Status and Distribution of the Leopard (*Panthera pardus*) in Turkey and the Caucasus Mountains

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Abstract

For millennia large mammalian carnivores, including the Caspian tiger (*Panthera tigris virgata*), Asiatic lion (*Panthera leo persica*), brown bear (*Ursus arctos*), gray wolf (*Canis lupus*), striped hyena (*Hyaena hyaena*), Eurasian lynx (*Lynx lynx*) and three subspecies of leopard (*Panthera pardus tulliana, P.p. saxicolor* and *P.p. ciscaucasica*) roamed mountains, plateaus and grasslands of Turkey, historically known as Asia Minor or Anatolia. Of the big cats, only the leopard and Eurasian lynx remain in increasingly isolated mountainous habitats. Evidence suggests a few leopards remain in Turkey's Black Sea mountain ranges and the inaccessible peaks of the Taurus Mountains in the south. Also, despite centuries of persecution, the leopard still exists in the Greater and Lesser Caucasus Ranges of Armenia, Azerbaijan and Georgia, receiving some juvenile immigration from a larger population in northern Iran's Zagros Mountains. Leopard conservation throughout the Caucasus countries and Turkey will only succeed if viable populations of ungulate prey such as the Bezoar goat (*Capra aegagrus*), and wild boar (*Sus scrofa*) can be sustained in protected and unprotected habitats, and people in the region are educated about the importance of these species to the sustainability of the ecosystem.

Estatus y Distribución del Leopardo (*Panthera pardus*) en Turquía y las Montañas Caucásicas

Resumen

Durante miles de años varias especies de carnívoros poblaron las montañas, planicies y praderas de Turquía, región históricamente conocida como Asia Menor o Anatolia. Entre las especies que anteriormente existían en esta región se encuentran el tigre del Mar Caspio (*Panthera tigris virgata*), el león asiático (*Panthera leo persic*a), el oso café (*Ursus arctos*), el lobo gris (*Canis lupus*), la hiena rayada (*Hyaena hyaena*), el lince euroasiático (*Lynx lynx*) y tres subespecies de leopardo (*Panthera pardus tulliana*, *P.p. saxicolor* y *P.p. ciscaucasica*). De todos los grandes felinos, sólamente el leopardo y el lince euroasiático persisten en hábitats montañosos cada vez más aislados. Existe evidencia que sugiere que un número pequeño de leopardos aún existe en la cadena montañosa turca del mar Negro y lugares de gran altitud en las montañas Taurus en el sur. Además, a pesar de siglos de persecución, el leopardo aún existe en las cadenas montañosas menor y mayor del Cáucaso en Armenia, Azerbaijan y Georgia, las cuales reciben algunos individuos jóvenes de una población de tamaño considerable localizada en las montañas Zagros en el norte de Irán. La única manera en la que la conservación del leopardo en los paises caucásicos y en Turquía será exitosa es mediante el mantenimiento de poblaciones viables de especies de ungulados como la cabra montés de las montañas asiáticas (*Capra aegagrus*) y el jabalí (*Sus scrofa*) dentro y fuera de hábitats protegidos y mediante programas educativos para la gente de la región sobre la importancia de estas especies para la preservación del ecosistema.

Le Statu et la Distribution du Léopard (*Panthera pardus*) en Turquie et les Montagnes de Caucase

Résumé

Pour des millénaires, des grandes carnivores mammifères, y compris le tigre caspien (*Panthera tigris virgata*), le lion asiatique (*Panthera leo persica*), l'ours brun (*Ursus arctos*), le loup gris (*Canis lupus*), le hyène rayé (*Hyaena hyaena*), le lynx eurasien (*Lynx lynx*) et trois sous-espèces de léopard (*Panthera pardus tulliana, P.p. saxicolor* and *P.p. ciscaucasica*) parcourraient les montagnes, les plateaux et les prairies de la Turquie, anciennement l'Asie Mineure ou Anatolie. Seules le léopard et le lynx d'Eurasien restent des grands chats qui habitent dans les régions montagneuses de plus en plus isolées. Il y a des indications que quelques léopards persistent dans les montagnes de la Mer Noire en Turquie et les sommets inaccessibles des Montagnes de Taurus dans le sud. En outre, en dépit des siècles de persécution, le léopard existe toujours dans les chaînes du Grand et Petit Caucase de l'Arménie, de l'Azerbaïdjan et de la Géorgie, recevant des jeunes individus qui émigrent d'une plus grande population dans les montagnes nordiques de Zagros en Iran. La conservation du léopard dans l'ensemble des pays des Caucases et de la Turquie réussira seulement si les populations viables des onglons proie, comme la chèvre de Bezoard (*Capra aegagrus*) et le sanglier (*Sus scrofa*), peuvent être soutenues dans des habitats protégés et non-protégés et les personnes dans la région sont instruites au sujet de l'importance de cette espèce en ce qui concerne la durabilité de l'écosystème.

Leopard
Kingdom: Animalia
Phylum: Chordata
Class: Mammalia
Order: Carnivora
Family: Felidae
Genus: Panthera
Species: *Panthera pardus*

For millennia large mammalian carnivores, including the Caspian tiger (*Panthera tigris virgata*), Asiatic lion (*Panthera leo persica*), brown bear (*Ursus arctos*), gray wolf (*Canis lupus*), striped hyena (*Hyaena hyaena*), Eurasian lynx (*Lynx lynx*) and three subspecies of leopard (*Panthera pardus tulliana*, *P.p. saxicolor* and *P.p. ciscaucasica*) roamed mountains, plateaus and grasslands of Turkey, historically known as Asia Minor or Anatolia. Of the big cats, only the leopard and Eurasian lynx remain in increasingly isolated mountainous habitats. Evidence suggests a few leopards persist in Turkey's Black Sea mountain ranges and the inaccessible peaks of the Taurus Mountains in the south. Also, despite centuries of persecution, the leopard still exists in the Greater and Lesser Caucasus Ranges of Armenia, Azerbaijan and Georgia, receiving some juvenile immigration from a larger population in northern Iran's Zagros Mountains (Figure 1).

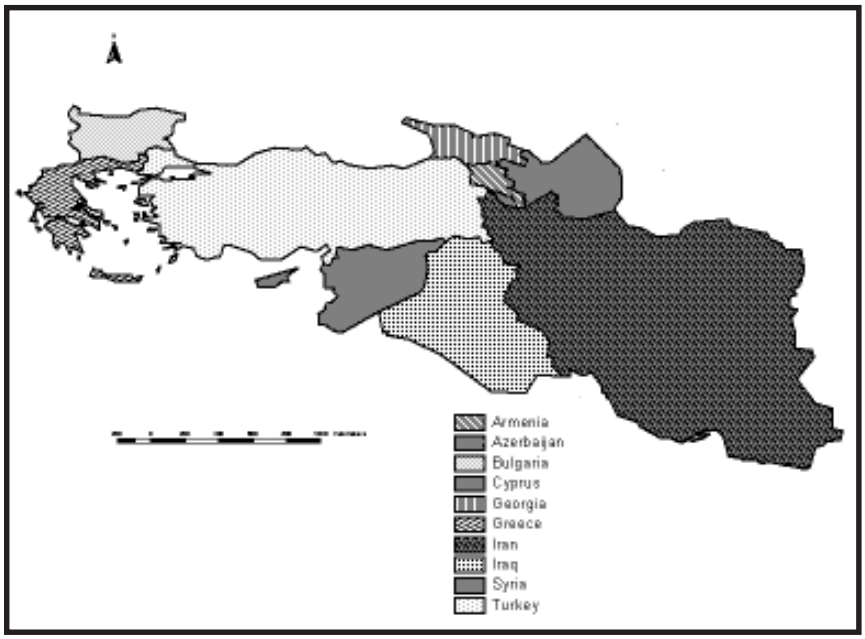


Figure 1. Turkey and bordering countries.

The DNA in leopard hair samples collected in scat may help settle a taxonomic controversy. In recent years, there has been considerable discussion as to the validity of dividing southwestern Asia's leopard population into several distinct subspecies based on morphological differences (Uphyrkina et al. 2001; Khorozyan 1999c). Recently, the mitochondrial DNA sequences of 77 leopards from known geographic locations representing 13 of the 27 described subspecies were studied (Uphyrkina et al. 2001). The research revealed abundant diversity that could be divided into a minimum of nine discrete populations that include *P.p. saxicolor*, although *P.p. tulliana* and *P.p. ciscaucasica* were not identified as distinct subspecies (Uphyrkina et al. 2001).

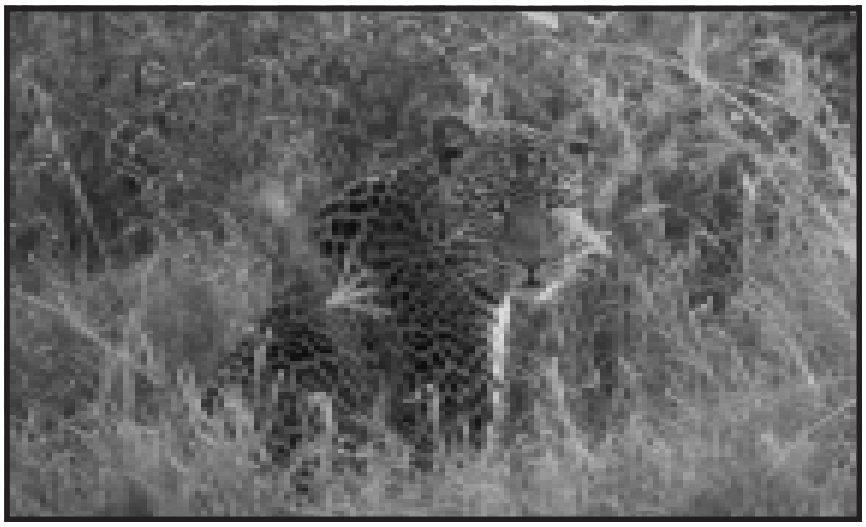
This corroborates other recent proposals to reclassify all southwestern Asian leopard subspecies from Asia Minor to Afghanistan (including *P.p. ciscaucasica, P.p. dathei, P.p. jarvisi, P.p. nimr, P.p. saxicolor, P.p. sindica* and *P.p. tulliana*) as *P.p. saxicolor*, based on the absence of significant morphological differences or geographic barriers in the region (Miththapala et al. 1996). This reclassification may well be too broad, since different research demonstrated that *P.p. nimr,* the Arabian leopard, has mDNA distinct from *P.p. saxicolor* (Uphyrkina et al. 2001). The Arabian leopard is the smallest leopard subspecies, with adult females weighing as little as 23 kg (Holby 2003). Due to the fact that the controversy on the leopard's subspecies remains, we are using the traditional subspecies division in this article.

Panthera pardus tulliana, once ranged widely throughout Anatolia and south into Syria, Lebanon and Israel. Some

specimens of *P. p. tulliana* killed in Anatolia were among the largest leopards known, exceeding 100 kg in weight and reaching a length of 2.5 meters, including an 80 cm long tail (Tubitak Sage 2002). Leopard deaths were reported in 1964 and 1965 in the southwestern Aegean Mountains near Kusadasi and Milas and in 1966 from the districts of Semdinli and Ozalp (Hurriyet 2002). In the 1950s and 1960s, German zoologist H. Kumerloeve discovered evidence of leopards existing in the western Taurus Mountains. The Turkish hunter Mantolu Hasan (also known as Mehmet Mantoluoglu) claimed to have killed more than fifteen leopards, mostly by poisoning, between the1950s and early 1970s (Samli 2002; Ulrich and Riffel 1993). In the 1970s Turkish biologist Tansu Gurpinar estimated that only ten leopards still existed in the southern Taurus and western Pontic (Kure) Mountains (Cat News 1989). In 1974, a leopard was killed near the village of Bagozu in Ankara Province in west-central Turkey. This cat had reportedly attacked and severely wounded a woman, and was tracked by villagers for 12 hours before it was cornered and killed (Cat News 1989; Can 2001).

In 1978 the International Union for the Conservation of Nature (IUCN) estimated there were no more than 23 leopards left in Anatolia (Can 2001). It is estimated that at present time 250 Arabian leopards survive on the Arabian peninsula, the Gulf countries, and possibly Egypt's Sinai Peninsula, with 100-150 of these living in Oman's Jebel Dhofar Mountains (Hilotin 2003). There is evidence that a relict population of leopards still persists in the Taurus Mountains of southern and eastern Turkey, from both confirmed tracks and scat discovered (Can 2001). The Ala Dagi (3,734 m) is the highest point of the Taurus Range, which extends approximately 560 km roughly parallel to the Mediterranean coast, connecting with the Anti-Taurus Range, a thickly wooded eastern Anatolian chain along the Seyhan River (Encyclopedia.com 2002).

From 1985 to 1992 two German biologists conducted several field surveys in Termessos National Park in the Taurus Mountains of southwestern Turkey, and examined fresh scat clearly demonstrated by size and odor to be from a big cat (Ulrich and Riffel 1993). The Termessos National Park, the contiguous Olimpos-Beydaglari National Park and the Duzlercami Game Reserve form a total protected area of nearly 100,000 hectares west, southwest and south of Antalya (Figure 2) (Ulrich and Riffel 1993). The game reserve, in particular, is known as the last indigenous stronghold of the fallow deer *(Dama dama)* in Turkey, and contains abundant wild boar (*Sus scrofa),* plus a 4,000-5,000-strong population of Bezoar wild goat (*Capra aegagrus)* (Ulrich and Riffel 1993). This protected region consists of rough limestone mountain ridges rising to 3,000 m, and its dense pine and oak forests are undoubtedly one of the last retreats of the Anatolian leopard (Ulrich and Riffel 1993). Nevertheless, there is convincing evidence that some leopards may still survive in unprotected areas of the western Taurus Range. In 1989, a leopard was shot near the town of Kas south of Antalya, and there was a reported sighting near Alanya, east of Antalya, in 1991 (Ulrich and Riffel 1993).



Leopard (*Panthera pardus*). Photograph by Gary M. Stolz (U.S. Fish and Wildlife Service).

The historic range of Anatolian leopards extended well south of southern Turkey into Palestine. In the late

1970s, Turkish biologists estimated that just ten leopards still survived in Hakkari Province bordering Syria (Cat News 1989). There are confirmed reports of leopards, possibly *P.p. tulliana,* in the disputed Golan Heights region on the Israeli-Syrian border, and Mount Hermon in Lebanon, indicating that an endemic population in this area still exists (Gazelle 2002).

Mountains of soutwest Turkey's coastline. Photograph by Kirk Johnson.

Caucasus leopard (*Panthera pardus ciscaucasica)* population relicts still persist not only in the mountain ranges of northern Turkey, but also in the Caucasus Mountains that border the Black Sea, within the republics of Georgia, Armenia and Azerbaijan (Environment News Service 2003; Tolordava 2003). In Georgia, the Caucasus leopard historically inhabited the 3,000-meter "Lesser Caucasus" Range that is adjacent to the Kackar Range (Environment News Service 2003). In contrast to the sheer precipices of the Kackars, however, the Lesser Caucasus Mountains' rounded subalpine grassy slopes consist largely of treeless mountain steppe and meadows.

In February 2002 Turkish mountaineers discovered and photographed a 13 centimeter-wide track in the snow along the higher slopes of Kackar Mountain. The track was later confirmed to be from a big cat by Marmara Forest Services Regional Manager Erkan Kayaoz (Samli 2002). A team of Turkish researchers had been tracking from the Pokut Plateau onto Hazidag Mountain in the Kackar Range what they assumed to be a leopard, but was unsuccessful in sighting the felid (Gulas 2003). In the spring of 2002 two separate teams re-ascended Hazidag and both claimed to see a leopard in separate encounters, even taking videotape and photographs (Gulas 2003; Samli 2002). The first expedition took footage of a leopard in a pine tree, while the second team spotted a leopard on a Hazidag outcrop (Gulas 2003; Samli 2002).

As of 2003, two discrete endangered populations of the Caucasus leopard are known to still inhabit Georgia's Lesser Caucasus Mountains, and also the Talysh Mountains in the south bordering Azerbaijan (Tolordava 2003; Environment News Service 2003). Only a total of 20-23 individuals are thought to survive in both ranges, and are described as "secretive, cautious, and highly mobile" (Environment News Service 2003). Currently, a study of leopard numbers in northern Azerbaijan's Talysh Mountains is underway, with only 10-12 of the big cats thought to survive in that country (Environment News Service 2003). In the Nagorno-Karabakh Armenian enclave within Azerbaijan, data from hunters indicate another five to seven cats may survive (Tolordava 2003). According to recent data, between one and two leopards are killed each year in the Caucasus countries (BBC News 2003).

The Caucasus and eastern Anatolia region historically hosted a third leopard subspecies, *P.p. saxicolor*, known as the Iranian or Persian leopard (Tubitak Sage 2002). The Persian leopard is still considered relatively common in northern Iran, especially in the Zagros Mountains (Khorozyan 2000; Tubitak Sage 2002). Leopards in Iran have been known to exceed 90 kg and are often mistaken for snow leopards (*Uncia uncia*), due to their lighter color and long-haired winter coats (Holby 2003; Khorozyan 1999c). Armenian and Iranian biologists have noted frequent emigration of juvenile *P.p. saxicolor* from Iran into southern Armenia, especially

along Armenia's Zangezour Ridge, which acts as a wildlife corridor between the two countries (Khorozyan 2000; Khorozyan 1999c).

Since the 1990s, all confirmed records of Persian leopards are confined to three southern Armenian provinces: Ararat, Vayots Dzor, and Syunik (Khorozyan 2000). The southwestern province of Ararat borders Azerbaijan's isolated enclave province of Nakhichevan (Khorozyan 2000), while Vayots Dzor and Syunik provinces border northern Iran. Noravank Canyon, a habitat corridor lying along the Armenian-Nakhichevan border, still exists between southern Armenia and the Khosrov Reserve in Ararat province (Khorozyan 2000). Dispersal of juvenile leopards through Novavank Canyon, however, is threatened by roads connecting canyon villages and the complete diversion of water from the canyon for village uses and irrigation (Khorozyan 2000).

Between 2000 and 2002, Armenian biologist Igor Khorozyan studied an estimated population of ten *P.p. saxicolor*, including at least two females with cubs that lived within a 780 km^2 region in Ararat province, encompassing the 258.6 km^2 Khosrov Reserve (Khorozyan 1999b; Khorozyan 2003a). Unfortunately, this rugged mountainous habitat is severely fragmented into five small, isolated pockets and leopards move in and out in unprotected private land adjacent to the reserve (Khorozyan 2003a). Within the reserve itself, leopards prefer sparse juniper/beech/oak forests growing along the ridge tops, where their preferred prey, the bezoar wild goats (*Capra aegagrus*), lives. Bezoar wild goats are still plentiful within the preserve and surrounding areas, and anecdotal evidence suggests that between 900-3,000 of the ungulates live in Khosrov (Khorozyan 2003a). Leopard scat analyses demonstrated that bezoar goats make up to 90% of all prey consumed (Khorozyan 2003a). In 2003, research continues with the use of infrared cameras to photograph leopards in southern Armenia (Khorozyan 2003b). In addition, studies are planned with the goal of enlarging adjacent protected areas within northern Azerbaijan's Talysh Mountains (Tolordava 2003).

The World Wildlife Fund (WWF) is currently surveying for leopard populations that may still persist in the central and northwestern portions of the Greater Caucasus Mountains (Environment News Service 2003; Tolordava 2003). The Greater Caucasus Mountains has a particularly high ratio of endemic life, with approximately 6,300 plant species, 1,600 of which are restricted to the region (Conservation International 2003). In addition, 59 of the 632 vertebrate species found in the Caucasus are endemic, a diversity up to three times greater than the one found in surrounding regions (Conservational International 2003). Species of ungulates include such mammals as the endemic East Caucasian and West Caucasian tur (*Capra cylindricornis and Capra caucasica,* respectively), the non-endemic chamois *(Rupicapra rupicapra)*, Caucasian red deer *(Cervus elaphus maral),* bezoar wild goat, and mouflon wild sheep (*Ovis orientalis gmelini*) (Gokhelashvili 2003). All of these ungulates are potential prey species for leopards. Protecting a keystone species like the leopard may help to preserve this astounding array of species and the Caucasus' unique

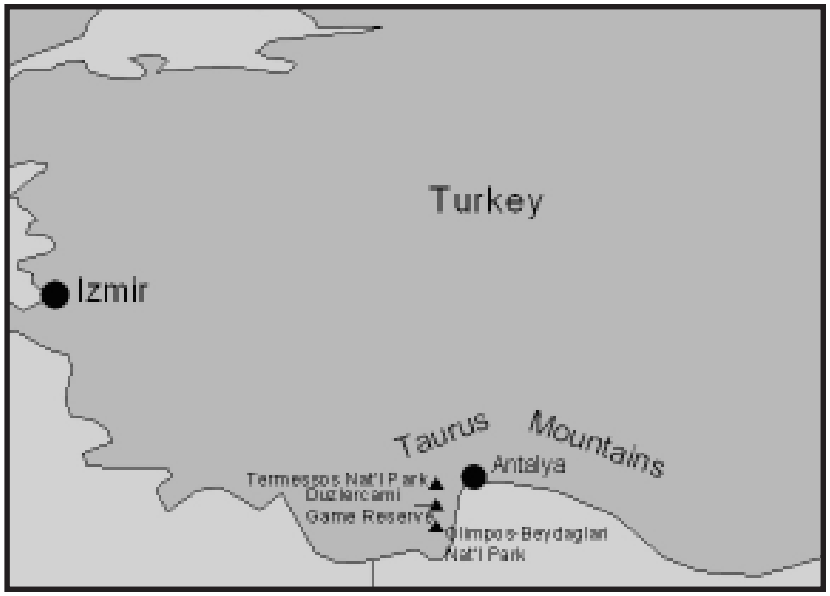
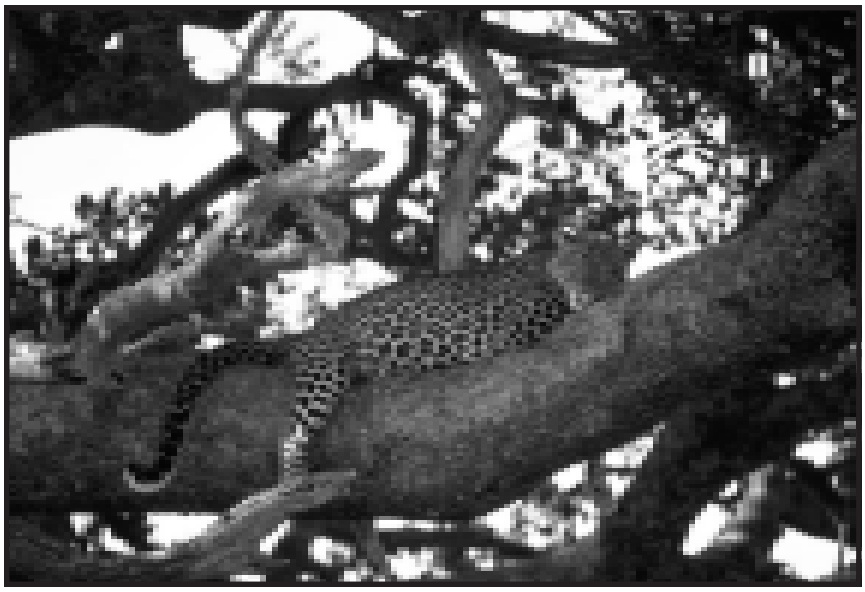


Figure 2. Protected areas in southwest Turkey. Map by Kirk Johnson.

fragile web of life.

Approximately 35% of the Greater Caucasus ecoregion remains as natural forest, but only five percent has protective guidelines (Gokhelashvili 2003). The principal threats to the ecosystem include rural poverty and escalating corruption, resulting in increasing demands for firewood, livestock overgrazing, poor forest management, illegal timber harvesting, and poaching of wildlife, especially economically valuable species (Gokhelashvili 2003). For example, local people have turned to hunting wild goats, boar and deer—the leopard's main prey, to supplement their small incomes (BBC News 2003). This has forced the leopard to increasingly prey on flocks of domestic sheep and goats near human settlements (BBC News 2003).



Leopard (*Panthera pardus*). Photograph by Gary M. Stolz (U.S. Fish and Wildlife Service).

Studies in the Khosrov reserve confirm that one of the most serious dangers to the existence of the leopard is degraded or developed private land buffer zones, which represents a significant leopard mortality threat (Khorozyan 2003a). This risk was verified in 1986, when a herdsman poached a pregnant female illegally in the reserve. Due to this loss, the population vanished for several years, reemerging in early 1992 through immigration (Khorozyan 1999a). Although people sometimes kill leopards (three out of ten confirmed records between 1990-2000 in Khosrov Reserve were killings: two cubs and one adult male, all in January 2000), the majority of Armenians living around the reserve feel completely indifferent to the leopard and its conservation, primarily due to the fact that they rarely attack livestock (Khorozyan 2001).

Unfortunately, state-run wildlife protection safeguards have collapsed due to a lack of government funding (BBC News 2003). WWF is developing partnerships with governmental and non-governmental agencies and leopard experts from Armenia, Azerbaijan, Georgia and Russia in an attempt to assess critical habitat and then initiate conservation and protection of these sites (Environment News Service 2003). WWF plans call for the strengthened legal protection for the leopard and key prey species, better management of existing protection areas, and the establishment of new protected zones (Environment News Service 2003). In addition, there are plans for the formation of anti-poaching units in each country, development of education programs, and compensation to local farmers for any livestock depredation (Tolordava 2003; Environment News Service 2003). The leopard mortalities in Armenia demonstrate the importance of connectivity in habitat protection. *P.p. saxicolor* inhabiting northern Iran, *P.p. ciscaucasica* ranging in Georgia, and *P.p. tulliana* found in territories in the Turkey's Black Sea area may well represent one continuous leopard population.

Like all big cats, leopards are charismatic predators that generate attention and excitement of people around the globe. If this excitement can be translated into concrete plans on the ground to protect the leopard and its habitat, all animals and plants down in the food chain will benefit. The fact that some leopards have survived centuries of indiscriminate shooting and warfare throughout this region offers hope that even limited efforts to save the cat may reap lasting dividends.

Literature Cited

British Broadcasting Corporation News (BBC News). Battle on to save Caucasus big cat. <news.bbc.co.uk/1/hi/world/europe/2700129.stm> (March 6, 2003).

Can, E. 2001. Bir efsane yasiyor. Atlas **98** (May): 16-17.

Cat News. 1989. Anatolian leopard on the brink. Cat News **11**: (summer).

Conservation International. Biodiversity hotspots: Caucasus. <www.biodiversityhotspots.org/xp/Hotspots/caucasus> (March 6, 2003).

Encyclopedia.com. Taurus Mountains. <www.encyclopedia.com> (October 29, 2002).

Environment News Service. WWF champions Caucasus leopard. <www.ens-news.com/ens/jan2003/2003-01-27-19.asp> (February 4, 2003).

Gazelle. Wild Cats in Palestine. The Palestinian Biological Bulletin. <www.gazelle.8m.net/> (November 19, 2002).

Gokhelashvili, R. Terrestrial ecoregions: Caucasus mixed forests (PA0408). <www.worldwildlife.org/wildworld/profiles/terrestrial> (March 6, 2003).

Gulas, C. The leopard. <www.cemalgulas.com/dosya/pars> (May 6, 2003).

Hilotin, J.B. Public awareness key to protecting Arabian leopard. <www.gulfnews.com/articles/news.asp?> (March 6, 2003).

Holby, H. Leopard. <www.hazelh.best.vwh.net> (May 6, 2003).

Hurriyet. 2002. Anadolu leopari acaba yasiyor mu? Hurriyet Bilim ve Teknoloji Gazetesi **22** (June 8).

Khorozyan I. Persian leopard *(Panthera pardus saxicolor)* in Armenia: diet and prey; spacing and activities. <www.persianleopard.com/diet.htm> (May 20, 2003a).

Khorozyan, I. Chairman, Armenian Leopard Conservation Society, Armenia: personal communication. (May 20, 2003b).

Khorozyan, I. 2001. Human attitudes to the leopards in Khosrov reserve, Armenia. Cat News **34**: 14-17.

Khorozyan, I. 2000. The leopard in Armenia's Khosrov reserve: spots, rosettes and population genetic status. Cat News **33**: 16-18.

Khorozyan, I. 1999a. Modeling mortality patterns of Armenian leopard population. Natural Science **1**: 24-27.

Khorozyan, I. 1999b. Leopard records in Armenia in the 1990s. Cat News **31**: 13-15.

Khorozyan, I. 1999c. The leopard in Armenia: which subspecies is it? Cat News **30**: 22-24.

Miththapala, S., J. Seidensticker, and S. O'Brien. 1996. Phylogeographic subspecies recognition in leopards *(Panthera pardus)* molecular genetic variation. Conservation Biology **10**: 1115-1132.

Samli, M. Anatolian leopard is alive. <www.wildlifeeasyst.com/Anatolian_leopards.htm> (May 7, 2003).

Tolordava, K. WWF launches project to save the Caucasus leopard. <www.panda.org/news_facts/newsroom/other_news> (June 17, 2003).

Tubitak Sage. Anadolu parsi. <www.sage.tubitak.gov.tr/Yasam> (November 5, 2002).

Ullrich, B. and M. Riffel. 1993. New evidence for the occurrence of the Anatolian leopard, *Panthera pardus tulliana* (Valenciennes, 1856), in western Turkey. Mammalia, Zoology in the Middle East **8**: p. 5-14.

Uphyrkina O., W.E. Johnson, H. Quigley, D. Miquelle, L. Marker, M. Bush, and S.J. O'Brien. 2001. Phylogenetics, genome diversity and origin of modern leopard, *Panthera pardus.* Molecular Ecology **10**: 2617-2633.

Leopardo
Reino: Animalia
Phylum: Chordata
Clase: Mammalia
Orden: Carnivora
Familia: Felidae
Género: Panthera
Especie: *Panthera pardus*

Durante miles de años varias especies de carnívoros poblaron las montañas, planicies y praderas de Turquía, región históricamente conocida como Asia Menor o Anatolia. Entre las especies que anteriormente existían en esta región se encuentran el tigre del Mar Caspio (*Panthera tigris virgata*), el león asiático (*Panthera leo persic*a), el oso café (*Ursus arctos*), el lobo gris (*Canis lupus*), la hiena rayada (*Hyaena hyaena*), el lince euroasiático (*Lynx lynx*) y tres subespecies de leopardo (*Panthera pardus tulliana, P.p. saxicolor* y *P.p. ciscaucasica*). De todos los grandes felinos, sólamente el leopardo y el lince euroasiático persisten en hábitats montañosos cada vez más aislados. Existe evidencia que sugiere que un número pequeño de leopardos aún existe en la cadena montañosa turca del mar Negro y lugares de gran altitud en las montañas Taurus en el sur. Además, a pesar de siglos de persecución, el leopardo aún existe en las cadenas montañosas Menor y Mayor del Cáucaso en Armenia, Azerbaijan y Georgia, las cuales reciben algunos individuos jóvenes de una población de tamaño considerable localizada en las montañas Zagros en el norte de Irán (Figura 1).

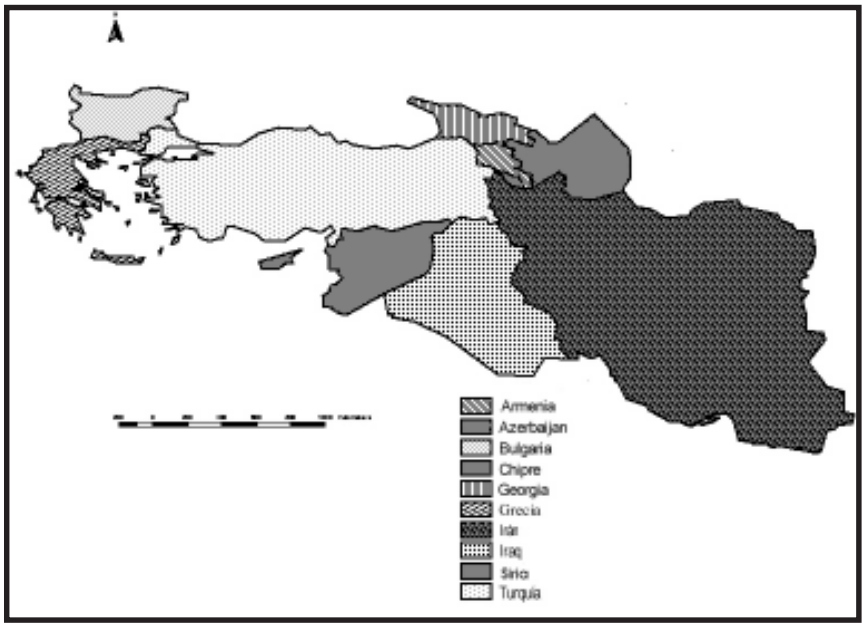


Figura 1. Turquía y países circunvecinos.

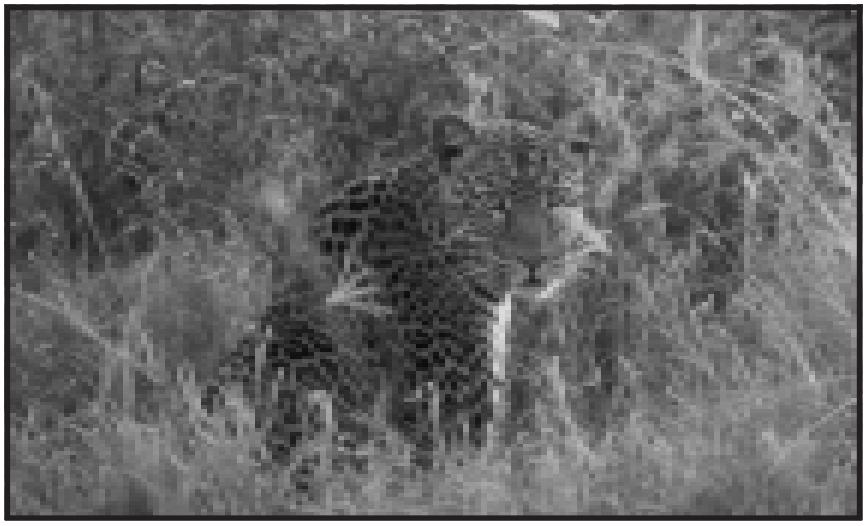
El ADN proveniente de pelambre colectado en heces fecales pudiera ayudar a esclarecer una controversia relacionada a la clasificación taxonómica de subespecies de leopardo. Se ha discutido considerablemente en años recientes acerca de la justificación de dividir la población de leopardos de Asia en varias subespecies distintas en base a diferencias morfológicas (Uphyrkina et al. 2001; Khorozyan 1999c). Recientemente se estudiaron las secuencias de ADN mitocondrial de 77 leopardos de origen geográfico conocido y que representan 13 de las 27 subespecies que se encuentran descritas (Uphyrkina et al. 2001). La investigación reveló la existencia de una diversidad abundante que pudiera ser dividida en un mínimo de nueve poblaciones distintas, incluyendo *P.p. saxicolor*, aunque *P.p. tulliana* y *P.p. ciscaucasica* no fueron identificadas como subespecies diferentes (Uphyrkina et al. 2001).

Esto corrobora otras propuestas recientes sobre la reclasificación de todas las subespecies de leopardo del suroeste asiático desde Asia Menor hasta Afganistán (lo que incluiría *P.p. ciscaucasica, P.p. dathei, P.p. jarvisi, P.p. nimr, P.p. saxicolor, P.p. sindica* y *P.p. tulliana*) como *P.p. saxicolor*, en base en la ausencia de diferencias morfológicas significativas o de barreras geográficas en la región (Miththapala et al. 1996). Esta reclasificación podría ser demasiado general, ya que otro estudio demostró que *P.p. nimr,* el leopardo arábigo, tiene un ADN mitocondrial distinto al de *P.p. saxicolor* (Uphyrkina et al. 2001). El leopardo arábigo es la subespecie de

leopardo más pequeña, con algunas hembras adultas que pesan sólamente 23 kg (Holby 2003). Debido al hecho de que la controversia sobre las subespecies de leopardo sigue en pie, para este artículo utilizamos la tradicional división de subespecies.

Panthera pardus tulliana, originalmente tuvo un rango geográfico bastante amplio a través de toda Anatolia y hacia sur en Siria, Líbano e Israel. Algunos especímenes de *P. p. tulliana* cazados en Anatolia se cuentan entre los leopardos más grandes alguna vez encontrados, con un peso de hasta más de 100 kg y llegando a medir 2.5 m, incluyendo una cola de 80 cm de longitud (Tubitak Sage 2002). Algunas muertes de leopardos fueron reportadas en 1964 y 1965 en el suroeste de las montañas egeas cerca de Kusadasi y Milas y en 1966 en los distritos de Semdinli y Ozalp (Hurriyet 2002). En los años cincuenta y sesenta, el zoólogo alemán H. Kumerloeve descubrió evidencia de leopardos en el oeste de las montañas Taurus. El cazador turco Mantolu Hasan (también conocido como Mehmet Mantoluoglu) proclamó haber matado más de 15 leopardos, en su mayoría por medio de veneno, entre los años cincuenta y principios de los años setenta (Samli 2002; Ulrich and Riffel 1993). En los años setenta el biólogo turco Tansu Gurpinar estimó que sólamente diez leopardos existían en el sur del Taurus y al oeste de las montañas Pontic (Kure) (Cat News 1989). En 1974, un leopardo fue cazado en el pueblo de Bagozu en la provincia de Ankara en el centro-oeste de Turquía. Según un reporte, el felino había atacado y herido gravemente a una mujer, por lo que fue buscado por los pobladores durante 12 horas antes de ser acorralado y sacrificado (Cat News 1989; Can 2001).

En 1978 la Union Internacional para la Conservación de la Naturaleza (International Union for the Conservation of Nature; IUCN) estimó que no había mas de 23 leopardos sobrevivientes en Anatolia (Can 2001). Se estima que en la actualidad 250 leopardos arábigos sobreviven en la península arábiga, los países del Golfo Pérsico y posiblemente en la península egipcia del Sinaí, de los cuales 100-150 viven en las montañas Jebel Dhofar en Omán (Hilotin 2003). Existe evidencia, de huellas que han sido confirmadas o de heces fecales que han sido descubiertas, de que una población remanente de leopardos aún persiste en las montañas Taurus en el sur y este de Turquía (Can 2001). El Ala Dagi (3,734 m) es el punto más alto de la cadena montañosa del Taurus, la cual se extiende aproximadamente 560 km en forma más o menos paralela a la costa del Mediterráneo, conectándose con la cadena montañosa del Anti-Taurus, una cadena del este de Anatolia densamente boscosa a lo largo del río Seyhan (Encyclopedia.com 2002).



Leopardo (*Panthera pardus*). Fotografía de Gary M. Stolz (U.S. Fish and Wildlife Service).

De 1985 a 1992 dos biólogos alemanes llevaron a cabo varios muestreos de campo en el parque nacional Termessos en las montañas Taurus del suroeste de Turquía y examinaron heces fecales frescas que por el olor y el tamaño mostraron ser de un felino de gran tamaño (Ulrich and Riffel 1993). El parque nacional Termessos, contiguo al parque nacional Olimpos-Beydaglari y la área de reserva de especies de caza Duzlercami forman un área total protegida de un tamaño cercano a 100,000 hectáreas al oeste, suroeste y sur de Antalya (Figure 2) (Ulrich and Riffel 1993).

Especialmente Duzlercami es conocida como el último lugar en Turquía donde se encuentra en forma silvestre el gamo blanco *(Dama dama)*; ademá contiene una población abundante de jabalí (*Sus scrofa),* así como una población de entre 4,000-5,000 de cabra montés de las montañas asiáticas (*Capra aegagrus)* (Ulrich and Riffel 1993). Esta región protegida está conformada por formaciones montañosas calizas de hasta 3,000 m y cuyos densos bosques de pino y encino son sin lugar a dudas uno de los últimos refugios del leopardo de Anatolia (Ulrich and Riffel 1993). Sin embargo, existe evidencia convincente de que algunos leopardos podrían aún sobrevivir en áreas no protegidas al oeste de la cadena montañosa del Taurus. En 1989 un leopardo fue cazado cerca del pueblo de Kas al sur de Antalya, y existe el reporte de que un leopardo fue avistado cerca de Alanya, al este de Antalya, en 1991 (Ulrich and Riffel 1993).

Montañas en la costa suroeste de Turquía.
Photografía de Kirk Johnson.

La distribución geográfica histórica de los leopardos de Anatolia se extiende hacia el sur y sureste en Palestina. A finales de los años setenta, los biólogos turcos estimaron que sólamente diez leopardos aún sobrevivían en la provincia de Hakkari en la frontera con Siria (Cat News 1989). Existen reportes confirmados de leopardos, posiblemente *P.p. tulliana,* en la región en disputa de los altos del Golan en la frontera entre Israel y Siria y en la montaña Hermon en Líbano, lo que indica que una población endémica existe aún en esta área (Gazelle 2002).

Algunos relictos de la población del leopardo del Cáucaso (*Panthera pardus ciscaucasica)* se encuentran no sólamente en las cadenas montañosas del norte de Turquía, sino también en las montañas Caucásicas limitrófes al mar Negro, dentro de las repúblicas de Georgia, Armenia y Azerbaijan (Environment News Service 2003; Tolordava 2003). En Georgia, el leopardo del Cáucaso habitaba históricamente la cadena montañosa del "Cáucaso Menor" cuya longitud es de 3,000 m y la cual es adyacente a la cadena montañosa de Kackar (Environment News Service 2003). En contraste a los precipicios intactos de las montañas Kackar, sin embargo, las colinas subalpinas de las montañas del Cáucaso Menor carecen de árboles y consisten mayormente de montañas con estepas y pastos.

En febrero del 2002 unos alpinistas turcos descubrieron y fotografiaron una huella en la nieve de 13 cm de ancho a lo largo de las colinas de la montaña Kackar. El director del Servicio Forestal Regional de Marmara, Erkan Kayaoz, confirmó posteriormente que la huella pertenecía a un felino de gran tamaño (Samli 2002). Un grupo de investigadores turcos había estado siguiendo de la planicie Potuk hasta la montaña Hazidag en la cadena montañosa de Kackar lo que asumían era un leopardo, aunque nunca pudieron ver al felino (Gulas 2003). En la primavera del 2002 dos grupos en forma separada reascendieron la montaña Hazidag y ambos aseguraron ver a un leopardo en dos ocasiones independientes, y hasta lograron tomar video y fotografías (Gulas 2003; Samli 2002). La primera expedición tomó escenas de un leopardo en un árbol de pino, mientras que el segundo grupo observó un leopardo en una zona rocosa de Hazidag (Gulas 2003; Samli 2002).

Hasta lo que va del 2003, se conocen dos poblaciones distintas de leopardos del Cáucaso en peligro de extinción que aún habitan las montañas del Cáucaso Menor en Georgia, y también al sur en las montañas Talysh, en la frontera con

Azerbaijan (Tolordava 2003; Environment News Service 2003). Se piensa que sólamente un total de 20 a 23 individuos sobreviven en ambas cadenas montañas, los cuales son descritos como "silenciosos, precavidos y altamente móviles" (Environment News Service 2003). Actualmente se está llevando a cabo un estudio sobre el número de leopardos en las montañs de Talysh en el norte de Azerbaijan, y los estudios preliminares señalan que sólamente entre 10 a 12 individuos sobreviven en este país (Environment News Service 2003). Datos dados por cazadores indican que otros cinco a siete leopardos viven en el enclave armenio de Nagorno-Karabakh dentro de Azerbaijan (Tolordava 2003). De acuerdo a datos recientes, entre uno y dos leopardos son cazados cada año en los países del Cáucaso (BBC News 2003).

La región del Cáucaso y el este de Anatolia albergaron históricamente a una tercera subespecie de leopardo, *P.p. saxicolor*, la cual es conocida como el leopardo iraní o pérsico (Tubitak Sage 2002). El leopardo pérsico es aún considerado relativamente común en el norte de Irán, especialmente en las montañas de Zagros (Khorozyan 2000; Tubitak Sage 2002). Se sabe que los leopardos en Irán llegan a pesar más de 90 kg y frecuentemente son erróneamente identificados como leopardos nivales (*Uncia uncia*), debido a su color más claro y a su grueso pelaje de invierno (Holby 2003; Khorozyan 1999c). Biólogos armenios e iraníes han notado una frecuente emigración de *P.p. saxicolor* jóvenes de Irán hacia el sur de Armenia, especialmente a lo largo de la cordillera armenia del Zangezour, la cual actúa como un corredor para vida silvestre entre los dos países (Khorozyan 2000; Khorozyan 1999c).

Desde los años 90 todos los registros confirmados del leopardo pérsico están confinados a tres provincias sureñas de Armenia: Ararat, Vayots Dzor y Syunik (Khorozyan 2000). La provincia de Ararat comparte frontera con un enclave aislado de la provincia azerbaijana de Nakhichevan en el suroeste (Khorozyan 2000), mientras que las provincias de Vayots Dzor y Syunik comparten frontera con Irán. El cañon Noravank, un corredor de hábitat natural que se encuentra a lo largo de la frontera Armenian-Nakhichevan, aún existe entre el sur de Armenia y la reserva de Khosrov en la provincia de Ararat (Khorozyan 2000). Sin embargo, la dispersión de leopardos jóvenes a través del cañón Noravank está siendo amenazada por la construcción de caminos que conectan el cañón con los pueblos y la desviación total de agua del cañón para el uso doméstico e irrigación (Khorozyan 2000).

Del 2000 al 2002, el biólogo armenio Igor Khorozyan estudió una población estimada de diez *P.p. saxicolor*, que incluía al menos dos hembras con cachorros que vivían dentro de una región de 780 km^2 en la provincia de Ararat, que comprende 258.6 km^2 de la reserva Khosrov (Khorozyan 1999b; Khorozyan 2003a). Desafortunadamente este hábitat montañoso se encuentra severamente fragmentado en cinco territorios aislados y pequeños, y los leopardos se mueven fuera y dentro de la porción que no se encuentra protegida, la cual es adyacente a la reserva (Khorozyan 2003a). Dentro de la reserva, los leopardos prefieren el bosque de

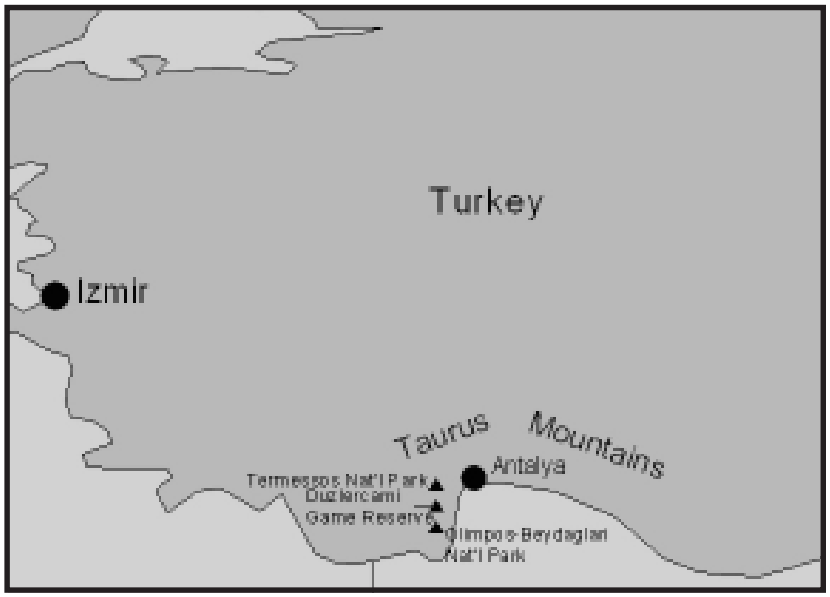
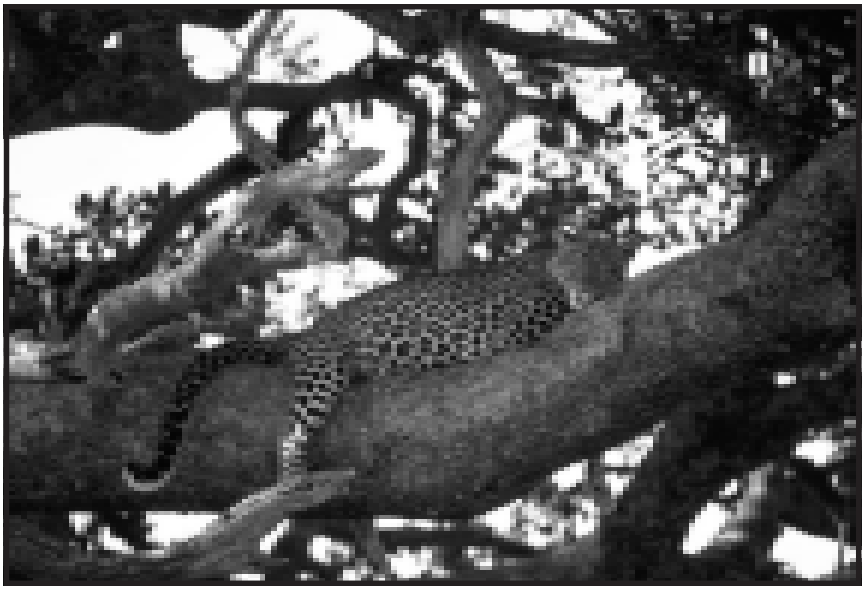


Figura 2. Areas protegidas en el suroeste de Turquía.
Mapa creado por Kirk Johnson.

juníperos/hayas/robles que crecen a lo largo de los picos de la cordillera, donde su presa preferida, la cabra montés de las montañas asiáticas (*Capra aegagrus*), vive. Las cabras de las montañas asiáticas son aún abundantes dentro de la reserva y las áreas circundantes y existe evidencia anecdótica que sugiere que entre 900 a 3,000 de estos ungulados viven en Khosrov (Khorozyan 2003a). Análisis de las heces fecales de leopardos demostraron que las cabras forman aproximadamente el 90% de



Leopardo (*Panthera pardus*). Photografía de Gary M. Stolz (U.S. Fish and Wildlife Service).

todas presas consumidas (Khorozyan 2003a). En el 2003, la investigación continúa con el uso de cámara infrarrojas para fotografiar leopardos en el sur de Armenia (Khorozyan 2003b). Además, existen estudios cuyo objetivo es aumentar las áreas protegidas adyacentes dentro de las montañas Talysh en Azerbaijan (Tolordava 2003).

El Fondo Mundial para la Vida Silvestre (The World Wildlife Fund, WWF) está actualmente haciendo estudios sobre la población de leopardos que podría aún existir en las porciones centrales y del noroeste de las montañas Mayores del Cáucaso (Environment News Service 2003; Tolordava 2003). Las montañas Mayores del Cáucaso tienen un alto grado de vida silvestre endémica, con aproximadamente 6,300 especies de plantas, de las cuales 1,600 se encuentran únicamente en la región (Conservation International 2003). Adema, 59 de las 632 especies de vertebrados son endémicas, una diversidad de este grupo tres veces mayor que la encontrada en las regiones aledañas (Conservational International 2003). Algunas de las especies de mamíferos en esta región son el íbice del este caucásico y el íbice del oeste caucásico (*Capra cylindricornis and Capra caucasica*, respectivamente), la no endémica gamuza *(Rupicapra rupicapra)*, el venado rojo caucásico *(Cervus elaphus maral)*, la cabra montés de las montañas asiáticas y el muflón silvestre (*Ovis orientalis gmelini*) (Gokhelashvili 2003). Todos estos ungulados son presas potenciales para el leopardo. Proteger una especie clave como el leopardo podría ayudar a la preservación del increíble conjunto de especies y la cadena de vida frágil y única del Cáucaso.

Aproximadamente 35% de la ecoregión del Cáucaso Mayor sigue siendo un bosque natural, pero únicamente 5% tiene algún tipo de protección (Gokhelashvili 2003). Entre las principales amenazas al ecosistema están la pobreza rural y la cada vez mayor corrupción, lo que resulta en un incremento en la demanda de leña, sobrepastoreo, mal manejo forestal, tala ilegal del bosque y caza furtiva de la vida silvestre, especialmente de especies económicamente valiosas (Gokhelashvili 2003). Por ejemplo, la gente local ha empezado a cazar cabrá silvestre, jabalí y venado- las principales presas del leopardo, para complementar sus pocos ingresos económicos (BBC News 2003). Esto ha forzado al leopardo a incrementar su ataque a rebaños de ovejas y cabras silvestres cerca de asentamientos humanos (BBC News 2003).

Los estudios en la reserva de Khosrov confirman que uno de los riesgos más serios para la existencia del leopardo es la degradación o el desarrollo humano en tierra en propiedad privada alrededor de áreas

protegidas, lo cual representa una amenaza de incremento de la mortalidad del leopardo (Khorozyan 2003a). Este riesgo fue verificado en 1986, cuando un pastor mató, en forma ilegal, dentro de la reserva, una hembra preñada . Debido a esta pérdida, la población de leopardos se desvaneció por varios años, reemergiendo a principios de 1992 por inmigración (Khorozyan 1999a). Aunque la gente mata a veces leopardos (tres de los diez registros confirmados de muertes entre 1990 y el 2000 en la reserva de Khosrov fueron causadas por humanos: dos cachorros y un macho adulto, los tres en enero del 2000), la mayoría de los armenios que viven alrededor de la reserva son completamente indiferentes al leopardo y su conservación, debido principalmente al hecho de que existen muy pocos ataques al ganado (Khorozyan 2001).

Desafortunadamente, la protección por medio de guardias de vida silvestre gubernamentales se ha colapsado debido a la carencia de fondos del gobierno (BBC News 2003). WWF está desarrollando convenios con agencias gubernamentales y no gubernamentales y con expertos en leopardos de Armenia, Azerbaijan, Georgia y Rusia en un intento de evaluar el hábitat crítico e iniciar la conservación y protección de estos sitios (Environment News Service 2003). Los planes del WWF buscan el fortalecimiento de la protección legal para el leopardo y otras especies claves, un mejor manejo de las áreas protegidas existentes y el establecimiento de nuevas zonas protegidas (Environment News Service 2003). También, existen planes para la formación de unidades para el control de la caza furtiva en cada país, el desarrollo de programas educativos y la compensación económica a ganaderos locales por la depredación de ganado (Tolordava 2003; Environment News Service 2003). La muertes de leopardos en Armenia demuestran la importancia de la conección dentro de la protección de hábitats. *P.p. saxicolor* que habita en el norte de Irán, *P.p. ciscaucasica* que se encuentra a lo largo de Georgia y *P.p. tulliana* que es hallado en los territorios del mar Negro en Turquía bien podrían representar una población continua de leopardos.

Como todos los grandes felinos, los leopardos son depredadores carismáticos que generalmente atraen y apasionan a la gente alrededor del mundo. Si esta pasión pudiera ser traducida en planes concretos en la vida real para proteger al leopardo y su hábitat, todos los animales y plantas que se encuentran en los niveles menores de la cadena alimenticia se beneficiarían. El hecho de que algunos leopardos hayan sobrevivido siglos de exterminio y guerra a través de toda esta región ofrece esperanza de que aún un esfuerzo limitado para salvar este felino pudiera rendir dividendos duraderos.

Bibliografía

British Broadcasting Corporation News (BBC News). Battle on to save Caucasus big cat. <news.bbc.co.uk/1/hi/world/europe/2700129.stm> (March 6, 2003).

Can, E. 2001. Bir efsane yasiyor. Atlas **98** (May): 16-17.

Cat News. 1989. Anatolian leopard on the brink. Cat News **11**: (summer).

Conservation International. Biodiversity hotspots: Caucasus. <www.biodiversityhotspots.org/xp/Hotspots/caucasus> (March 6, 2003).

Encyclopedia.com. Taurus Mountains. <www.encyclopedia.com> (October 29, 2002).

Environment News Service. WWF champions Caucasus leopard. <www.ens-news.com/ens/jan2003/2003-01-27-19.asp> (February 4, 2003).

Gazelle. Wild Cats in Palestine. The Palestinian Biological Bulletin. <www.gazelle.8m.net/> (November 19, 2002).

Gokhelashvili, R. Terrestrial ecoregions: Caucasus mixed forests (PA0408). <www.worldwildlife.org/wildworld/profiles/terrestrial> (March 6, 2003).

Gulas, C. The leopard. <www.cemalgulas.com/dosya/pars> (May 6, 2003).

Hilotin, J.B. Public awareness key to protecting Arabian leopard. <www.gulfnews.com/articles/news.asp?> (March 6, 2003).

Holby, H. Leopard. <www.hazelh.best.vwh.net> (May 6, 2003).

Hurriyet. 2002. Anadolu leopari acaba yasiyor mu? Hurriyet Bilim ve Teknoloji Gazetesi **22** (June 8).

Khorozyan I. Persian leopard *(Panthera pardus saxicolor)* in Armenia: diet and prey; spacing and activities. <www.persianleopard.com/diet.htm> (May 20, 2003a).

Khorozyan, I. Chairman, Armenian Leopard Conservation Society, Armenia: personal communication. (May 20, 2003b).

Khorozyan, I. 2001. Human attitudes to the leopards in Khosrov reserve, Armenia. Cat News **34**: 14-17.

Khorozyan, I. 2000. The leopard in Armenia's Khosrov reserve: spots, rosettes and population genetic status. Cat News **33**: 16-18.

Khorozyan, I. 1999a. Modeling mortality patterns of Armenian leopard population. Natural Science **1**: 24-27.

Khorozyan, I. 1999b. Leopard records in Armenia in the 1990s. Cat News **31**: 13-15.

Khorozyan, I. 1999c. The leopard in Armenia: which subspecies is it? Cat News **30**: 22-24.

Miththapala, S., J. Seidensticker, and S. O'Brien. 1996. Phylogeographic subspecies recognition in leopards *(Panthera pardus)* molecular genetic variation. Conservation Biology **10**: 1115-1132.

Samli, M. Anatolian leopard is alive. <www.wildlifeeasyst.com/Anatolian_leopards.htm> (May 7, 2003).

Tolordava, K. WWF launches project to save the Caucasus leopard. <www.panda.org/news_facts/newsroom/other_news> (June 17, 2003).

Tubitak Sage. Anadolu parsi. <www.sage.tubitak.gov.tr/Yasam> (November 5, 2002).

Ullrich, B. and M. Riffel. 1993. New evidence for the occurrence of the Anatolian leopard, *Panthera pardus tulliana* (Valenciennes, 1856), in western Turkey. Mammalia, Zoology in the Middle East **8**: p. 5-14.

Uphyrkina O., W.E. Johnson, H. Quigley, D. Miquelle, L. Marker, M. Bush, and S.J. O'Brien. 2001. Phylogenetics, genome diversity and origin of modern leopard, *Panthera pardus.* Molecular Ecology **10**: 2617-2633.

FOCUS ON NATURE ™ *by Rochelle Mason*

Insight into the lives of animals

Sitting in the warm sun amongst other native forest plant species the KO'OLOA'ULA (*Abutilon menziesii*) benefits from the pollinating bees. Attracted to the shrub's pendulous, 1 inch-long, maroon flowers the native bees are buzzing with activity. The flowers bloom throughout the year except during the hottest months and produce small, seed-filled fruits. The soft, grayish-green, 1 1/4-5 inch-wide heart-shaped leaves and light-brown stems, both covered with trichomes or fine hairs, attract feral ungulates grazing in this dry, lowland forest. Soon the lower portion of the 6-10 foot-tall (and nearly as wide) ko'oloa'ula are destroyed and the plant weaken becoming vulnerable to disease and parasites. Through conservation efforts, exclosures on Hawai'i, East Mau'i and Lana'i provide a fair amount of protection for wild populations of this endemic shrub and member of the hibiscus family. Artwork and text by Rochelle Mason.

News from Zoos

New Survey Finds Children Want To Help Save the Environment

Children worldwide want to get involved in conservation efforts, and among all age-groups, most think young people are doing a better job caring for wildlife, according to a new survey by the American Zoo and Aquarium Association (AZA). Sixty thousand children and adults worldwide responded to "Aza's Poll for the Planet" via the Internet or on-site at AZA-accredited zoos and aquariums across the country. The global opinion poll asked children to share their thoughts about the environment and questioned them on who they thought was doing the best job caring for the planet. "This is first time an organization has polled children on such a large scale regarding their feelings on this critical subject. They want very much to work with a leader in conservation so they can help make a difference," says former U.S. Senator Bill Bradley. "AZA, by virtue of its unmatched collective body of scientific and educational work, is qualified to be that leader, and in partnering with young people, can help ensure that we will all be able to enjoy the rich diversity of species in our environment for generations to come."

In addition to sharing the results of "Aza's Poll for the Planet" with the communities through the country, AZA facilities are continuing to educate the public, especially children, about how to get involved in conservation in a variety of other ways. Events tied to Earth Day, and targeted to children, are scheduled at AZA-accredited zoos and aquariums, providing unique opportunities for them to connect with nature and learn how to make a difference.

"AZA-accredited zoos and aquariums are uniquely qualified to care for animals within their facilities," said Ron Forman, director of The Audubon Nature Institute, New Orleans, Louisiana and chairman of AZA's National Awareness Campaign targeted to children and other audiences. "Over 134,000,000 people visit accredited zoos and aquariums every year, but few of them understand the urgent conservation work these beloved and respected organizations are doing every day locally, nationally and internationally. We have learned so much from this poll and we guarantee that children – and people of all ages – who visit AZA-accredited facilities can learn how they can become involved in helping AZA ensure that species will be around for future generations to experience and enjoy." With their incomparable commitment to conservation education in living classrooms, zoos and aquariums teach more than 12.5 million people each year, bringing important wildlife and conservation stories to them. Additionally, more than 9.5 million students visit and enjoy on-site education programs at zoos and aquariums each year.

North Carolina Aquarium Receives Sea Turtle Satellite Tracking Grant

The North Carolina Aquarium at Roanoke Island received $49,800 from the Institute of Museum and Library Services (IMLS) to use satellite telemetry to track rehabilitated cold-stunned juvenile loggerhead sea turtles (*Caretta caretta*), in order to assess post-release survival and behavior. The Aquarium's sea turtle tracking project was one of only 86 out of 234 applicants to receive funding. An additional $9,975 was awarded for educational activities to disseminate results of the IMLS conservation project to the public via the Internet, and to develop multidisciplinary curriculum activities for grades six through twelve. Results will also be incorporated into existing education programs and live sea turtle exhibits at the North Carolina Aquariums.

Satellite telemetry provides a cost effective and efficient means of monitoring sea turtle migration and behavioral parameters in the field, and has been used successfully by many researchers. Transmitters are now smaller, better hydro-dynamically designed, more reliable, and methods for transmitter attachment have been refined and published. Live cold-stunned animals that are rescued along the North Carolina coast will be held for rehabilitation purposes and then released back to coastal waters. Satellite transmitters will be securely fastened onto the carapace of each turtle before release, and the device will be programmed to collect the turtles' geographical location data, water temperature, and dive profiles (duration and maximum depth).

Brazilian Ocelot Consortium

The Brazilian Ocelot Consortium (BOC) was initiated in May 2002 as an international partnership focused on establishing and managing a captive population of Brazilian ocelots in the United States and Brazilian zoos while assisting in the conservation of wild ocelot populations. Recently, two additional AZA-accredited U.S. zoos (Bergen County Zoo and Santa Ana Zoo) have joined as full participants in the Consortium. This brings to nine the number of AZA institutions providing support for BOC activities. The list includes Cincinnati Zoo and Botanical Garden, Cleveland Metroparks Zoo, Dallas Zoo, Oklahoma City Zoological Park, Oregon Zoo, Salisbury Zoological Park, and the Caribbean Garden (a zoo located in Naples). This year funding is being used in Brazil in planting nursery operations for ocelot habitat restoration and publishing and distributing studbooks (detailed inventories and breeding histories of captive populations) for all Brazilian zoos.

In the United States, the Brazilian ocelot population reached ten individuals with the recent birth of a male ocelot kitten to the Cincinnati Zoo's pair of Brazilian ocelots. This kitten is the third offspring produced by this breeding pair and is an invaluable addition to this endangered species' genetic reservoir.

Information for News and Zoos is provided by the American Zoo and Aquarium Association

Instructions to Authors

The Endangered Species UPDATE is committed to advancing science, policy, and interdisciplinary issues related to species conservation, with an emphasis on rare and declining species. The UPDATE is a forum for information exchange on species conservation, and includes a reprint of the U.S. Fish and Wildlife Service's *Endangered Species Technical Bulletin*, along with complementary articles relaying conservation efforts from outside the federal program.

The UPDATE welcomes articles related to species protection in a wide range of areas including, but not limited to:

-Research and management of rare and declining species;
-Theoretical approaches;
-Strategies for habitat protection and reserve design;
-Policy analyses and approaches to species conservation;
-Interdisciplinary issues;
-Emerging issues (e.g., wildlife disease ecology).

In addition, book reviews, editorial comments, and announcements of current events and publications are welcome.

Subscribers to the UPDATE are very knowledgeable about endangered species issues. The readership includes a broad range of professionals in both scientific and policy fields including corporations, zoos, and botanical gardens, university and private researchers. Articles should be written in a style that is readily understood but geared to a knowledgeable audience.

Acceptable Manuscripts

The Endangered Species UPDATE accepts several kinds of manuscripts:

1. Feature Article — on research, management activities and policy analyses for endangered species, theoretical approaches to species conservation, habitat protection, and interdisciplinary and emerging issues. Manuscripts should be approximately 3000 words (8 to 10 double spaced typed pages).

2. Opinion Article — concise and focused argument on a specific conservation issue; may be more speculative and less documented than a feature article. These are approximately 450-500 words (About 2 double spaced typed pages).

3. Technical Notes/Reports from the Field — ongoing research, application of conservation biology techniques, species conservation projects, etc., at the local, state, or national level. These are approximately 750 words (3 double spaced typed pages).

4. Species at Risk — profiles of rare and declining species, including the following information: taxonomy, distribution, physical characteristics, natural/life history, conservation status, and economic importance. These profiles are approximately 750-1500 words (3 to 6 double spaced typed pages).

5. Book Reviews — reviews should include such information as relevant context and audience, and analysis of content. Reviews are approximately 750-1250 words (3 to 5 double spaced typed pages). Please contact the editor before writing a book review.

Manuscript Submissions and Specifications

Submit the manuscript to:
Editor, Endangered Species UPDATE
School of Natural Resources and Environment
University of Michigan
430 E. University
Ann Arbor, MI 48109-1115

To submit your manuscript electronically, e-mail the manuscript as a Word file or rich formatted text (.rft) attachment to: esupdate@umich.edu.

Manuscripts should be typed, double-spaced, with ragged right margins to reduce the number of end of line hyphens. Print must be in upper- and lower-case letters and of typewriter quality. Metric measurements must be given unless English measurements are more appropriate, in which case metric equivalents must be given in parentheses. Statistical terms and other measures should conform to the *Council of Biology Editors Style Manual.* All pages should be numbered. Manuscripts must be in English.

Initial acceptance of a proposal or manuscript does not guarantee publication. After initial acceptance, authors and editors work closely on all revisions before a final proof is agreed upon.

Citations, Tables, Illustrations, and Photographs

Literature citations in the text should be as follows: (Buckley and Buckley 1980b; Pacey 1983). For abbreviations and details consult the Editor and recent issues of the Endangered Species UPDATE.

Illustrations and photographs may be submitted as electronic documents or as hard copies. If hard copies are submitted, the author's name and the figure number should be penciled on the back of every figure. Lettering should be uniform among figures. All illustrations and photos should be clear enough to be reduced 50 percent. Please note that the minimum acceptable resolution for all digital images is 300dpi.

Author credit instructions for each author of the article should accompany the manuscript.

Policy on Reviewing Proofs

Authors are asked to do the final copy editing of their articles. It is in the authors' power to save themselves and the journal the embarrassment of having to explain mistakes that could have been avoided.

FOCUS ON NATURE ™ *by Rochelle Mason*

Insight into the lives of animals

Silence. Nothing can be heard except the soft rustling of 5 newborns here in the moist, underground den of a **POINT ARENA MOUNTAIN BEAVER** *(Aplodontia rufa nigra)*. Their velvety bodies squirm under the mother's dense, warm fur. She takes a break from nursing to forage on the moonlit vegetation above-ground. Here in coastal, montane, northern California, she relies on the small, meandering stream nearby for edible aquatic plants and bathing. Unlike her true beaver cousin, her life is terrestrial. As such, her species has evolved without the large, flattened tail and webbed hindfeet. After bathing at the water's edge she gathers some drying vegetation from the "haystack" outside the burrow's entrance and returns to her nest. Several other dens diverge from the 6-inch diameter tunnel and belong to other members of her small, non-social group. *Artwork and text by Rochelle Mason.*

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