

Summary Report

April 19-May 1, 2004

Fire Management Program Rapid Assessment and Training

Sierra de las Minas Biosphere Reserve Guatemala

Conducted by

**U.S. Department of the Interior
International Technical Assistance Program**

Sponsored by

U.S. Agency for International Development/Guatemala

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Pine Oak Forest looking down at the Mortagua Valley and agricultural burning.

EXECUTIVE SUMMARY

The United States Department of the Interior, International Technical Assistance Program (DOI-ITAP) in conjunction with the United States Agency for International Development/Guatemala (USAID/Guatemala) sponsored consultation for rapid assessment and training of the fire management program at the Sierra de las Minas Biosphere Reserve, Guatemala. The program assessment and training was conducted in Reserve areas managed by Fundación Defensores de la Naturaleza (FDN) and Consejo Nacional de Areas Protegidas (CONAP, the Guatemalan National Park Service). The training and evaluation team consisted of Mark Kaib, of the Fish and Wildlife Service within DOI, and Tim Bradley, of the National Park Service within DOI. The primary objective of the team was to assess and make recommendations on all aspects of the fire management program. The main focus was on the mid-elevation pine-oak forest that extends across the southern slopes of the Sierra de las Minas, where the majority of the fire activity and concerns exist. Additionally, several fire training courses and fire management meetings were conducted with local managers, firefighters, and politicians. These meetings were useful in the appraisal of the cultural and sociopolitical aspects of fire management.

Site evaluations and program summary meetings were conducted over the first week of the trip. The summary meetings introduced the ITAP team to the area, with an emphasis on the priority fire management issues and concerns within the pine-oak forest and adjacent communities. Site meetings highlighted environmental and ecological conditions of managed lands, cultural challenges facing managers, land-use history, and logistical and tactical complexities of fire management. These meetings and site evaluations provided useful background information that was subsequently incorporated into the team's fire training that occurred over three days the following week. Two additional days of field assessments were conducted after the training followed by a close-out session where observations and recommendations were provided to the FDN and USAID managers.

During the two week detail, team members gained a basic understanding of the Sierra de las Minas fire management program. It was clearly evident that managers have a good understanding of the primary issues facing them, and have developed an integrated strategy to address these issues. Significant challenges do exist however and more planning and training is needed in order to safely and effectively manage the long-term ecological effects of high fire incidence. Key issues that the team identified include the need to continue strengthening community education, prevention, and outreach programs; to develop detailed fire training opportunities to enhance the knowledge and skills of mid-level managers, leadership, fire safety, and instructor training; and the need for a long-term landscape-scale fire and fuels management plan to mitigate the environmental effects of catastrophic fire.

Fire Management Program and Training Recommendations

General Recommendations;

Fundación Defensores de la Naturaleza (FDN) should elevate their planning and management efforts for fire and fuels in the arid pine-oak forest, to increase the combined use of fire and forest thinning where appropriate. This would include increased fire prevention and education to reduce the numbers of human-caused fires that threaten the biological diversity and ecological integrity of these forests. Due to the prevalent use of fire (i.e., clearing land, maintaining fields, maintaining pasture, and hunting), the pine-oak forest should be managed in the context of high fire incidence originating from nearby communities. If fires are consistently suppressed at natural or man-made fire breaks above these communities, forest densities and fuels outside of these fire breaks rapidly buildup as observed, thereby greatly increasing the risk and impacts of catastrophic fire in these higher-elevation areas. Therefore fire and fuels should be managed for the long-term to reduce the risk of catastrophic fire to the entire forested landscape and watershed.

Ecological Context;

The two dominant pines (*Pinus oocarpa* and *Pinus maximinoi*), as well as the oaks in this forest have numerous adaptations to fire, whether from humans or lightning (Farajon and Styles 1997). "*Pinus oocarpa* has semi-serotinous cones and is adapted to fire"; "Nearly everywhere fire is an integral part of the ecosystem" (Farajon and Styles 1997). *Pinus oocarpa* has many fire adaptations including thick bark, semi-serotinous cones that open with the heat of fire dispersing seeds, and this species resprouts from the root crown and can withstand 100% crown scorch and resprout (Farajon and Styles 1997). *Pinus maximinoi* "may prevail under a regime of grazing or burning, with the undergrowth dominated by grasses" (Farajon and Styles 1997). *Pinus maximinoi* also has very thick bark particularly at the base. The many species of oak found in these forests have thick bark and the majority if not all resprout following fires of various intensities.



Pinus Oocarpa sapling resprouts after being completely scorched over by fire.

In the absence of an anthropogenic fire regime, which may have been the case, it is possible that hundreds and possibly thousands of years ago these forests would have been much denser and choked full of fuel and biomass. Under this scenario, when rare very dry (i.e., El Niño Years) conditions prevailed, these forests would have burned with mixed-severity fires including stand-replacement-type fires of severe intensity, setting back the forest in patches of variable size over large areas. Such high severity patches would have likely been ideal for the regeneration of the same pine and oak forests as a result of the receptive soil seedbed and reduced competition from mature vegetation.

The contribution and extent of lightning caused fires in these forests is unknown. Reports received by the team downplayed the importance of lightning fires, although lightning scarred trees and lightning caused fires were observed in the field on several occasions. Because of this, and through discussions with elders from the community, it was felt that the influence of lightning fires has been underestimated, particularly since human burning is so prevalent and commonly acknowledged that even the few natural lightning caused fires are typically misinterpreted as originating from humans. It is possible the extent of lightning caused fires is extensive enough to yield a mixed-fire regime with smaller surface fires occurring occasionally combined with stand-replacement fires occurring less frequent. The spatial extent of past fire regimes is, however, unknown; even modern day records are incomplete. Scientific research on the fire history and ecology of the pine-oak forest would be very helpful in guiding the objectives of this fire management program.



Pinus Maximinoi cat face with history of a dozen or more fire scars.

A preliminary fire history collection was made in the Monte Verde region. Many of the pines and oaks in the pine-oak forest zone exhibited scarring at the base due to the influence of repeated surface fires. A dozen samples were collected using a non-destructive technique from 2 sites along the road above Montaña Monte Verde. These samples were selected after a brief field reconnaissance to determine the trees which

contained the best history of fire scars. The samples through course preliminary analysis appeared to have on average about 50 annual rings within the area sampled, and between 5 to 12 fire scars recorded during this period. Although preliminary and a very course analysis, these trees suggest a mean fire return interval at these sites above Rio Hondo of about 6 years. These forests have sustained frequent surface fires in the lower slopes above communities on this order of magnitude for a century or more. The forest health and diversity in these areas appears to be acceptable given this level of fire activity and possibly even enhanced by the natural variability of fire effects with increasing distance from the communities and higher fire frequency.

The arid pine-oak forest is relatively productive and surface fuels accumulate rapidly. It was observed that in areas burned several months prior to our visit that there was already enough pine litter cast to carry a surface fire under moderate burning conditions. In areas that had not burned for several years, the surface fuel buildup varied depending upon the number of years without a fire. Several areas were observed directly above typical fire breaks that buffer the communities with litter depths of 10 to 15 cm or more. The fire management program emphasis on aggressive fire suppression surrounding communities will result in rapid fuel accumulations outside these areas, where they will likely reach dangerous levels in a decade or less. Eventually and predictably fires will spread into these areas given the high incidence of human-caused fire. During severe droughts or periods with very high fire behavior indices, these fires will be beyond the control of firefighters, resulting in adverse long-term forest and watershed effects. These effects could be mitigated by proactively managing the fire and fuels. Such a management approach would be based on an integrated landscape management plan designed with a mosaic of forest patches having a diverse range of fuel loadings and forest densities across the broader pine-oak forest, with the goal to reduce the frequency and extent of catastrophic fire events.



Pine and oak needle and leaf litter accumulation 1 year after a fire.



Agricultural and forest clearings are the origin of the majority of forest fires.

Specific Recommendations;

FDN should revise the fire management plan for the arid pine-oak forest to include different levels of fire management and suppression. For Example;

Area A: Surrounding and above settled communities and within the lower multiple-use zone. Manage for high fire frequencies with low fire intensities and severity (e.g., approximately 1-5 year intervals).

Area B: Adjacent to and in the forested slopes above Area A, more distant from communities, in the upper slopes of the multiple use zone and lower sustainable use zone. Manage fuels and forest with fire and thinning for high to moderate fire frequencies at low to moderate intensities (e.g., approximately 4-12 year fire return intervals).

Area C: Adjacent to and in the forested slopes above Area B, most distant from communities, in the upper slopes of the sustainable use zone and below the cloud forest or nucleus zone. Manage here focused on reduction of the fuel loads and minimizing the chances of catastrophic fire. Manage fire at moderate to low frequencies and at low to moderate intensities (e.g., approximately 6-20 year intervals). Need for monitoring and research to further assess the possibility of using fire as an ecological process and forest management tool in this Area. Prescribed fires may not be possible or appropriate in this zone.

Thinning, logging, piling, and pile burning may be necessary as a preliminary treatment to reduce fuels and fire intensities before broadcast prescribed burning can be effectively accomplished, particularly in Areas B and C. Additionally prescribed fires may need to

be initially conducted early when conditions are good for control and low to moderate fire intensities and severities (i.e., January – March).

In all areas manage for a diverse range of forest, fuel, herbaceous, and environmental conditions across the landscape with some units managed without the influence of fire, others with high fire frequencies and everything in between. This will create a diversity of landscape and forest conditions that will enhance habitat diversity and facilitate fire control and management in the future. Breaking up the fuel and forest homogeneity and connectivity over the landscape planning area will result in less extensive and less severe fire effects over time. The effects of different types, intensities, severities, frequencies, and seasons of fires need to be monitored and reassessed on a regular basis to ensure that the effects are within the range of desired management objectives. The potential fire effects to endangered species or species of special concern and their habitats need to be further assessed (i.e., golden cheeked warbler, quetzal).

Additional Interrelated Recommendations

1. Pine Beetle Outbreaks:

- a. **Native Forests:** Beetle and insect outbreaks are a natural ecological process in forests. Proactive management prior to outbreaks that improves forest health and reduces forest competitive stress will mitigate some adverse effects of bark beetles. Fire is a tool that should be considered for reducing tree densities. Overall, management is usually not economically practical or effective. Once infestations do occur, feasibility of treatment is generally limited to roadway corridors with easy access and should only occur if damaged trees could be harvested with limited soil and watershed impacts. Under severe conditions, large pockets of mortality may require some attention to address hazard fuels buildup.
- b. **Pine Plantations:** A long term management plan should be developed for a plantation that identifies interim management steps that will be needed to maintain and produce a healthy, mature tree crop. One important step that should be identified in such a plan is the repeated thinning of the trees early before they become too dense and show effects from competition, stress, and beetle mortality. In one plantation that was visited by the team, current tree densities were very high and have resulted in competition for resources between trees, reduced water availability, increased stress, in combination increasing susceptibility to bark beetle infestations. Fire should also be considered as a thinning tool in these plantations to reduce unhealthy trees and fuels, although fire should be applied under very cool prescriptions to minimize injuries to desired trees. Reducing the tree density and needle cast (fuel) will reduce the risk of fire, provide more water availability, reduce competition, and increase the overall yield of the plantation.



Dense pine plantation with competition and pine beetle effects.

2. **Education and Prevention:** Reduce human-caused fires through active education and prevention at the schools and communities using multimedia resources. A fire prevention program has been established within the region. Increased development of this prevention program is needed consisting of media advisories (newspaper, radio and television), community workshops, designated community outreach coordinators, grade school fire prevention presentations, and varied print medium including billboards, posters, and pamphlets. Given the nature of the problem, good planning in the area of prevention and education should continue to be a major component of the overall fire management strategy. Additional recommendations include:
 - a. The development of a national fire prevention mascot or icon that would be adopted by all departments within the country. The purpose of the chosen icon would be to provide a familiar and culturally significant image that portrayed a strong fire prevention message to people of all ages. The logo should have human significance, suggests intelligence, one which the Guatemalan people can empathize with, and that could be potentially vulnerable to wildfires (such as an anteater, monkey, sloth, or coati). This may be best determined through a public survey of several candidate animals/logos.
 - b. Continue to develop and implement agricultural burning schedules for all communities. This will increase fire risk awareness and foster community group participation while improving their ability to take responsibility in protecting natural resources adjacent to their community, for those communities adjacent to protected areas.
 - c. Develop a fire hazard rating system that incorporates a simple, color coded hazard warning and display such ratings at strategic locations.

- d. Present GIS based materials to national fire management meetings and/or fire ecology conferences in an effort to develop international support for fire programs.
3. **Community Outreach/Prevention:** Regulate when agricultural clearings are burned and limit them to times and months when they can be best controlled. Organize community volunteer groups to help conduct the field burning safely with less risk of an escaped fire. Provide these groups fire training and tools for fighting fires.
4. **Fire Operations, Training, and Equipment:** Invest in fire crews to make them more professional in their eyes and in the public eyes. Provide them better training, transportation, tools, equipment, uniforms, boots, etc... The leaders of the crews need to be trained at a higher level so they can provide training to the crews and communities and in order to make these crews safer. This will greatly enhance their safety and also help with the education and outreach. When the people and communities begin to recognize and respect these firefighters, and what they represent as protectors of the natural resources, they will also likely better understand their role in environmental protection.

A number of basic fire training courses have been conducted over the past few years by or with the assistance of different local and international organizations. Because of the lack of a well organized training program and the lack of a centralized record keeping system, the team had difficulty piecing together the fire training history and in determining what resources were available within FDN for training. An additional challenge facing the agency is that they appear to lack sufficient qualified personnel that can provide mid- or upper- level fire management training. An identified training system supporting an annual refresher or sequential, tiered training program for fire fighters and mid-level managers was also lacking. Given these observations, the team identified the need to have training efforts that incorporated the following objectives:

- Conduct basic courses every year for new firefighters.
- Conduct basic courses every year for new firefighters.
- Conduct annual refresher training for all firefighters with a minimum of 8 hours. Annual refresher training should include a summary of last year's fire season, safety and security of the firefighter and LCES (lookout, communications, escape routes, safety routes).
- Advanced fire management and leadership training for the fire supervisors to develop their skills in supervision and training.

The team was limited in its review to existing fire management infrastructure. Even so, it was very evident through discussions and observations

that increased training and organizational experience would greatly strengthen the ability of managers to efficiently and effectively manage during actual fire operations. Besides identified training courses, the team identified the concept of personnel exchanges as a primary means of increasing the local manager's abilities to improve fire operations. Questions pertaining to identified and unidentified logistic, social, economic and political challenges aside, the concept behind this fire management personnel exchange between Guatemala and the US or Mexico would include:

- Detail of US or Mexico fire personnel at the crew boss (Type 3) level that could be placed within the department of Zacapa during the local fire season (April–May).
- Detail consisting of Guatemalan mid-level fire control technicians who would be placed on US or Mexico Incident Management Teams for a period of 6 weeks during the fire season.
- Develop and implement daily fire weather reporting system between all remote guard stations and operations base during fire season.



The Rio Hondo fire crew taking a lunch break during a normal work day.

Fire Equipment: During recent years FDN has begun building up a store of equipment for the support of suppression activities. Most of the available equipment is housed at the central office in Rio Hondo, with the remote stations maintaining only limited equipment stocks. These initial efforts have focused on securing basic fire fighting hand-tools and other miscellaneous items. Identified equipment needs are still very high; of particular note is the limited availability of

personal protective equipment such as Nomex shirts and pants. Due to budget priorities and available funds, the acquisition of the identified equipment needs is expected to take many years. Of particular note, the team identified the following list of priority target needs:

- Increased versatility of tool mix including McLoeds, Pulaski's, Shovels, Fire Swatters, and 12-18 inch bar chainsaws.
 - Portable belt weather kits, with one located at each ranger control station within the MBR.
 - Fire-retardant clothing (Nomex shirts and pants) available to all fire fighters.
 - Area topographic maps and GPS units in each station of control.
 - Improved, reliable communications infrastructure connecting all remote field stations with the central office of control.
 - Automated weather stations for the collection of fire weather data that could be utilized in developing baseline data on seasonal fire risk to support fire prevention programs, suppression activities, and application of prescribed burning.
5. **Preparedness:** On severe fire years like the El Niño event in 1998 implement large prevention campaigns and elevate the preparedness of the fire brigades. When conditions and predictions indicate that a large fire event year like this is going to occur allocate additional resources to prevention and suppression particularly in sensitive resource areas. Likewise on relatively cool and wet years when conditions are right to conduct burning with limited adverse environmental effects, allow fires to burn over larger areas, and increase prescribed burning activities.
6. **Ecotourism:** Develop ecotourism in the communities using the San Cristobal Acasaguastlan hotel zone as a center (i.e., Hotel Atlantic and others in this area). Coordinate and collaborate with the hotel owners and tourism companies and Guatemala tourism agency (INGUAT) to develop some tourism opportunities in this region. The target market would include regular foreign tourists, travelers, backpackers and upper to middle class Guatemalans. These tourism satellite locations would be developed in some of the Sierra de las Minas communities in close proximity to large rivers for swimming and wildlife viewing. They could support a small guest house and cafe/restaurant for travelers within a short walk (0.5 – 1.5 km) from the river recreation areas. These could be developed as ½ day or longer trips as the demand and interest grows. Security will be provided by the locals and enforced once the value of tourism dollars becomes known. Additionally this will provide incentives for local protection of the natural resources and development of sustainable forest products.



Baskets woven from pine needles for sale at the San Augustin Field Office.

7. **Sustainable Forest Products:** Develop a much greater number of sustainable forest products including handicrafts, art, furniture, etc that can be constructed from the pines, oaks and other forest resources (including small scale, sustainable timber extraction). Locate local tradesmen at the Mercado Central in Guatemala City and elsewhere to help provide training and the market for these products. Consult with the Sierra Madrean communities in Chihuahua and Durango Mexico for ideas and technology transfer. Two Non-Government Organizations that can possibly be of assistance include the Sierra Madre Alliance (Randy Gingrich, Chihuahua, Mexico; www.sierramadrealliance.org), and Native Seed Search (Barney Burns, Tucson Arizona; www.nativeseeds.org). Additional fire protection of the natural resources will develop when the communities realize the income generated from these sustainable forest products.
8. **Thornscrub Forest Protection:** The thornscrub forest in the lower slopes of the Sierra de las Minas is biologically diverse. The thornscrub forest is one of the most threatened biotic communities in Latin America due to widespread clearing for agriculture. FDN should provide added protection to the thornscrub forest to reduce clearing, introduction of exotic grasses, and fire.
9. **Research:** The Sierra de las Minas are a center for rich biological diversity, as well as having the largest intact cloud forest in Central America. Very little scientific research has been conducted in this region. There are many important management concerns and ecological questions that would benefit from some basic research. The FDN/CONAP staff should develop a list of research priorities based on management concerns. Literature searches should be conducted on these research needs to locate all and any potential researchers to solicit to conduct the research. Many researchers would be interested in conducting

research in a place like Sierra de las Minas if they only new about the needs and assistance available from FDN.

10. **Prescribed Fire:** Fire is a tool that can be used to the managers benefit. Specific recommendations include the following:
- a. Use prescribed fire to reduce fuels, the risk of catastrophic fire, and watershed impacts from severe fires in the arid pine-oak forest.
 - b. Use prescribed fire to reduce fuels or enlarge perimeters of fuel breaks and buffer zones surrounding strategic protected areas (or critical habitat).
 - c. Use prescribed fire for clearing agricultural lands.
 - d. Only use prescribed fire where clearly articulated goals and objectives are identified, and ensure that prescribed fire plans are written by knowledgeable professionals and approved by an agency administrator.

Training Activities Summary

Training was conducted on several levels during the week of April 26th. Mark Kaib (DOI), Francisco Hernadez, Selvin Perez, and Gonzalo Lopez from the Fundación Defensores de la Naturaleza were the primary instructors.

On April 26th, a full day training course was conducted on fire suppression and fire management strategies. This training included basic fire suppression standards (S-130/S-190), fire behavior, 10 standard firefighting orders, 18 watch out situations, common denominators of fire behavior on tragedy fires, and the history of fire suppression and fire suppression effects in the U.S. and Northern Mexico.



Fire preparedness, safety, and prevention training at the community of Aloea Mal Paz.

On April 27th an interagency forum was held to discuss fire management issues in the Sierra de las Minas and lessons that can be learned from the U.S. DOI experience. This forum included topics upon the socio-economic, environmental, and cultural concerns with fire specific to the Zacapa region, the role of fire in the pine-oak forest,

pine and oak species fire adaptations, and planning and management recommendations for the pine-oak forest. Additionally, the history, ecology, and management of fire in the Southwest U.S. and Mexico were presented along with lessons learned from these countries.

On April 28th fire preparedness, safety, and prevention training was conducted for the fire brigade and primary school classes at the community of Aloea Mal Paz. This included the 10 standard firefighting orders, 18 watch out situations, common denominators of fire behavior on tragedy fires, fire tool use and maintenance, and fire safety and prevention topics.

Training Localities, Dates, and Participants

Fire Suppression and Fire Management Strategies

Santa Cruz, Rio Hondo 4/26/2004

List of Participants

1. Luis Alberto Gregoria
2. Byron Leal Onvej
3. Erwin Lopez Juarez
4. Ariel Saucedo Sosa
5. Edwin Orlando Madrid
6. Jose Miguel Ruiz
7. Izabel Majera Garcia
8. Dimas Armindo Paz
9. Danilo Saavedra
10. Gonzalo Lopez Franco
11. Selvin Perez
12. Mark Kaib
13. Israel Alveines

Interagency Forum on Fire Management Issues in the Sierra de las Minas

Santa Cruz, Rio Hondo 4/27/2004

List of Participants

1. Vilma Esperanza Sosa
2. Armando Prene Portillo
3. Bugoseinel Saiz
4. Byron E. Paz Villalobos
5. Jose I. Raldon
6. Faipe Cabreri
7. Edgar Garcia
8. Angel Cordon
9. Cesar A. Paiz
10. Julio Rivera Berganza
11. David Maldonado
12. Gonzalo Lopez Perez
13. Glenda Rosa
14. Edgar Marquez

15. Cayetano de Paz
16. Otto Idone Salazar
17. Axel Calderon
18. Mark Kaib
19. Francisco J. Hernandez
20. Selvin Perez
21. Gonzalo Lopez Franco
22. Danilo Saavedra
23. Edwin Orlando Sosa Madrid
24. Israel Alvizures

**Fire Preparedness, Safety, and Prevention Training
Aloca Mal Paso, Gualan, Zacapa, 4/28/2004**

List of Participants

1. Pedro Mindez
2. Zenon Gomez Garcia
3. Paro Aldema
4. Hecto Orellana
5. Francisco Hernández
6. Mark Kaib
7. Anjel A. Jordan
8. Alejandro Rodrequez
9. Regimberto Rodreguez
10. Manor Sosa
11. Orlando Roque
12. Nery Rene Rogue
13. Jose Olvin Gutirez
14. Nery Aldana Leiva
15. Petronido Gutirez
16. Faustino Leiva
17. Jose Barrientos
18. Hector Aldana
19. Carlos Alfredo
20. Adgar Aldana Leiva

ACKNOWLEDGEMENTS

Several key personnel contributed to a very constructive assignment and to the effectiveness of the training courses. Francisco Hernandez, the regional fire management officer from FDN provided excellent leadership and logistical support to our group. Francisco was very helpful throughout the assignment, he was a great guide and he provided important insight to the fire program and management needs. Selvin Perez and Gonzalo Lopez the FDN biologists were very helpful in providing the biological and ecological background for the fire program as well as in the translation of fire training materials. Igor de la Roca and Cesar Tot from FDN were instrumental in making the consultation trip a success through logistical and organizational support.

Literature Cited

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Appendix I

RECOMENDACIONES SOBRE MANEJO DEL FUEGO Y COMBUSTIBLE EN SIERRA DE LAS MINAS

Recomendaciones Generales:

General: Es necesario planificar y manejar el combustible vegetal y los incendios forestales en el bosque de pino encino con una buena administración del fuego a través de: a) disminuir la cantidad disponible de hojarasca haciendo quemaduras prescritas y b) manejo de incendios rastrojeros de baja intensidad c) cortar ramas de árboles para disminuir incendios de copas, esto ayuda a que el bosque se desarrolle disminuyendo densidad. Este manejo es el más recomendable debido a constante riesgo que existe en estos bosques por actividades de quema previa a cultivos hechas por agricultores y los intencionales.

- El sentido que quiero dejar claro es que no debemos ser sensacionalistas en querer evitar todo tipo de incendio, sino, más bien en el contexto ecológico de adaptación y evolución de las especies locales; este tipo de manejo conlleva a mantener condiciones más o menos naturales (con estudios sobre dendroecología se puede tener una idea de la periodicidad o regímenes naturales de incendios).

Contexto Ecológico de las Recomendaciones

El bosque mixto de pino encino de Sierra de las Minas es un ecosistema relativamente productivo (hojas y biomasa) y las hojas que caen se acumulan rápidamente. La condición anterior, unida a una política de “No incendios” puede ser desastroso en algunas áreas cuando ocurra un incendio forestal, debido a la acumulación de combustible vegetal. Algunos aspectos seriamente afectados a corto y largo plazo son: diversidad biológica, suelo, cuencas hidrográficas.

Pinus oocarpa y *P. maximinoi* y encinos (*Quercus* spp) están adaptados de varias maneras a los incendios forestales: tienen corteza gruesa, los conos de *oocarpa* necesitan el fuego para liberar semillas, *P. oocarpa* desarrolla raíces como tubérculos para rebrotar en siguiente época lluviosa, los encinos y pino tienen una vigorosa capacidad de rebrotar en todas las edades. Hace cientos o miles de años, estos bosques sin la influencia del hombre, probablemente eran más densos y con una fuerte acumulación de combustible; por lo mismo cuando había eventos de fuegos naturales las áreas quemadas eran grandes y con fuertes cambios en la estructura y composición de la vegetación. El ciclo de estos incendios en estado “natural” fue probablemente de cada 50 a 100 años cuando las condiciones son muy secas o se les llama sequías o años secos. Esta condición a nivel local se pudo observar en el año 1998 por Sierra de las Minas, año con mayor cantidad de área quemada.

Recomendaciones Específicas

Revisar el plan de incendios forestales en el que se incluyan distintos niveles de incendios (tratamientos) con el objeto de priorizar las áreas de acción en el gradiente altitudinal o en referencia a la distancia entre el bosque y las comunidades humanas.

Área A: Áreas aledañas o poblados o aldeas, en estas áreas se debe hacer un manejo de incendios con alta frecuencia pero de intensidad baja o rastreros (mas o menos 1-5 años).

Área B: Esta sigue del área A, más lejos de las comunidades. Manejar el combustible vegetal y evitar que los incendios rastreros se vuelvan de copas (podar ramas), en este nivel los incendios deben ser de frecuencia e intensidad moderada (mas o menos 4-10 años).

Área C: arriba o concéntrica al área B y bajo el bosque nuboso. En este nivel el manejo de incendio debe tener una frecuencia moderada (mas o menos 6-20 años). Tratamientos para evitar incendios masivos son: a) Poda de ramas y raleo para evitar incendios de copas b) amontonar y quemar este material. Adicional a lo anterior deben conducirse quemas prescritas en la entrada del verano (enero febrero) cuando las condiciones ambientales permiten tener mas control. En este nivel o piso C, debe evaluarse las quemas prescritas como una herramienta de manejo o prevención de incendios, debido a que puede interrumpir procesos ecológicos que no conocemos.

A nivel de gran paisaje o ecología del paisaje, el manejar áreas con y sin influencia de fuegos en el tiempo y el espacio puede resultar en algo interesante de investigar debido a que no conocemos como esta diferente intensidad de fuegos (áreas a,b y c) puede afectar la estructura y composición del bosque y mas importante aun, si esto es lo que nosotros queremos (objetivos de manejo). En este sentido, se recurre al monitoreo como herramienta para hacer manejo adoptivo de nuestras actividades de prevención y control de incendios forestales. Por otra parte, el efecto que los incendios forestales tienen sobre especies en peligro (i.e. Goleen cheeked Warbler) debe ser medida en un futuro.

Recomendaciones Adicionales Interrelacionadas

1. No preocuparse por los ataques del gorgojo del pino o explosión poblacional en las poblaciones de insectos debido a que esto es un efecto de procesos ecológicos y muchas veces son difíciles de controlar (acceso).
2. El manejo de plagas en la SM en algunos casos es por la alta densidad, por lo mismo se debe efectuar podas y raleos en los primeros años de plantaciones o regeneración natural. La densidad de bosques evita infiltración de agua (por alta densidad de broza) entonces la salud de los árboles se debilita y están mas propensos a ataques, esto es un síntoma de vulnerabilidad a incendios y ataques de plagas.
3. Reducir la tasa de incendios causados por personas a través de un programa de educación hacia la prevención (radio, periódico etc). Crear una mascota o logo humano que sugiera inteligencia para que las persona se identifiquen con el. Esto puede se determinado a través de un censo que indique que animal es el mas indicado para esto (un oque sea vulnerable a incendios): monos, pizotes, aves, etc...
4. Invertir mas en la profesionalización de las brigadas así como dotarlos del equipo adecuado para la actividad: camisas, pantalones, botas anteojos, así como también de un vehículo para transportarse de un lugar a otro sin

dificultad, lo anterior va a mejorar grandemente la seguridad y también va a ayudar a que las personas comunes vean y demuestren más respeto a los bomberos forestales, que reconozcan su rol en la protección de los recursos naturales.

5. En años severos como el de 1998 se debe de implementar un buen programa de prevención y limitar los permisos para rozas, y cuando las condiciones sean favorables (años húmedos) se debe permitir quemar grandes áreas.
6. Regular cuando debe extenderse permisos de rozas y limitar estas cuando las condiciones son adversas.
7. Organizar voluntarios locales para quemar (rozar y quemar) con menos riesgo a que el fuego se escape y proveer entrenamiento y equipo a estas brigadas.
8. Desarrollo de Ecoturismo; Se debe desarrollar el ecoturismo y construir hoteles utilizando materiales naturales (zacate,) en sitios cercanos a ríos y áreas verdes y construir senderos interpretativos de uno a dos días para que los visitantes se sientan en contacto con la naturaleza y los valores, todo lo anterior debe de ser coordinado con el INGUAT para desarrollar rutas y proveer seguridad a los visitantes.
9. PRODUCTOS FORESTALES SOSTENIBLES: Se debe desarrollar un gran número de productos forestales como muebles y artesanías de hoja de pino y otros recursos del bosque, se necesita consultar a los comunitarios de sierra madre en occidente de Chihuahua y Durango sobre ideas y posibilidades de compartir tecnología. Hay dos organizaciones no gubernamentales que pueden ayudar que son La Alianza de la Sierra Madre en Chihuahua el contacto es Randy Gringrich y Native Seed Search (Tucson Arizona) el contacto se llama Barney Burns.
10. La protección de los bosques se dará cuando los comunitarios reciban un ingreso económico como beneficio del bosque y tendrán más respeto sobre el bosque.
11. RECOMENDACIONES PARA EL BOSQUE ESPINOSO: Se debe reconocer que es un ecosistema muy raro alrededor del mundo y posee una alta diversidad, y está en peligro de desaparecer debido al cambio de uso (meloneras, pastizales) y por estas razones se debe de incrementar las medidas de protección para evitar que este bosque desaparezca enfatizando que es un área de alta diversidad biológica y de especies. Para la Fundación Defensores de la Naturaleza se recomienda que se debe de dar especial protección al bosque seco que se ubique dentro del área protegida.

Appendix II

Contact Information

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