BIOLOGICAL OPINION
ON THE IMPACTS OF FOREST MANAGEMENT AND OTHER ACTIVITIES TO THE BALD EAGLE, INDIANA BAT, CLUBSHELL AND NORTHERN RIFFLESHELL ON THE ALLEGHENY NATIONAL FOREST, PENNSYLVANIA

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CONSULTATION HISTORY

On January 17, 1985, the Forest Service requested formal consultation with the Service on the Forest Plan for the Allegheny National Forest (ANF). On January 29, 1985, the Service issued a non-jeopardy biological opinion for the bald eagle (*Haliaeetus leucocephalus*).

On January 5, 1995, the Forest Service reinitiated informal consultation with the Service on the Forest Plan for the ANF. The need for reinitiation was based on the 1985 biological assessment (BA) not fully addressing potential effects to listed species, and the inclusion of additional species on the federal list of threatened and endangered species. The Service provided comments back to the ANF dated February 8, 1995, concurring with the Forest Service's no effect and not likely to adversely affect determinations for the peregrine falcon (*Falco peregrinus*), Indiana bat (*Myotis sodalis*), American burying beetle (*Nicrophorus americanus*), small whorled pogonia (*Isotria medeoloides*), and eastern cougar (*Felis concolor couguar*); but not concurring with the Forest Service's no effect determinations for the bald eagle, clubshell mussel (*Pleurobema clava*), and northern riffleshell mussel (*Epioblasma torulosa rangiana*). We recommended 1) that specific measures be implemented to avoid adverse effects to bald eagles, and 2) that the Forest Service undertake studies and prepare a biological assessment evaluating the effect of Forest Plan implementation on the clubshell and northern riffleshell. On March 6, 1995, representatives of the Service and Forest Service met to discuss the Service's comments. In a letter dated March 17, 1995, the Forest Service rebutted concerns raised by the Service.

On November 27 and December 14, 1995, the Service provided comments to the Forest Service on the Draft Environmental Impact Statement, Draft River Management Plan, and associated draft biological assessment (covering the bald eagle, clubshell, northern riffleshell, and small whorled pogonia) for the Allegheny Wild and Scenic River (a proposed amendment to the Forest Plan). The Forest Service submitted their revised BA to the Service on April 12, 1996, and on May 8, 1996, the Service concurred with the Forest Service's not likely to adversely affect determinations.

On August 12, 1996, the Forest Service submitted a BA regarding the potential effects of vegetation management on electric utility rights-of-way on the ANF (a proposed amendment to the Forest Plan). On August 22, 1996, the Service concurred that vegetation management, when conducted in accordance with the conditions and restrictions outlined in the DEIS, was not likely to adversely affect the bald eagle, clubshell, northern riffleshell or small whorled pogonia.

On August 20, 1997, the Forest Service submitted a programmatic biological evaluation for the Indiana bat for the Forest Plan, seeking Service concurrence with their "may affect, not likely to adversely affect," and "may affect, beneficial affect" determinations. The Service provided comments back to the ANF dated October 29, 1997, indicating non-concurrence with their "may affect" determinations in favor of a "no effect" determination, and recommending that the Forest Service, pursuant to their section 7(a)(1) responsibilities, conduct Indiana bat surveys on the ANF. On February 12, 1998, the Forest Service affirmed that they would be conducting Indiana bat surveys, and on March 10, 1998, they submitted a draft survey proposal to the Service. On July 14, 1998, representatives of the Service and Forest Service met to discuss the recent discovery (via Anabat detector) of Indiana bats on the ANF, and in a letter dated August 24, 1998, the Forest Service provided preliminary bat survey results to the Service.

In a letter dated September 2, 1998, the Service recommended that the Forest Service prepare a BA evaluating the potential effects of Forest Plan implementation on the Indiana bat, bald eagle, clubshell, northern riffleshell, and small whorled pogonia, and advised the Forest Service that formal consultation would be required if adverse effects to these species could not be avoided. In October and November 1998, the ANF provided to this office draft BA's as part of a reinitiation of informal consultation on the potential effects of actions outlined in the Forest Plan to federally listed species. Our office reviewed the BAs and provided comments back to the ANF dated October 28 and 29, 1998; and November 3, 4, and 13, 1998. On November 9, 1998, representatives of the Service and Forest Service met to discuss the Service's comments. In a letter dated November 30, 1998, the Forest Service submitted a revised BA to the Service and requested initiation of formal consultation. However, not all information necessary to initiate formal consultation was submitted with the November 30 letter. In a letter dated December 17, 1998, the Forest Service submitted a revised and final BA. In their BA, the Forest Service concluded that actions outlined in the Forest Plan would adversely affect the bald eagle, Indiana bat, clubshell, and northern riffleshell. They also determined that the adverse effects identified in the BA could not be removed through informal consultation. Consequently, the submission of a final BA was accompanied by a request by the Forest Service for formal consultation on the potential effects of actions outlined in the Forest Plan on the bald eagle, Indiana bat, clubshell and northern riffleshell. In a letter dated December 21, 1998, the Service indicated that the initiation package associated with the Forest Service's request for formal consultation was adequate, and confirmed that formal consultation between the two agencies had begun.

On April 5, 1999, the Service received an amendment to the BA, reflecting substantial increases in the number of acres subject to timber harvest and in the projected miles of new road construction. In addition, on April 22, we received a report indicating the presence of Indiana bats at seven sites on the ANF, rather than the three sites reported in the BA. On April 30, 1999, the Service requested a 30-day extension of the consultation period in order to re-evaluate the effects of the action and anticipated levels of take based on the receipt of this new information and modified project scope.

The Service delivered a draft biological opinion to the Forest Service on May 4, 1999. On May 6 and May 19, 1999, we met with ANF personnel to discuss the terms and conditions associated with the reasonable and prudent measures outlined in our opinion. On May 14, 1999, we received written comments from the Forest Service on the draft opinion. In their May 6, 14, and 19 comments, the Forest Service again modified the scope of the action, most significantly by: 1) increasing the action period from 1998-2001 to 1998-2003, and 2) removing most of the conservation measures from the proposed action. After considering Forest Service comments, we prepared and sent this final biological opinion to the Forest Service.

In their request for formal consultation of December 17, 1998, the Forest Service determined that activities outlined in the Forest Plan would not likely adversely affect the small whorled pogonia. The Forest Service further requested our concurrence on this effect determination. In a letter dated December 21, 1998, the Service concluded that activities outlined in the Forest Plan were not likely to adversely affect the small whorled pogonia.

The Service requested additional information to clarify activities on the ANF or to clarify comments made in the Forest Service's BA (by electronic mail or facsimile) on March 31, and

April 1, 13, 23, and 29, 1999. This information was received (by electronic mail or facsimile) from Brad Nelson (Forest Service ANF) on April 1, 2, 5, 13, 14, 23 and 29, 1999 (*in litt.*).

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

As defined in 50 CFR 402.02, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the United States or upon the high seas. The "action area" is defined as all areas to be affected directly or indirectly by the federal action and not merely the immediate area involved in the action. The direct and indirect effects of the actions and activities must be considered in conjunction with the effects of other past and present federal, state, or private activities, as well as cumulative effects of reasonably certain future state or private activities within the action area. This biological opinion (opinion) addresses only those actions for which the Service believes adverse effects may occur. In their BA, the Forest Service outlined those activities in the Forest Plan that would adversely affect the bald eagle, Indiana bat, clubshell and northern riffleshell. The following opinion addresses whether continued implementation of the Forest Plan on the ANF is likely or not likely to jeopardize the continued existence of these species.

The proposed action, as defined in the BA, is "continued implementation of the Allegheny National Forest Land and Resource Management Plan (Forest Plan), as amended, and projects predicated upon it. The proposed action includes those projects currently ongoing, as well as future site-specific projects" (BA, p. 1). The 1986 Forest Plan is scheduled for revision in 2003, at which time consultation with the Service will be reinitiated. Therefore, the subject consultation and opinion include the 1986 Forest Plan, and projects predicated upon it, through the year 2003. Prior to Forest Plan revision, we encourage the Forest Service to identify new information available concerning endangered, threatened, and proposed species' habitat requirements; identify the management requirements necessary to protect these species; and identify appropriate recovery strategies applicable to the ANF. This will assist the Forest Service in meeting its continuing responsibilities under sections 7(a)(1) and 7(a)(2) of the Endangered Species Act.

The action area includes the entire ANF, as well as the Allegheny River and Allegheny Reservoir adjacent to the ANF (i.e., from the Pennsylvania/New York border south to the town of Tionesta). The ANF includes approximately 513,000 acres in Warren, McKean, Elk and Forest Counties, Pennsylvania. Elevations on the ANF range from 1,000 to 2,300 feet above sea level. The ANF lies within the Allegheny River and Susquehanna River watersheds, and contains 770 miles of perennial cold-water streams, 43 miles of warm-water streams, and 800 acres of impoundments (BA, p. 4), the largest of which is the Allegheny Reservoir, formed by Kinzua Dam.

This opinion addresses a variety of management directions and associated activities that are planned, funded, executed, or permitted by the Forest Service on the ANF. These activities are implemented in accordance with the provisions contained in the 1986 ANF Land and Resource Management Plan (Forest Plan). The Forest Plan is a general programmatic planning document that provides management goals, objectives, and standards and guidelines under which project level activities (e.g., timber sales, wildlife habitat management, road construction, special uses,

etc.) may be planned and implemented to carry out the management direction of the ANF. Additional management direction and guidelines are included in the Forest Plan for specific management areas, whose extent and purpose are summarized in Table 1 (drawn from Appendix D of the BA). Land use allocations are made and outputs projected based upon the direction established in the Forest Plan. All project-level activities undergo National Environmental Policy Act review by appropriate Forest Service personnel when proposed, as well as assessment of project effects on federally listed species in compliance with section 7 of the Endangered Species Act. The Forest Plan establishes multiple-use management area prescriptions (including associated standards and guidelines) for future decision-making which are adjustable (via monitoring and evaluation) through amendment and revision.

Management of the ANF pursuant to the Forest Plan includes the implementation of several types of activities which, for the purposes of this opinion, have been grouped into the following categories: 1) tree harvesting and removal activities; 2) road construction, maintenance and operation; 3) trail construction, maintenance and operation; 4) operation and maintenance of recreation facilities; 5) herbicide application; 6) insecticide application; 7) prescribed burning; and 8) oil, gas and mineral development. The anticipated levels of activity associated with most of the above categories of activities through the year 2003 are summarized in Table 2 and further described below.

The BA did not contemplate or assess implementation of the following activities on the ANF through the year 2003; therefore, these activities are not included in this opinion, and would be subject to separate consultation(s) pursuant to section 7 of the Endangered Species Act: construction of utility line rights-of-way; construction of additional fishing access areas, boat launches, picnic areas, campgrounds, canoe access sites, beaches and scenic overlooks; use of insecticides other than *Bacillus thuringiensis* for forest insect pest control; use of herbicides other than glyphosate or sulfometuron methyl for the purposes of forest regeneration; use of herbicides or other means of vegetation control beyond those covered in the EIS prepared for vegetation control on electric utility line rights-of-way; and development of additional oil and gas wells on federally-owned mineral leases. In addition, Forest Service activities proposed to occur at annual levels higher than those projected in the BA (see Table 2) will require further consultation with the Service.

Table 1. Management areas on the Allegheny National Forest.

Management Area	Size (acres)	Description and Purpose/Management Objective(s)
1	7,000	Hardwood forest with interspersed conifers and openings * timber production, using even-aged management * recreation in a roaded setting * habitat management for species associated with early-successional forest habitat
2	6,000	Continuous-crown canopy forest consisting of shade-tolerant vegetation; intensive oil and gas development may be evident * timber production, using uneven-aged management * motorized recreation in a roaded setting
3	327,000	Consists predominantly hardwood forests, consisting of even-aged stands; intensive oil and gas development may be evident * timber production, using even-aged management * motorized recreation in a roaded setting
5	10,000	Congressionally-designated wilderness area * ecosystem preservation * wilderness setting for non-motorized recreation
6.1	101,000	Forests undergoing succession to mature/overmature hardwood forest * maintain/enhance scenic quality * dispersed recreation in semi-primitive motorized setting * manage for wildlife species requiring mature/overmature hardwood forest * timber management for wildlife habitat improvement
6.2	20,000	Contains four 5,000-acre blocks intensively managed for timber production * sawtimber production, using even-aged management on a 40-year rotation * non-motorized recreation
6.3	1,000	Buzzard Swamp Management Area. Contains large savanna-like areas and open water bodies intensively managed for wildlife species which require riparian habitat * wildlife management (e.g., waterfowl, furbearers, warm-water fish) * recreation (e.g., hunting, fishing, wildlife observation)
6.4	23,100	Cornplanter, Tracy Ridge and Allegheny Front RARE II inventory areas, and the section of the Allegheny Reservoir between Cornplanter and Tracy Ridge * preserve and protect the scenic, scientific, historic, archaeological, ecological, educational, watershed and wildlife values * semi-primitive motorized and non-motorized recreation * limited vegetation management - to enhance wildlife habitat or recreation
7	1,000	Recreational area with extensive facilities, structures and utilities present * high-density recreation developments
8	6,000	Tionesta Scenic Area, Tionesta Research Natural Area, Hearts Content Scenic Area, Kane Experimental Forest * ecosystem preservation, forest research and dispersed recreation
9.1	1,000	Forest undergoing succession to mature/overmature hardwood and softwood forests; intensive oil and gas development evident * minimal management will be done

Table 2. Estimated range of activities likely to occur between FY 1998 and FY 2003 on the Allegheny National Forest[1].

Activity	Unit of Measure	FY 1998	FY 1999	FY 2000	FY 2001-2003 (annually)	Total
Trail Construction						
pedestrian	miles	0	13.6	0-3	0-3	13.6-25.6
motorized - winter	miles	2.9	0	0-3	0-3	2.9-14.9
motorized - summer	miles	0	0	0-3	0-3	0-12
Timber management						
Total sell	MMBF	9.8	14	38-55	38-55	175.8-243.8
Clearcut	acres	100-220	177-220	100-420	100-220	677-1323.8
Shelterwood seed/prep	acres	1200-1640	1200-1640	3000-4000	1200-2000	9000-13,280
Shelterwood removal	acres	1120-1864	1120-1864	1120-1864	1120-1864	6720-11,184
Thinning	acres	1342-3225	1342-3225	3000-7000	1342-3225	9684-23,115
Selection cut	acres	300-334	300-334	300-700	300-800	1800-3768
Herbicide treatment						
Forest regeneration	acres	1453	1251	1315-1638	1315-1638	7964-9256
Utility line management	acres	<300	<300	<300	<300	<1800
Roads						
Construction	miles	0.3	0	10-20	5-15	25.3-65
Reconstruction/betterment	miles	0	0	0-50	0-50	0-170
Restoration	miles	36.4	35.1	50-130	30-70	201.5-375.1
Wildlife and Fish						
WL habitat improvement	acres	1663	1500	2000-2200	2000-2200	11,163-11,963
WL habitat improvement	structures	42	23	80-120	80-120	385-545
Fish habitat improvement	acres	45	47	20-45	20-45	172-232
Soil/Water/Air						
Water/soil improvement	acres	124	17	14-42	14-42	197-309
Prescribed burning	acres	30-40	30-40	30-40	30-40	180-240
Oil and Gas Development	wells	199	~150	~150	~150	~949
Land clearing	acres	149	~112.5	~112.5	~112.5	~711.5
Associated roads/pipeline	miles	~53	~40	~40	~40	~253

[1] Adapted from information provided in the 1998 Biological Assessment for Threatened and Endangered Species on the Allegheny National Forest; and amended by the April 1, 1999, and May 14, 1999 revisions to the Biological Assessment

Tree Harvesting/Removal Activities

Forest vegetation on the ANF is composed primarily (74 percent) of Allegheny hardwoods (black cherry, white ash and yellow poplar) and Northern hardwoods (American beech, sugar maple, yellow birch and hemlock) which occupy approximately 377,000 acres. Conifer, oak, and aspen comprise 3.6 percent, 15.9 percent, and 1 percent of the forest, respectively. Seventy-eight percent of the forest on the ANF is sawtimber-sized and older than 60 years of age. Forest age classes and acreages on the ANF are represented in Table 3, which is adapted from Table 1 of the BA (p. 5). Timber harvest on the ANF between 1987 and 1997 averaged 69.2 million board feet annually, representing an average of 7,627 acres harvested annually, or 1.5 percent of the ANF (BA, p. 7).

Table 3. Forest age classes on the Allegheny National Forest in 1997.

Age Class (years)	Acres	% of forest
0-19	36,179	7.0
20-59	38,036	7.4
60-89	292,874	57.0
90-109	102,201	19.9
110+	7,445	1.5
no age (includes openings and low-stocked savannas)	36,192	7.0

Timber harvesting is one of the primary management activities which alters and/or disturbs the greatest acreage of forested habitat on the ANF. Table 2 summarizes the projected levels of timber harvest annually through the year 2003. The maximum annual acreage proposed to be harvested through 2003 is anticipated to range from 7283 to 13,984 acres (1.4 to 2.7 percent of the ANF). Currently, the focus is on even-aged silvicultural management practices, using intermediate thinnings, shelterwood seed cuts, shelterwood removal cuts, and clearcuts. Intermediate thinnings reduce the number of trees in stands which are above 80 percent relative density (71 percent canopy closure) to approximately 60 percent relative density (54 percent canopy closure) in order to concentrate growth on the better trees. Shelterwood seed cuts reduce relative density from above 80 percent to 50 to 60 percent, to promote seedling regeneration and growth. Once adequate seedlings are established (usually in three to 10 years following the shelterwood seed cut), a shelterwood removal cut is done, resulting in the almost complete removal of overstory trees. Clearcuts are done to remove nearly all overstory trees in stands where adequate seedlings exist or will develop in the understory. Clearcuts are done primarily in aspen stands on the ANF.

Uneven-aged silvicultural management practices are occasionally used on the ANF, and include improvement cuts, and selection cuts (individual tree and group). Improvement cuts reduce overstory stocking to 60 percent and concentrate tree removals in specific age and size classes to convert an even-aged stand into an uneven-aged stand. Individual tree selection cuts reduce the number of trees in stands which are above 80 percent relative density (71 percent canopy

closure) to approximately 60 percent relative density (54 percent canopy closure) in order to concentrate growth on the better trees. Group selection cuts involve the removal of small clumps of trees (0.25 to 0.5 acre in size), resulting in a relative stand density of about 50 percent (45 percent canopy closure) across the stand.

Forest Plan standards and guidelines have been developed to minimize adverse effects to forest wildlife and water quality that may result from timber harvesting. These standards and guidelines include, among other things, criteria for snag and den tree retention, and maintenance of riparian vegetative buffer strips.

Forest Plan standards and guidelines require than an average of five to 10 snags per acre be left in areas subject to timber harvesting, with the exception of Management Areas 2, 3, 6.1, 6.2 and 6.3. In Management Areas 2 and 6.1, three snags 10-16 inches diameter at breast height (d.b.h.), three snags 18-24 inches d.b.h., and three snags greater than 24 inches d.b.h are retained per acre. In Management Areas 3, 6.2 and 6.3, five snags per acre are retained.

Forest Plan standards and guidelines also require that a certain number of den trees be left in areas subject to timber harvesting. Up to three den trees per acre in intermediate cuts; six to 15 den or potential den trees per acre in clearcuts; and a clump of approximately 75 trees (0.25 acre) within each five acres of regeneration cut are retained. In Management Areas 2, 6.1 and 6.2, three to five den trees per acre greater than or equal to 14 inches d.b.h. are retained. In Management Area 3, four to six den trees per acre greater than or equal to 14 inches d.b.h. in the oak type are retained.

In order to minimize the movement of silt, humus and other organic materials into streams, Forest Plan standards and guidelines recommend that temporary stream crossings be minimized, and a filter strip 50 feet wide, plus two feet in width for every one percent slope, be retained adjacent to streams or riparian areas. Recommendations such as these are also known as "Best Management Practices" and minimize, but do not prevent, non-point source pollution. According to the BA (p. 46), Forest Plan standards and guidelines "meet or exceed" the Best Management Practices required by the Commonwealth of Pennsylvania.

Timber is also harvested for personal use through a firewood permit system. Annually, 600 to 800 firewood permits are sold, each allowing the cutting of up to three cords of wood. The cutting of standing dead or down trees is allowed within 150 feet of most open Forest Service roads.

Tree removal/forest clearing activities are also associated with road construction, trail construction, oil and gas development, and wildlife habitat improvement. Most new road construction is associated with timber harvesting, which results in the clearing of 3.64 acres per mile of road (assuming a road width of 30 feet). Total acres to be cleared through 2001 include 127 acres for new road construction, 109 acres for road betterment, and five acres for road restoration (Brad Nelson, ANF, *in litt.*). Trail construction affects 1.21 acres of forest per mile (assuming a motorized trail width of 10 feet). Oil and gas development results in the permanent loss of 0.75 acre per well site (0.25 acre for the well pad and 0.5 acre for the road), totaling approximately 112 acres annually. Wildlife habitat management results in the conversion of

approximately 10 acres of forested habitat to wildlife openings annually.

Road Construction, Maintenance and Operation

Roads are constructed on the ANF primarily to support timber harvest operations. Between 1986 and 1995, 157.3 miles of road were constructed, 116.9 miles reconstructed, and 426.1 miles restored (BA, p. 12). The type and extent of existing roads on the ANF are represented in Table 4, which is adapted from the BA (Table 4, p. 12).

Table 4. Road statistics for the Allegheny National Forest.

TYPE OF ROAD	**MILES**
Oil, gas and mineral access (federal)	67
Oil, gas and mineral access (non-federal)	620
Forest Service roads - TOTAL	1,139
Open	430
Seasonally open	285
Closed	424
State and township	758
Special use	30
TOTAL ROADS ON THE ANF	2,614

Projected annual levels of road construction, reconstruction/betterment, and restoration through the year 2003, include: 10 to 20 miles of road construction, 0 to 50 miles of reconstruction or betterment, and 30 to 130 miles of restoration. New road construction to support timber harvesting and recreation access follows the sedimentation and water quality standards provided in the fisheries amendment, and guidelines for road design in proximity to streams. The focus of road restoration is to improve existing old roads to bring them into compliance with current Forest Plan standards and guidelines by replacing and adding culverts, directing runoff away from streams and using less erosive surface material (BA, p. 50).

Trail Construction, Maintenance and Operation

The trail system on the ANF consists of 171 miles of hiking trails, 54 miles of cross-county skiing trails, 14 miles of interpretive trails, 106 miles of all-terrain vehicle trails, and 360 miles of snowmobile trails. From 1996 to 1997, 3.1 miles of new trail were constructed and 12 miles were reconditioned.

In 1999, 13.6 miles of new pedestrian trail are planned for construction. From 2000 to 2003, zero to three miles each of pedestrian, motorized winter, and motorized summer trails are proposed to be constructed annually.

Forest Plan standards and guidelines propose that off-road vehicle trails be constructed outside riparian areas, and that trails be cross-drained to minimize erosion and sedimentation into streams, similar to standards and guidelines for other activities (e.g., tree harvesting or road construction).

Operation and Maintenance of Recreation Facilities

Recreation facilities on the ANF include: 16 campgrounds, seven fishing access areas, 11 picnic areas, four beaches, and three scenic overlooks. Other recreation facilities include boat launches, canoe access sites and a marina. The Forest Service maintains six boat launches on the Allegheny Reservoir, and operates (under special use permit) the Wolf Run Marina on the Reservoir; fees are charged to use these facilities. The Forest Service maintains one boat launch on the Allegheny River at Buckaloons Recreation Area (BA, p. 57); commerical canoe businesses must obtain a special use permit to use this facililty. The Forest Service also maintains six canoe access sites at the following locations: Beaver Meadows Recreation Area (access to Beaver Meadows Lake near Marienville), Buckaloons Recreation Area (access to the Allegheny River), Dunkle Boat Launch and Sugar Bay Boat Launch (access to the Allegheny Reservoir), Irvin Run Canoe Launch (access to the Clarion River), and Tionesta Creek Boat Launch (access to Tionesta Creek near Sheffield) (Brad Nelson, ANF, *in litt*. 1999).

Through the year 2003, the focus will be on maintaining existing facilities. The construction of new recreation facilities was not proposed in the BA, therefore, this opinion does not cover such activities.

Herbicide Application

Two herbicides, glyphosate (Accord®) and sulfometuron methyl (Oust®), are used to control understory vegetation and tree seedlings which interfere with the establishment of commercially preferred trees. Application of herbicides is usually by a sprayer attached to a skidder, although occasionally back-pack sprayers are used. Forest Plan standards and guidelines require a 75-foot buffer zone along perennial streams during herbicide application, a 50-foot buffer along intermittent streams and springs with flowing water, and a 25-foot buffer around seeps that do not have an outflow (BA, p. 57). Between 1986 and 1995, 11,240 acres were treated with herbicide. Between 1251 and 1638 acres are proposed to be treated annually through the year 2003.

Herbicides are also used to control vegetation on electric utility rights-of-way on the ANF, with less than 300 acres being treated annually. An environmental impact statement (EIS) was completed in 1997 covering 125 miles of rights-of-way (totaling 955 acres) on the ANF. Vegetation management in utility line rights-of-way is conducted by the utility companies, who control vegetation manually, mechanically, and/or with fosamine ammonium, glyphosate, imazapyr, metsulfuron methyl, picloram, triclopyr, and mineral oil carriers (BA, p. 10). The ANF consulted with the Service on the draft EIS, and the Service concluded that, provided that the precautions outlined in the draft EIS were followed, the use of herbicides to maintain rights-of-way was not likely to adversely affect the bald eagle, clubshell, or northern riffleshell. The Indiana bat was not covered in that particular consultation, but is covered in this opinion.

Insecticide Application

Insecticides, including *Bacillus thuringiensis* (*B.t.*) and diflubenzuron (Dimilin), were used between 1985 and 1995 on the ANF to attempt to control gypsy moth, elm spanworm and forest tent caterpillar populations. The maximum area treated in any one year was 65,128 acres (13 percent) of the ANF (BA, p. 35). No treatments were conducted between 1996 and 1998, and none are planned to occur in 1999.

Due to impacts to non-target organisms, diflubenzuron has not been used on the ANF since 1989, and its use is not contemplated in the future. Control of forest pests is proposed to be achieved using *B.t.* in the future when insect populations are documented or anticipated to present a threat to forest health and to reduce impacts in recreation areas. Based on insect surveys conducted in the fall of 1998, no spray program is proposed for 1999. No riparian buffer zones are implemented during *B.t.* application.

Prescribed Burning

Prescribed burning was conducted on 73 acres in 1996 and 1997, and is projected to occur on 30 to 40 acres annually through 2003. Burns are conducted primarily in the spring (April or May) and occasionally in the fall (October or November).

Oil, Gas and Mineral Development/Management Activities

The Forest Plan provides the basis for the ANF's administration of oil, gas and mineral development (BA, p. 12). About 93 percent of the subsurface minerals on the ANF are privately owned. There are about 6,000 producing wells on the Forest, with another 80 to 200 new wells drilled annually. A well normally produces for 20 to 25 years. No wells have been drilled on federal leases since the Forest Plan was approved in 1986, and none are anticipated to be drilled before the Forest Plan is revised in 2003. Although the ANF has more direct control over extraction of federally-owned minerals, the ANF, as steward of the surface rights, works to ensure that extraction of privately-owned minerals is compatible with surface management goals and objectives (BA, p. 12). Activities associated with oil, gas, and mineral development, regardless of ownership, include: tree harvest (loss of forest associated with oil and gas wells is considered permanent), road construction/maintenance, waste management (e.g., brine disposal), earth disturbance, and pipeline construction/maintenance.

Oil and gas development results in the permanent loss of 0.75 acre per well site (0.25 acre for the well pad and 0.5 acre for the road), totaling approximately 112 acres annually. Most of this development is associated with privately-owned minerals (i.e., the Forest Service only owns the surface rights).

Conservation Measures

Conservation measures represent actions pledged in the project description that the action agency will implement to further the recovery of the species under review. Such measures should be closely related to the action and should be achievable within the authority of the action agency.

The beneficial effects of conservation measures are taken into consideration in the Service's conclusion of a jeopardy vs. a non-jeopardy opinion and in the analysis of incidental take. However, such measures must minimize impacts to listed species within the action area in order to be factored into the Service's analyses. The proposed actions subject to consultation on the ANF also include ongoing conservation measures implemented through standards and guides outlined in the Forest Plan to reduce or minimize the adverse effects of actions on the bald eagle, Indiana bat, clubshell and northern riffleshell.

Bald Eagle

Forest Plan guidelines to protect nesting bald eagles from February 1 to July 31 of each year include: 1) prohibiting disturbances within approximately 330 feet of each nest, except those necessary to protect the nest; 2) prohibiting significant changes in the landscape within 660 feet of each nest; 3) restricting management activities (i.e., road and trail construction and maintenance, timber cutting and hauling, oil and gas development (where possible), right-of-way management, etc.) that result in adverse disturbance to nesting birds within approximately 1,320 feet of each nest; and 4) closing local roads to the public where active nests are located (p. 4-38). In addition, the Forest Service is to identify and manage potential nest trees in suitable locations for the bald eagle (p. 4-37), and locate new roads, trails, recreation facilities and other developments to avoid potential nesting sites for the bald eagle (p. 4-38).

Indiana Bat

The Forest Plan indicates that although the Indiana bat "has not been recorded as occurring within the Allegheny National Forest, its historic and suspected range includes this area. Old growth habitat in riparian areas preferred by this species for nursery colonies will be provided through implementation of the standards and guidelines as well as the management area assignments" (p. 4-36). The Forest Plan also commits the Forest Service to: 1) carrying out National Forest responsibilities in Recovery Plans for federally listed threatened and endangered species; 2) developing management plans for all federal and state threatened and endangered species; 3) assessing the occurrence of threatened and endangered animal and plant species in all areas to be affected by land adjustment or resource management activities, and designing actions to avoid, minimize, or mitigate potential adverse effects; and 4) protecting specific key habitats and specialized habitats through coordination with other resource management activities or area closure (p. 4-37).

There are no standards and guidelines designed specifically to protect, maintain, or enhance summer or winter Indiana bat habitat, or prevent impacts to Indiana bats roosting in trees. However, impacts to Indiana bats resulting from the implementation of various land management activities (e.g., timber harvesting), may be incidentally minimized through the implementation of standards and guidelines specific to those activities. For example, impacts to potential Indiana bat roosting and foraging habitat may be minimized by implementing the snag and den tree retention, and riparian filter strip standards and guidelines for timber harvesting. Also, managing approximately 33 percent of the ANF for late-successional/old-growth values and riparian values may provide the Indiana bat with potentially suitable foraging and roosting habitat.

Clubshell and Northern Riffleshell

Neither the clubshell mussel nor the northern riffleshell mussel were federally listed at the time the Forest Plan was completed, therefore, there are no standards and guidelines designed specifically to protect, maintain, or enhance mussel habitat. However, impacts to endangered mussels resulting from the implementation of various land management activities (e.g., timber harvesting, road building), may be incidentally minimized through the implementation of standards and guidelines specific to those activities. For example, impacts to endangered mussels and their habitat may be minimized by implementing the riparian filter strip standards and guidelines for timber harvesting, and road and trail construction guidelines. Also, managing streamside management zones for fisheries and wildlife objectives will help to maintain or improve water quality and riparian habitat.

STATUS OF THE SPECIES

Bald Eagle

Species Description

The bald eagle is a large raptor. The characteristic adult plumage consists of a white head and tail with a dark brown body. Juvenile eagles are completely dark brown and do not fully develop the white head and tail until the fifth or sixth year. Male bald eagles generally measure three feet from head to tail, weigh seven to 10 pounds and have a wingspan of about 6.5 feet. Females are larger, some reaching 14 pounds and having a wingspan of up to eight feet.

Life History

Bald eagles are strongly associated with aquatic environments throughout most of their range (Gerrard and Bortolitti 1988, Millar 1995), but will use upland areas when water is frozen over (Stenhof *et al*., 1980). Nesting eagles are associated almost exclusively with lakes, rivers, or sea coasts (U.S. Fish and Wildlife Service 1983) and are usually no farther than two miles from water (McEwan and Hirth 1979, Gerrard and Bortolotti 1988). Although fish predominate in the typical diet of eagles, many other types of prey are also taken, including waterfowl (Munro 1938, Swisher 1964, Griffin *et al*. 1982) and small mammals (Edwards 1969, Platt 1976), depending on location, time of year, and population cycles of prey species (Stenhof 1978, Millar 1995). Lincer *et al*. (1979) documented that carrion are also taken when available, especially in wintering areas.

Both nesting and wintering habitats must have adequate perching, roosting, and nesting sites, generally trees, and an adequate food base to support eagles. Nesting birds build their nests in mature trees, on cliffs, or rock outcrops where large trees are not available (U.S. Fish and Wildlife Service 1983). Nest sites are usually in large trees along shorelines in relatively remote areas (Millar 1995) or where there is reduced human activity (Andrew and Mosher 1982). Outside the nesting season, bald eagles usually prefer areas away from human disturbance (Lish and Lewis 1975, Buehler *et al*. 1991a), but are tolerant of limited activity in some situations (Stenhof 1978, Martell 1992). Some studies have shown, however, that human disturbance,

especially of night roosts, can overburden the daily energy budget of wintering eagles, causing a significant increase in physiological stress (Stalmaster and Newman 1978, Stalmaster and Gessaman 1984).

Generally, trees greater than 11 inches d.b.h. and within 100 to 600 feet of water are preferred perching sites (Vian 1971, Lish and Lewis 1975, Stenhof 1976, 1978). Eagles tend to roost on the tallest trees (> 63 feet) (Lish and Lewis 1975, Stalmaster and Newman 1979). Where they occur throughout the range, cottonwood (*Populus deltoides*) trees are often selected over other trees for perching and roosting (Lish and Lewis 1975, Stenhof 1978, Osterfeld 1988). Larger more open-branching trees are also favored by wintering eagles for night roosts (Stenhof 1978). Sheltered timber stands are important as alternative night roosts during severe winter weather because of the thermal protection they provide (U.S. Fish and Wildlife Service 1983, Osterfield 1988, Martrell 1992). This is probably less important, however, at lower latitudes within the species range where temperatures are less severe. Distance of communal night roosts from foraging areas varies between 0.5 and 17.8 miles (Stenhof 1978).

Bald eagles breed at four to five years of age, the same time they develop their white head and tail. Adult birds mate for life, establishing nesting territories that they usually return to each year. Nesting pairs may remain near their territory year-round, particularly towards the southern range of the species. Bald eagles construct large nests, sometimes measuring as much as six to ten feet across and weighing hundreds of pounds. Nests are built in the tops of large trees near rivers, lakes, marshes, or other wetland areas, and are often used by the same breeding pair year after year. Females lay an average of two eggs, but clutch size ranges from one to three eggs. Incubation lasts about 35 days, and the young fledge nine to 14 weeks after hatching. Parental care may extend four to 11 weeks after fledging (Wood *et al*. 1998).

During the day, eagles spend approximately 94 percent of their time perching (Gerrard *et al*. 1980, Watson *et al.* 1991). During the breeding season, 54 percent of their time is spent loafing, 23 percent foraging, and 16 percent nesting (Watson *et al*. 1991). Eagles prefer high perches in trees that rise above the surrounding vegetation to provide a wide view that faces into the wind (Gerrard *et al*. 1980). In Maryland, eagles used shoreline that had more suitable perch trees, more forest cover, and fewer buildings than unused areas at all times of the year (Chandler *et al*. 1995). Chandler *et al*. (1995) found that distance from the water to the nearest suitable perch tree was shorter for areas used by bald eagles than areas that did not receive eagle use. In their study, eagles tended to perch within 164 feet of the shore. They recommended that shoreline trees greater than 7.87 inches d.b.h. and dead trees not be removed. Eagles often locate prey from a shoreline perch, and hunting forays from perches appear to be more successful than those initiated from flight (Jaffee 1980). Gerrard *et al*. (1980) found that after a successful fishing trip, eagles flew to a low perch to feed; these perches were less than 33 feet above the water and were well below the level of neighboring tree tops.

Status of the Species within Its Range

Historically, bald eagles were plentiful along major river systems and coastal areas in the United States and Canada. However, habitat loss associated with human settlement, and later the use of persistent pesticides (such as DDT) for crop management, resulted in a dramatic decline in eagle

populations. By the late 1960s, most breeding populations had been decimated by eggshell thinning and associated low productivity. Since the nationwide ban on most persistent pesticides, bald eagle populations have experienced gradual recovery in both productivity and total numbers.

The "Southern" bald eagle was federally listed as endangered in 1967. The remaining bald eagle populations in the coterminous United States were listed as endangered or threatened in 1978 and the "Southern" designation was dropped. The Service divided bald eagles in the lower 48 states into five recovery regions based on geographic location. The five regions are the Chesapeake Bay, Pacific, Southeast, Northern, and Southwest. A recovery plan was prepared for each region by separate recovery teams. The Northern Recovery Region, which includes 24 states, is pertinent to this opinion.

In 1963, the National Audubon Society reported only 417 active nests in the lower 48 States, with an average of 0.59 young produced per active nest. In 1994, about 4,450 occupied breeding areas were reported by the States with an estimated average young per occupied territory (for 4110 territories) of 1.17. Compared to 1974, the number of occupied breeding areas in the lower 48 States had increased by 462 percent, and since 1990, there has been a 47 percent increase. As a result of the significant increase in numbers of nesting pairs, increased productivity and greatly expanded distributions, in 1995 the bald eagle was reclassified in the lower 48 States from endangered to threatened where it was not already so classified *(Federal Register*, July 12, 1995, Vol. 60, No. 133, pp. 36000 - 36010). In 1997, the Service estimated the breeding population exceeded 5,290 pairs. Currently, the Service is drafting a proposed rule to remove the bald eagle in the lower 48 states from the federal list of endangered and threatened wildlife (Jody G. Millar, USFWS, Rock Island, Illinois, *in litt*., January 29, 1999). No Critical Habitat has been designated for the species.

Recovery of the bald eagle in the lower 48 states is continuing at an impressive rate. In the past 10 years, the bald eagle's nesting population has increased at an average rate of about nine percent per year. The current nesting population is more than ten-fold larger than the level reported by the National Audubon Society in 1963. The species population numbers have approximately doubled every seven to eight years for the past 30 years.

Status of the Species - Northern States Recovery Unit

The Service published the Northern States Bald Eagle Recovery Plan in 1983. Major recovery steps outlined in the plan include: 1) determine current population and habitat status; 2) determine population and habitat levels needed to achieve recovery; 3) protect, enhance, and increase bald eagle populations and habitats; and 4) establish and maintain communication to coordinate and conduct recovery efforts. The delisting goals within the Northern States Recovery Region are as follows: 1,200 occupied breeding areas distributed over a minimum of 16 States with an average annual productivity of at least 1.0 young per occupied nest.

These delisting goals were met in 1991 with 1,349 occupied territories distributed over 20 States and an estimated average productivity since 1991 in excess of 1.1. In 1994, there were 1,772 known occupied territories distributed over 21 states in the recovery region with an estimated

1.26 young per occupied territory. In 1997, estimated occupied territories for the Northern States Recovery Region exceeded 2,067. The Northern States Recovery Region includes large tracts of federally protected lands which are prime bald eagle habitat. However, some of the most rapidly expanding areas of bald eagle nesting are in States with the majority of their lands held in the private sector. For example, between 1990 and 1997, the Illinois bald eagle population has tripled from eight to 26 occupied territories; Indiana has gone from two to 26 occupied territories; Iowa increased from eight to 58 occupied territories; and Oklahoma has gone from 0 to 24 occupied territories. The three States with the largest population in the Northern States Recovery Region, Minnesota, Wisconsin, and Michigan, did not quite double their eagle population during the same seven-year span (i.e., 1990 to 1997). Private property is important habitat for the expanding bald eagle population.

The western half of Pennsylvania lies within the Northern States Recovery Region. Within this portion of the State, the number of occupied breeding areas has steadily increased from an estimated low of approximately one territory in the late 1960s, to four territories in 1984, and 15 in 1998 (four of which were new territories that year). In 1998, the 15 occupied breeding territories within the western half of the State yielded 12 young (0.8 young per territory). State-wide, 28 occupied breeding territories (eight of which were new territories that year) yielded 25 young (0.9 young per territory). Pennsylvania has exceeded its year 2000 recovery goal of 10 occupied breeding territories.

Threats to the Species

Reasons for this species previous decline have been well documented. These include: 1) environmental contamination, particularly organochlorine insecticides like DDT, which caused egg-shell thinning and reproductive failure, and the illegal use of pesticides; 2) human disturbance of eagle nests and night roosts; 3) intentional killing by shooting or poisoning; and 4) the degradation and alteration of roosting and nesting habitat (U.S. Fish and Wildlife Service 1983, Millar 1995). Illegal shooting continues to threaten the species in some parts of the country, particularly in some western states. Between 1985 and 1990 the National Wildlife Health Research Center in Madison, Wisconsin had diagnosed over 150 bald eagle deaths due to gunshot (Millar 1995). Eagle deaths occasionally occur throughout the species' range due to collisions with power lines or electrocutions at power poles.

The ban on use of DDT and other organochlorine insecticides in the 1970's and 80's has profoundly benefited bald eagle recovery. Nonetheless, pesticide poisoning of eagles has continued. Organochlorines have been replaced by organophosphates and carbamates which are much less persistent in the environment (Stinson and Bromley 1991). However, these compounds are acetylcholinesterase inhibitors that can be extremely toxic to birds and mammals. The National Wildlife Health Research Center has diagnosed over 100 cases of contaminant poisoning over the past 15 years. Poisonings have been attributed to phorate, carbamate, fenthion, and famphur, mostly in the western states. Secondary poisonings of bald eagles have increased in the Plains and Rocky Mountain regions from pesticide-laced carcasses used to kill predators. Eagle reproduction in the Great Lakes is still impaired by persistent contaminants such as PCBs. Heavy metals such as mercury and lead have also been implicated in the poisoning deaths of bald eagles and may have severe chronic effects on reproduction. Secondary

lead poisoning has been associated with eagles ingesting lead shot while feeding on crippled waterfowl. As was the case with organochlorine insecticides, this problem should be abating because of bans on lead shot for waterfowl hunting (Millar 1995). With increased oil and gas development in northwestern Pennsylvania, and the presence of thousands of abandoned wells (many of which are leaking and/or not capped), the potential exists for eagles to come into contact with oil resulting from spills.

Steps to reduce continued threats to the bald eagle have been undertaken by all levels of government and numerous private conservation groups nationwide. Increased protection of nesting habitat and winter roost sites has occurred in many areas throughout the country. Guidelines have been developed in many areas to minimize human disturbance around nesting and winter roost sites. Many harmful pesticides implicated in the death of bald eagles in the past have been banned and the levels of some persistent organochlorines or their metabolites have decreased in areas where the species is highly susceptible to contamination (Wiemeyer *et al*. 1993; Millar 1995; Millar *in litt*., January 22, 1999). The species has also benefitted from several years of captive propagation, reintroduction, and transplanting programs, as well as numerous public outreach and education efforts throughout the country.

Although the bald eagle has rebounded over the past 15 to 20 years, current patterns of habitat loss threaten to prematurely halt or even reverse this recovery. Nesting, roosting, and foraging habitat is being lost to shoreline development along rivers, lakes and reservoirs for housing, business, industry, recreational facilities, public utilities, and transportation. Conversion of woodlands to agricultural fields and timber harvesting is also resulting in the loss of eagle habitat. As the human population along these shoreline areas continues to grow, more undisturbed wooded habitat used by bald eagles will be permanently altered.

Chronic human activity may result in temporary or permanent disuse of areas by eagles (U.S. Fish and Wildlife Service 1989). Buehler *et al*. (1991b) found that bald eagle use of shoreline was inversely related to building density (magnitude of effect was greatest in summer) and directly related to the development set-back distance. Clark (1992) concluded that "increased numbers of waterfront buildings and decreased amounts of shoreline woodland...negatively affect eagle shoreline use." Clark also found that eagle numbers decreased with increased numbers of buildings and amount of medium duty roads. Buehler *et al*. (1991a) found that in the northern Chesapeake Bay, 76 percent of shoreline areas may now be unsuitable for eagle use because of the presence of development within 1,640 feet of the shoreline. Up to an additional 10 percent of the shoreline was found to be unsuitable at times because of boat and pedestrian traffic. When shoreline is developed, it is irretrievably lost as eagle habitat (Buehler *et al*. 1991b).

Human activity resulting in even temporary disruption of the bird's environment represents a major source of potential disturbance in many eagle populations (McGarigal *et al*. 1991, Stalmaster and Kaiser 1998). Human activity in perching areas can interrupt feeding and cause birds to relocate (Fraser 1988, Stalmaster and Kaiser 1998). Watts and Whalen (1997) examined eagle density as a function of human presence and their results suggested that the presence of people had a negative effect on shoreline use by eagles. Watts and Whalen (1997) stated that "...it is clear that eagles avoid shoreline segments that regularly have people within 100 m [328

feet] of the water." Buehler *et al*. (1991b) seldom observed eagles on the northern Chesapeake Bay within 1,640 feet of human activity, and found that the birds rarely used developed areas or areas frequented by people on foot. During the summer, birds on the northern Chesapeake Bay flush, on average, when humans get within 577 feet (Buehler *et al*. 1991b). Once birds are disturbed, they do not return to the area until several hours after the disturbance has occurred and only when the disturbance no longer persists (Stalmaster and Newman 1978, Stalmaster and Kaiser 1998).

In addition to human activity, removal of shoreline vegetation results in disturbance to eagles and loss of habitat. Clark (1992) found that within the Powell Creek (Virginia) concentration area, eagle abundance increased with increases in woodland width (defined as maximum width of woodland in each sampling plot measured in meters inland from the shore), snags (defined as number of standing dead trees over five meters in height on the shore of each sampling plot), and woodland length (defined as maximum length of woodland in each sampling plot measured in meters along the shoreline), which are indicative of the amount of forest habitat available. These three variables indicated lack of development, presence of a vegetation screen from human activities, and the presence of perching habitat. Removal of tall, large-diameter trees will decrease the amount of perching and roosting habitat available (Buehler *et al*. 1991b). Luukkonen *et al*. (1989) recommended maintaining shorelines with forested buffers at least 328 feet wide. In addition, the buffer should have a minimum of one tree per 820 feet of shoreline that is at least 15.7 inches d.b.h., is accessible to eagles, and contains suitable perching limbs. They also recommended conserving trees greater than or equal to 23.6 inches d.b.h.

It has been documented that eagles are more tolerant of sounds when the sources were partially or totally concealed from their view (*e.g.*, Stalmaster and Newman 1978, Wallin and Byrd 1984). Strips of vegetation that reduce line-of-site visibility will allow closer presence of humans and provide perching and roosting trees (Stalmaster and Newman 1978). Stalmaster (1980) recommended restricting land activities 820 feet from eagles perched in shoreline trees to protect 99 percent of the birds. He suggested that boundaries could be shortened to 246 to 328 feet in width if at least 164 feet of this zone contains dense, shielding vegetation.

Feeding behavior of bald eagles can be disrupted by the mere presence of humans (Stalmaster and Newman 1978, Stalmaster and Kaiser 1998). Early morning human activities are potentially the most disruptive to eagle foraging activity (McGarigal *et al*. 1991, Stalmaster and Kaiser 1998). Disturbance may result in increased energy expenditures due to avoidance flights and decreased energy intake due to interference with feeding activity (Knight and Knight 1984, McGarigal *et al*. 1991, Stalmaster and Kaiser 1998). "The difference between the presence of a species when food is available versus the ability of that species to utilize the food is important. Whereas scavengers might be present in an area and appear to be unaffected by human activity, closer inspection would be required to determine whether the individuals are actually able to feed on that food" (Knight *et al*. 1991). Camp *et al.* (1997) found that wildlife responds to disturbance physiologically before responding behaviorally. They stated that heart rate increases and attention is diverted to human activities at a distance greater than that which actually causes the wildlife to flush. Knight *et al*. (1991) examined winter bald eagle concentration areas in Washington and found that when anglers (not in boats) were present, fewer bald eagles were feeding and the eagles shifted their foraging from early morning to late afternoon. They

concluded that " . . . the presence of anglers disrupted feeding, which reduced energy intake and increased energy expenditure through avoidance flights. The ultimate effect of such disturbances on energy budgets and individual fitness is unknown."

Clark (1992) found that within the Powell Creek eagle concentration area, eagle abundance decreased with increased numbers of "boat landings." Boat landings were defined as "...piers, boat ramps, and sites where boats are regularly landed or anchored on the shore...." Wallin and Byrd (1984) had similar findings within the Caledon concentration area on the Potomac River.

Boating activity is likely to adversely affect eagles because it disrupts feeding activity and affects large areas in short periods of time (Knight and Knight 1984). Activities of recreational boaters are not predictable and thus are especially disruptive to birds (Wallin and Byrd 1984). McGarigal *et al*. (1991) found that eagles usually avoided an area within 656 to 2,952 feet of a single stationary experimental boat, with an average avoidance distance of 1,300 feet. During this time, eagles spent less time foraging and made fewer foraging attempts. McGarigal *et al*. (1991) recommend a 1,312 to 2,624 foot wide buffer around high-use foraging areas. Knight and Knight (1984) studied wintering eagles in Washington and found that a 1,148 foot wide buffer would protect 99 percent of birds perched in shoreline trees from a single canoe. However, eagles feeding on the ground were more sensitive to disturbance and required larger buffers. A buffer of at least 1,476 feet would be required to protect 99 percent of eagles feeding on the ground from a single canoe.

Moving boats also disrupt eagles. Buehler *et al*. (1991b) found that on the northern Chesapeake Bay, eagles were flushed by an approaching boat at an average distance of 575 feet. Watts and Whalen (1997) studied boats and eagles on the James River. They found that nearly 25 percent of eagles perched on the shoreline flushed when their survey boat was within 656 feet of the shoreline. When the boat was within 328 feet of the shoreline, nearly 80 percent of the birds flushed. During shoreline surveys, they found that nearly 50 percent of all boats observed were within 656 feet of the shoreline and more than 35 percent were within 328 feet. Jon boats, jet skis, and bass boats tended to be closer to the shoreline than sport boats. "The general distribution of boats relative to the shoreline...in combination with the observed flushing probabilities...suggest that a large number of boats may directly influence shoreline use by eagles." Their data analysis suggested that the presence of boats within 656 feet of the shoreline has a significant negative effect on shoreline use by bald eagles.

Stalmaster and Kaiser (1998) studied wintering eagles on the Skagit River in Washington and found that eagles foraging on the ground were intolerant of humans within 300 m (900 feet), especially in the morning and that the "...manner in which eagles responded to motorboats demonstrated that this activity was extremely disruptive to the population, even though only a small number of humans were involved." Luukkonen *et al*. (1989) studied non-breeding eagles in North Carolina and found "eagles and people tended to concentrate their activities on different portions of both lakes." They estimated that boat densities of more than 0.5 boats/km^2 altered eagle distribution patterns. "Disturbance by boaters or others may negatively affect eagle energy budgets by causing unnecessary eagle movements and by displacing eagles from foraging areas." Wood and Collopy (1995) studied breeding and non-breeding eagles on three lakes in Florida. They found a significant negative relationship between boat numbers and eagle numbers on one

of the lakes. The other two lakes did not show this relationship, but did not receive as much boat traffic. Boat use was highest on weekends and eagle use was highest on weekdays. Moving boats seemed to be more disruptive than stationary boats. Boating activity reduced the number of eagles using the shoreline, increased the perching distance from the shoreline, and increased the flushing distance (mean flush distance was 174 feet).

Indiana bat

Much of the information presented below on Indiana bat habitat requirements, life history, status, and threats is taken from the Fish and Wildlife Service's recent agency draft recovery plan (U.S. Fish and Wildlife Service 1999).

Species Description

The Indiana bat is a medium-sized, monotypic species (there are no subspecies) of the genus *Myotis* that is known to occur in much of the eastern half of the United States. Head and body length of individuals ranges from 41 to 49 millimeters (mm) (1 5/8 - 1 7/8 inches), and forearm length ranges from 35 to 41 mm (1 3/8 - 1 5/8 inches) (USFWS 1983). This species is similar in appearance to both the little brown bat *(M. lucifugus*) and the northern long-eared bat *(M. septentrionalis)*. The Indiana bat often has a distinctly keeled calcar. The hind feet tend to be small and delicate with fewer, shorter hairs (i.e., do not extend beyond the toenails) than its congeners. The fur lacks luster (Barbour and Davis 1969, Hall 1981). The ears and wing membranes have a dull appearance and flat coloration that do not contrast with the fur. The fur of the chest and belly is lighter than the flat (not glossy), pinkish-brown fur on the back, but does not contrast as strongly as does that of the little brown or northern long-eared bat. The skull has a small sagittal crest, and the braincase tends to be smaller, lower, and narrower than that of the little brown bat (Barbour and Davis 1969, Hall 1981).

Habitat Requirements

Winter habitat. The Indiana bat requires require specific roost sites in caves or mines (Tuttle and Taylor 1994) that attain appropriate temperatures for hibernation. In southern parts of the bat's range, hibernacula trap large volumes of cold air and the bats hibernate where resulting rock temperatures drop; in northern parts of the range, however, the bats avoid the coldest sites. In both cases, the bats choose roosts with a low risk of freezing. Ideal sites are 50^{o} F (10^{o} C) or below when the bats arrive in October and November. Early studies identified a preferred mid-winter temperature range of 39-46^{o} F (4-8^{o} C), but a recent examination of long-term data suggests that a slightly lower and narrower range of 37-43^{o} F (3-6^{o} C) may be ideal for the species (U.S. Fish and Wildlife Service 1999). Only a small percentage of available caves provide for this specialized requirement. Stable low temperatures allow the bats to maintain a low rate of metabolism and conserve fat reserves through the winter, until spring (Humphrey 1978, Richter *et al*. 1993). Indiana bats will occasionally use sites other than caves or mines if microclimate conditions are favorable. Kurta and Termanio (1994) found a single Indiana bat roosting with a large colony of 15,000 bats (mostly little brown and northern long-eared bats) at a hydroelectric dam in Manistee County, Michigan, and noted that the temperature was about 4.7° C.

Relative humidity at roost sites during hibernation usually is above 74 percent but below saturation (Hall 1962, Humphrey 1978, LaVal *et al*. 1976, Kurta and Teramino 1994), although relative humidity as low as 54 percent has been observed (Myers 1964). Humidity may be an important factor in successful hibernation (Thomas and Cloutier 1992).

Specific cave configurations determine temperature and humidity microclimates, and thus suitability for Indiana bats (Tuttle and Stevenson 1978, LaVal and LaVal 1980). Indiana bats select roosts within hibernacula that best meet their needs for cool temperatures; in many hibernacula, these roosting sites are near an entrance, but may be deeper in the cave or mine if that is where cold air flows and is trapped (Tuttle and Stevenson 1978, U.S. Fish and Wildlife Service 1999).

Indiana bats often hibernate in the same hibernacula with other species of bats, and are occasionally observed clustered with or adjacent to other species, including gray bats (*Myotis grisescens*), Virginia big-eared bats (*Plecotus townsendii virginianus*), little brown bats, and northern long-eared bats (Myers 1964, LaVal and LaVal 1980, Kurta and Teramino 1994).

Summer habitat. A full, well-integrated understanding of the summer needs of this endangered species has yet to be attained. Early researchers considered floodplain and riparian forest to be the primary roosting and foraging habitats used in the summer by the Indiana bat (Humphrey *et al*. 1977), and these forest types unquestionably are important. More recently, upland forest has been shown to be used by Indiana bats for roosting (Clark *et al*. 1987, Gardner *et al*. 1991*b*, Callahan *et al*. 1997, John MacGregor, Daniel Boone National Forest, Kentucky, *in litt*., April 14, 1997); and upland forest, old fields, and pastures with scattered trees have been shown to provide foraging habitat (Gardner *et al*. 1991*b*; MacGregor, *in litt*., April 14, 1997).
Indiana bats occupy highly altered landscapes in many areas of the eastern United States, and use ephemeral, mostly dead and dying trees for roosting. Anecdotal evidence suggests that the Indiana bat may, in fact, respond positively to some degree of habitat disturbance. In northern Missouri, maternity roosts were found in areas that were heavily disturbed (Callahan 1993, Miller 1996). Timber harvest activities neither directly damaged known roosts nor discouraged bats from continuing to forage in an area that had been harvested in Illinois (Gardner *et al*. 1991*a*), and the species has been found roosting in shelterwood cuts in Kentucky (U.S. Fish and Wildlife Service 1999).

Analysis of landscape changes in Missouri, especially in the Ozarks, provides strong, convincing evidence that Indiana bats evolved in an open to semi-open savanna-like environment, at least in the western part of the species' range (Sauer 1920, Schroeder 1981, Giessman *et al*. 1986, Ladd 1991, Nigh *et al.* 1992, Jacobson and Primm 1997). This is supported by the analysis conducted of several maternity sites by Romme *et al*. (1995), who found that most roosts were located in areas that had a canopy closure of 60 to 80 percent. Humphrey *et al.* (1977) hypothesized that roost trees were usually located in openings within the forest because they provided the necessary thermoregulatory characteristics.

Within the range of the species, the existence of Indiana bats in a particular area may be governed by the availability of natural roost structures, primarily standing dead trees with loose

bark. The suitability of any tree as a roost site is determined by 1) its condition (dead or alive); 2) the quantity of loose bark; 3) the tree's solar exposure and location in relation to other trees; and 4) the tree's spatial relationship to water sources and foraging areas.

A number of tree species have been reported to be used as roosts by Indiana bats. These include: American beech (*Fagus grandifolia*), ashes (*Fraxinus* spp.), black gum (*Nyssa sylvatica*), black locust (*Robinia pseudo-acacia*), cottonwood, elms (*Ulmus* spp.), hickories (*Carya* spp.), maples (*Acer* spp.), oaks (*Quercus* spp.), pines (*Pinus* spp.), sassafras (*Sassafras albidum*), sourwood (*Oxydendrum arboreum*), sweet birch (*Betula lenta*), and yellow buckeye (*Aesculus octandra*) (Cope *et al*. 1974, Humphrey *et al*. 1977, Gardner *et al*. 1991*a, b,* Garner and Gardner 1992, Kurta *et al*. 1993*a*, Romme *et al*. 1995, Kiser and Elliott 1996, Kiser *et al*. 1996, Kurta *et al*. 1996, MacGregor, *in litt*. September 3, 1996, Callahan *et al*. 1997, MacGregor *in litt*., April 14, 1997). Morphological characteristics of the bark of a number of trees make them suitable as roosts for Indiana bats; that is, when dead, senescent, or severely injured (e.g., lightning-struck) trees possess bark that springs away from the trunk upon drying. Additionally, the shaggy bark of some living hickories (*Carya* spp.) and large white oaks (*Quercus alba*) also provide roost sites. The most important characteristics of trees that provide roosts are not species but structure: exfoliating bark with space for bats to roost between the bark and the bole of the tree. The length of persistence of peeling bark varies with the species of tree and the severity of environmental factors to which it is subjected.

Occasionally, tree cavities or hollow portions of tree boles and limbs provide roost sites for Indiana bats (Gardner *et al*. 1991*a*, Kurta *et al*. 1993*b*). A crevice in the top of a lightning-struck tree (Gardner *et al*. 1991*a*), and splits below splintered, broken tree tops have also been used as roosts (U.S. Fish and Wildlife Service 1999).

Indiana bat maternity colonies use multiple roosts, in both dead and living trees. Exposure of roost trees to sunlight, and location relative to other trees are important factors in suitability and use. Because cool temperatures can delay the development of fetal and juvenile young (Racey 1982), selection of maternity roost sites may be critical to reproductive success. Dead trees with east-southeast and south-southwest exposures may allow solar radiation to effectively warm nursery roosts. Roosts in some species of living trees (e.g., shagbark hickory [*Carya ovata*]), on the other hand, may provide better protection from rain water and other unfavorable environmental conditions. Their greater thermal mass holds more favorable temperatures for roosting bats during cool periods (Humphrey *et al*. 1977).

Most roost trees used by a maternity colony are close together. The spatial extent and configuration of a colony's regular use area is probably determined by the availability of suitable roosts. The distances between roosts occupied by bats within a single maternity colony have ranged from just a few meters to several kilometers (km) and, in one case, five km for furthest distance between roosts (Callahan *et al*. 1997, U.S. Fish and Wildlife Service 1999). Miller (1996) compared habitat variables for sites in northern Missouri where surveys for Indiana bats had been conducted and noted that significantly larger trees [>30 cm (12 inches) d.b.h.] were found where reproductively active Indiana bats had been netted, than at sites at where bats had not been captured.

Indiana bat maternity roosts can be described as "primary" or "alternate" based upon the proportion of bats in a colony occupying the roost site, and location in relation to forest canopy cover (Callahan *et al*. 1997, Kurta *et al.* 1996). Maternity colonies have at least one primary roost (up to three have been identified for a single colony) used by the majority of the bats throughout the summer. Colonies may also have multiple alternate roosts that are used by small numbers of bats intermittently throughout the summer (U.S. Fish and Wildlife Service 1999). Kurta *et al.* (1996) studied a maternity colony in northern Michigan over a three-year period and noted that roosting bats changed roost trees every 2.9 days and that the number of roosts used by the colony ranged from five to 18. Other studies have shown that adults in maternity colonies may use as few as two, to as many as 33, alternate roosts (Humphrey *et al*. 1977, Gardner *et al.* 1991a, Garner and Gardner 1992, Callahan 1993, Kurta *et al.* 1993a, Romme *et al.* 1995).

Primary roosts are located in openings or at the edge of forest stands, while alternate roosts can be in either the open or the interior of forest stands. Thermoregulatory needs may be a factor in roost site selection. Primary roosts are not surrounded by closed canopy and can be warmed by solar radiation, thus providing a favorable microclimate for growth and development of young during normal weather. Alternate roosts tend to be more shaded, frequently are within forest stands, and are selected when temperatures are above normal or during periods of precipitation. Shagbark hickories seem to be particularly good alternate roosts because they provide cooler roost conditions during periods of high heat and their tight bark shields bats from the encroachment of water into the roost during rain events (Callahan *et al*. 1997). Roost site selection and use may differ between northern and southern parts of the species' range but, to date, such analyses have not been undertaken.

Primary roost trees that have been studied to date have ranged in size from 12.2 to 29.9 inches d.b.h. (Romme *et al*. 1995). Alternate roost trees also tend to be large, mature trees, but the range in size is somewhat wider than that of primary roosts (7.1 to 32.7 inches d.b.h.) (Romme *et al.* 1995). In Missouri, maximum distances between roost trees used by bats from the same maternity colony have ranged from 1.0 to 1.9 miles (Callahan 1993).

Because the roosting habitat characteristics preferred by Indiana bats are ephemeral, it is not possible to generalize or estimate their longevity due to the many factors that influence them. Bark may slough off completely or the tree may fall over. Although roosts may only be habitable for one to two years under "natural conditions" for some tree species (Humphrey *et al*. 1977), others with good bark retention such as slippery elm, cottonwood, green ash (*Fraxinus pennsylvanica*), and oaks, may provide roosting habitat four to eight years (Gardner *et al*. 1991*a*, Callahan *et al*. 1997, U.S. Fish and Wildlife Service 1999). Hickories also retain bark well.

Indiana bats exhibit varying degrees of site fidelity to summer colony areas, roosts, and foraging habitat. Females have been documented returning to the same roosts from one year to the next (Humphrey *et al*. 1977, Gardner *et al*. 1991*a,b*, Callahan *et al*. 1997). Kurta *et al*. (1996), however, noted that individuals in a maternity colony in northern Michigan "were not highly faithful to a particular tree." In Illinois, male Indiana bats exhibited some site fidelity to summering areas they had occupied during previous years (Gardner *et al*. 1991*b*).

The Indiana bat may be more adaptable with regard to roosts than previously believed. Humphrey *et al.* (1977) suggested that previously used summer roosts may be important to the reproductive success of local Indiana bat populations, and that if these roosts are lost or unavailable, adult females may be faced with finding suitable maternity sites at a time when they are already stressed from post-hibernation migration and the increased metabolic energy costs of pregnancy. Others (e.g., Kurta *et al*. 1996) have more recently noted that Indiana bats will use multiple roost sites within a maternity colony area. Bats move from one roost to another within a season, in addition to responding to changes in environmental conditions (temperature and precipitation), and when a particular roost becomes unavailable (Gardner *et al*. 1991*a*, Callahan *et al*. 1997). Thus, the species appears to be an adaptable animal that takes advantage of the ephemeral habitat available to it. Nonetheless, it is apparent that a variety of suitable roosts within a colony's occupied summer range should be available to assure the continuance of the colony in that area (Kurta *et al*. 1993*a*, Callahan *et al*. 1997).

Indiana bats are known to occupy distinct home ranges during the summer (Gardner *et al.* 1990). Average home range sizes vary from approximately 70 acres (juvenile males) to over 525 acres (post-lactating adult females). Roosts occupied by individuals ranged from 0.33 miles to over 1.6 miles from preferred foraging habitat, but are generally within 1.2 miles of water (e.g., stream, lake, pond, natural or manmade water-filled depression).

Fall and spring roosts. Indiana bats use roosts in the spring and fall similar to those selected during the summer. During the fall, when Indiana bats swarm and mate at their hibernacula, male bats roost in trees nearby during the day and fly to the cave during the night. In Kentucky, Kiser and Elliott (1996) found male Indiana bats roosting primarily in dead trees on upper slopes and ridgetops within 1.5 miles (2.4 km) of their hibernaculum. During September in West Virginia, male Indiana bats roosted within 3.5 miles (5.6 km) in trees near ridgetops, and often switched roost trees from day to day (U.S. Fish and Wildlife Service 1999). Fall roost trees more often tend to be exposed to sunshine rather than shaded (U.S. Fish and Wildlife Service 1999).

Upon emergence from hibernation in the spring, some males remain within the vicinity of their hibernacula, where they roost and forage in mature forest; movements of 2.5-10 miles (4-16 km) have been reported in Kentucky, Missouri, and Virginia (MacGregor, pers. comm., December 1998; Hobson and Holland 1995; 3D/International 1996). However, other males leave the area entirely upon emergence in the spring. Females dispersing from a Kentucky hibernaculum in the spring moved 4-10 miles (6.4-16 km) within 10 days of emergence (MacGregor, pers. comm., December 1998).

Foraging habitat and behavior. Indiana bats forage in and around the tree canopy of floodplain, riparian, and upland forests. In riparian areas, Indiana bats primarily forage around and near riparian and floodplain trees (e.g., sycamore [*Platanus occidentalis*], cottonwood, black walnut [*Juglans nigra*], black willow [*Salix nigra*], and oaks), and solitary trees and forest edge on the floodplain (Belwood 1979, Cope *et al*. 1974, Humphrey *et al*. 1977, Clark *et al*. 1987, Gardner *et al*. 1991*b*). Within floodplain forests where Indiana bats forage, canopy closures range from 30 to 100 percent (Gardner *et al*. 1991*b*). Cope *et al*. (1978) characterized woody vegetation within a width of at least 30 yards (~ 30 m) on both sides of a stream as excellent foraging habitat. Streams, associated floodplain forests, and impounded bodies of water (e.g., ponds, wetlands,

reservoirs) are preferred foraging habitats for pregnant and lactating Indiana bats, some of which may fly up to 1½ mi (2.5 km) from upland roosts (Gardner *et al*. 1991*b*). Indiana bats also forage within the canopy of upland forests, over clearings with early successional vegetation (e.g., old fields), along the borders of croplands, along wooded fencerows, and over farm ponds in pastures (Clark *et al*. 1987, Gardner *et al*. 1991*b*).

The extent of foraging area used by an Indiana bat maternity colony has been reported to range from a linear strip of creek vegetation 0.5 mi (0.8 km) in length (Belwood 1979, Cope *et al*. 1974, Humphrey *et al*. 1977), to a foraging area 0.75 mi (1.2 km) in length, within which bats flew over the wooded river or around the riverside trees (Cope *et al*. 1978). Indiana bats return nightly to their foraging areas (Gardner *et al*. 1991*b*).

Indiana bats usually forage and fly within an air space from 6 - 100 ft (2 - 30 m) above ground level (Humphrey *et al*. 1977). Most Indiana bats caught in mist nets are captured over streams and other flyways at heights greater than 6 ft (2 m) (Gardner *et al*. 1989).

During summer, male Indiana bats that remained near their Missouri hibernacula flew cross-country or upstream toward narrower, more densely wooded riparian areas during nightly foraging bouts, perhaps due to interspecific competition with gray bats (*M. grisescens*). Some male bats also foraged at the edges of small floodplain pastures, within dense forest, and on hillsides and ridgetops; maximum reported distance was 1.2 mi (2 km) (LaVal *et al*. 1976, LaVal *et al.* 1977, LaVal and LaVal 1980). In Kentucky, MacGregor (pers. comm., December 1998) reported that the maximum distance males moved from their hibernaculum in the summer was about 2.6 mi (4.2 km). In the fall, male Indiana bats tend to roost and forage in upland and ridgetop forests, but may also forage in valley and riparian forest; movements of 1.8 - 4.2 mi (2.5 - 6.8 km) have been reported in Kentucky and Missouri (Kiser and Elliott 1996, 3D/International 1996, MacGregor, *in litt*., June 1997).

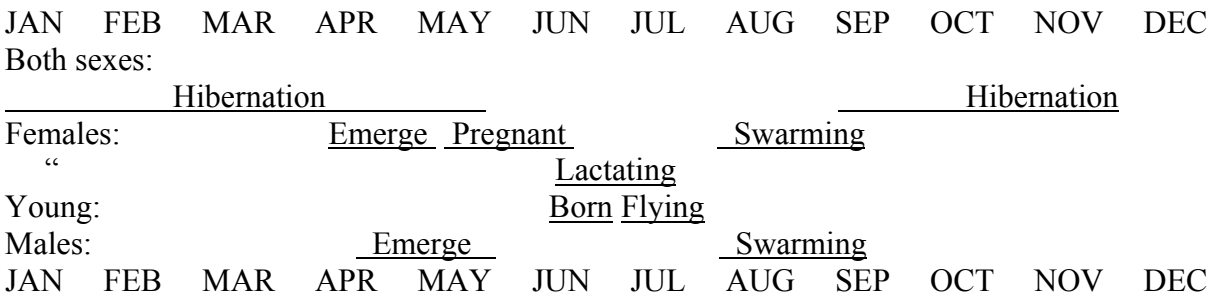
Life History

Generally, Indiana bats hibernate from October through April (Hall 1962, LaVal and LaVal 1980) (September - May in northern areas [U.S. Fish and Wildlife Service 1999]), depending upon local weather conditions (see Figure 1 for a depiction of the annual cycle). They hibernate in large, dense clusters, ranging from 300 bats per square foot (3,230 bats/m^2) (Clawson *et al*. 1980) to 484 bats per square foot (5,215 bats/m^2) (Clawson, pers. observ., October 1996). Indiana bats are very loyal to their hibernacula (LaVal and LaVal 1980).

Upon arrival at hibernating caves in August through September, Indiana bats "swarm," a behavior in which "large numbers of bats fly in and out of cave entrances from dusk to dawn, while relatively few roost in the caves during the day" (Cope and Humphrey 1977). Swarming continues for several weeks and mating occurs during the latter part of the period. Fat supplies are replenished as the bats forage prior to hibernation. Indiana bats tend to hibernate in the same cave in which they swarm (LaVal *et al*. 1976; Stihler, pers. observ., October 1996), although swarming has occurred in caves other than those in which the bats hibernated (Cope and Humphrey 1977; MacGregor, pers. observ., October 1996).

During swarming, males remain active over a longer period of time at cave entrances than do females (LaVal and LaVal 1980), probably to mate with the females as they arrive. After mating, females enter directly into hibernation. A majority of bats of both sexes hibernate by the end of November (by mid-October in northern areas [Kurta, pers. observ., June 1997]), but hibernacula populations may increase throughout the fall and even into early January (Clawson *et al*. 1980).

Figure 1. Indiana bat annual chronology (from U.S. Fish and Wildlife Service 1999).



Adult females store sperm through the winter and become pregnant via delayed fertilization soon after emergence from hibernation. Young female bats can mate in their first autumn and have offspring the following year, whereas males may not mature until the second year. Limited mating activity occurs throughout the winter and in late April as the bats leave hibernation (Hall 1962).

Females emerge from hibernation ahead of males; most wintering populations leave by early May. Some males spend the summer near hibernacula in Missouri (LaVal and LaVal 1980) and West Virginia (U.S. Fish and Wildlife Service 1999). In spring, when fat reserves and food supplies are low, migration is probably hazardous (Tuttle and Stevenson 1977). Consequently, mortality may be higher in the early spring, immediately following emergence.

Females may arrive in their summer habitats as early as April 15 in Illinois (Gardner *et al*. 1991*a*, Brack 1979). During this early spring period, a number of roosts (e.g., small cavities) may be used temporarily, until a roost with larger numbers of bats is established. Humphrey *et al*. (1977) determined that Indiana bats first arrived at their maternity roost in early May in Indiana, with substantial numbers arriving in mid-May. Parturition occurs in late June and early July (Easterla and Watkins 1969, Humphrey *et al*. 1977) and the young are able to fly between mid-July and early August (Mumford and Cope 1958, Cope *et al*. 1974, Humphrey *et al*. 1977, Clark *et al*. 1987, Gardner *et al*. 1991*a,* Kurta *et al*. 1996).

Most of the documented maternity colonies contained 100 or fewer adult bats. After grouping into nursery colonies, females give birth to a single young in late June or early July. Some males disperse throughout the range and roost individually or in small numbers in the same types of trees and in the same areas as females, while other males remain near their hibernacula.

Maternity colonies occupy roost sites in forested riparian, floodplain, or upland habitats, and exhibit strong roost site fidelity (Cope *et al*. 1978, Clark *et al* 1987, Gardner *et al.* 1991*a*, *b*, Brack 1983, Callahan *et al* 1977, U.S. Fish and Wildlife Service 1999).

Young Indiana bats are capable of flight within a month of birth. Young born in late June may be flying as early as the first week of July (Clark *et al.* 1987), others from mid- to late July. Indiana bats spend the latter part of the summer accumulating fat reserves for fall migration and hibernation.

Humphrey and Cope (1977) determined that female survivorship in an Indiana population of Indiana bats was 76 percent for ages one to six years, and 66 percent for ages six to 10 years; for males, survivorship was 70 percent for ages one to six years, and 36 percent for ages six to 10 years. The maximum ages for banded individuals were 15 years for females and 14 years for males. Mortality between birth and weaning has been estimated at eight percent (Humphrey *et al.* 1977).

Indiana bats feed solely on aquatic and terrestrial flying insects. They are habitat generalists and their selection of prey items reflects the environment in which they forage (LaVal and LaVal 1980). Diet varies seasonally and variation is observed among different ages, sexes, and reproductive-status groups (Belwood 1979, Lee 1993). Reproductively active females and juveniles exhibit greater dietary diversity than males and non-reproductively active adult females, perhaps due to higher energy demands. Reproductively active females eat more aquatic insects than do adult males or juveniles (Lee 1993).

Moths (Lepidoptera) are major prey items identified in several studies (Belwood 1979, LaVal and LaVal 1980, Brack and LaVal 1985, Lee 1993, Gardner and Virgil Brack (BHE Environmental, Inc., Cincinnati, Ohio, unpubl. data)), but caddisflies (Trichoptera) and flies (Diptera) are major prey items documented in another (Kurta and Whitaker 1998). A third major prey group includes mosquitoes and midges (Belwood 1979, Gardner and Brack unpubl. data), especially species that form large mating aggregations above or near water (Belwood 1979). Other prey include bees, wasps, and flying ants (Hymenoptera), beetles (Coleoptera), leafhoppers (Homoptera), treehoppers (Homoptera), stoneflies (Plecoptera), and lacewings (Neuroptera) (Whitaker 1972, Belwood 1979, Gardner and Brack, unpubl. data).

Male Indiana bats summering in or near a hibernation cave feed preferentially on moths and beetles. Additionally, caddisflies, flies, mosquitoes, midges, stone flies, leafhoppers, treehoppers, and true bugs are consumed, but in low percentages (U.S. Fish and Wildlife Service 1999). Brack and LaVal (1985) examined fecal pellets of 140 male Indiana bats and identified 83 percent of the prey items as Lepidoptera and seven percent as Coleoptera.

Drinking water is essential when bats actively forage. Throughout most of the summer range, Indiana bats frequently forage along riparian corridors and obtain water from streams. However, natural and man-made ponds and water-filled road ruts in the forest uplands are also very important water sources for Indiana bats in those regions.

Status of the Species Within its Range

The Indiana bat was listed as endangered by the Service pursuant to the Endangered Species Preservation Act on March 11, 1967. The following sites have been designated as critical habitat for the Indiana bat: Bat Cave in Carter County, Kentucky; Coach Cave in Edmonson County, Kentucky; White Oak Blowhole Cave in Blount County, Tennessee; the Blackball Mine in LaSalle County, Illinois; Big Wyandotte Cave, Crawford County, Indiana; Ray's Cave, Greene County, Indiana; Cave 021, Crawford County, Missouri; Cave 009, Franklin County, Missouri; Cave 017, Franklin County, Missouri; Pilot Knob Mine, Iron County, Missouri; Bat Cave, Shannon County, Missouri; Cave 029, Washington County, Missouri; and Hellhole Cave, Pendleton County, West Virginia.

The Service (1999) has completed an agency draft of a revised recovery plan for the Indiana bat. Reasons for updating the plan are: 1) to update the recovery plan with information on the life history and ecology of the Indiana bat, especially information on summer ecology that has been gathered since 1983; 2) to highlight the continued and accelerated decline of the species; 3) to continue site protection and monitoring efforts at hibernacula; and 4) to focus new recovery efforts towards research to determine the factor or factors causing population declines. Main recovery actions identified in the revised plan are:

- Conduct research necessary for the survival and recovery of the Indiana bat, including studies on ecology and life history; summer habitat requirements; genetics; potential chemical contamination; and assessments of temperature profiles and hibernation microclimates of major hibernacula.

- Obtain information on population distribution, status, and trends.

- Protect and maintain Indiana bat populations.

- Provide information and technical assistance outreach.

- Coordinate and implement the conservation and recovery of the Indiana bat.

The Indiana bat is a migratory species found throughout much of the eastern half of the United States. During winter, Indiana bats are restricted to suitable hibernacula that primarily are located in karst areas of the east-central U.S. More than 85 percent of the range-wide population occupies nine Priority One hibernacula (hibernation sites with a recorded population >30,000 bats since 1960 -- although two of these currently have extremely low numbers of bats). Indiana, Kentucky, and Missouri each contain three Priority One hibernacula. Priority Two hibernacula (recorded population >500 but <30,000 bats since 1960) are known from the above-mentioned States, in addition to Arkansas, Illinois, New York, Ohio, Tennessee, Virginia, and West Virginia. Priority Three hibernacula (i.e., with recorded populations <500 bats or records of single hibernating individuals) have been reported in the above states, plus Alabama, Connecticut, Florida, Georgia, Iowa, Maryland, Massachusetts, Michigan, Mississippi, New Jersey, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Vermont, and Wisconsin.

Although the number of band returns for the Indiana bat are limited, certain migration patterns may be inferred from what little information does exist. Based on sparse band recovery records, all of which are from the Midwest, it appears that females and some males migrate north in the spring upon emergence from hibernation (Hall 1962, Myers 1964, Hassell and Harvey 1965, Barbour and Davis 1969, Kurta 1980, LaVal and LaVal 1980, Bowles 1982), although there also is evidence that movements may occur in other directions. However, summer habitats in the eastern and southern United States have not been well investigated; it is possible that both sexes of Indiana bats occur throughout these regions. Very little is known about Indiana bat summer habitat use in the southern and eastern United States, or how many Indiana bats may migrate to form maternity colonies there. Most summer captures of reproductively active Indiana bats (pregnant or lactating females or juveniles) have been made between April 15 and August 15 in areas generally north of the major cave areas. While these observations suggest that many or most female Indiana bats in the Midwest migrate north in the spring and south in the fall, other individuals may potentially migrate in other directions (LaVal and LaVal 1980). Additional work is needed to better understand Indiana bat summer distribution.

Most of the maternity records of the Indiana bat originated in the Midwest (southern Iowa, northern Missouri, northern Illinois, northern Indiana, southern Michigan, and western Ohio). The first maternity colony was found and several studies of Indiana bat maternity habitat were conducted in the Midwest region. Although the woodland in this glaciated region is mostly fragmented, it has a relatively high density of maternity colonies. Today, small bottomland and upland forested tracts with predominantly oak-hickory forest types and riparian/bottomland forests of elm-ash-cottonwood associations exist in an otherwise agriculturally dominated (non-forested) landscape (U.S. Fish and Wildlife Service 1999).

Unglaciated portions of the Midwest (southern Missouri, southern Illinois, southern Indiana), Kentucky, and most of the eastern and southern portions of the species' range appear to have fewer maternity colonies per unit area of forest. However, such conclusions may be premature, given the lack of search effort in these areas.

Male Indiana bats may be found throughout the entire range of the species. Males appear to roost singly or in small groups, except during brief summer visits to hibernacula.

Based on censuses taken at hibernacula, the total known Indiana bat population in 1997 was estimated at 353,000 bats. Indiana bat populations were first surveyed in the late 1950s (Hall 1962). In the decades since then, additional colonies of hibernating Indiana bats were discovered and our knowledge of the distribution and status of the species has expanded. Many hibernacula populations have decreased in number since monitoring began, especially in Kentucky and Missouri.

More than half of the current population of the Indiana bat hibernates in the nine Priority One hibernacula. Eight of the nine have been surveyed every two years from 1983 to 1998. During the period 1983 through 1997, the populations in these caves declined by 38 percent.

The status of the Indiana bat in the three States with the largest hibernating populations is reviewed below:

Indiana: The known population in Indiana apparently dropped from the earliest known surveys through 1980, but has increased steadily in recent years. Indiana now contains half (182,500) of all Indiana bats in existence.

Kentucky: This state has exhibited the most significant decline in population numbers of Indiana bats with the loss of an estimated 145,000 bats between 1960 and 1975. Losses at two of the major hibernacula were attributable to microclimate changes due to a poorly designed cave gate at one hibernation site (Humphrey 1978), and the construction of a building over the upper entrance to another (U.S. Fish and Wildlife Service 1999). Although not as dramatic as earlier losses, many of the major remaining hibernating populations have declined steadily during the past 15 years. For reasons not totally understood, populations in west-central, northeastern, and extreme southeastern Kentucky declined between 1960 and 1975, while the populations in east-central and western Kentucky increased.

Missouri: Despite efforts such as the construction of appropriate gates at cave entrances, populations of hibernating Indiana bats in Missouri have declined steadily and drastically since 1980. The colonies of Indiana bats in the two Priority One caves that can be surveyed, and 12 of the 13 Priority Two hibernacula in the state, have declined during this period. Since 1983, the overall Missouri population has shown a cumulative estimated decline of over 250,000 bats, a loss of more than 80 percent of the population. The current total estimated population of Indiana bats in the State is less than 50,000 (MDC Natural Heritage Database 1997).

Other States: Among the other States with regularly occurring hibernating populations of Indiana bats, recent trends are mixed. Population trends in Alabama, Illinois, Ohio, Tennessee, and Virginia are either not known or are not well documented. Alabama, Illinois, Tennessee, and Virginia do not have enough recent survey information for a trend analysis, and the only known hibernaculum in Ohio was not discovered until the winter of 1995/1996. The population of Indiana bats is apparently declining in Arkansas. The species may be increasing in New York, Pennsylvania, and West Virginia, but complex cave systems such as those at Hellhole Cave in West Virginia and several caves in New York make surveying Indiana bats difficult, and complicate population trend analysis.

A few Indiana bats have been documented in the winter in Connecticut, Florida, Georgia, Iowa, Maryland, Massachusetts, Michigan, Mississippi, New Hampshire, New Jersey, North Carolina, Oklahoma, South Carolina, Vermont, and Wisconsin. However, because most of these records usually involve less than 10 individuals, no regular hibernacula surveys are conducted in these States.

Active programs by State and federal agencies have led to the acquisition and protection of a number of Indiana bat hibernacula. Of 127 caves/mines with populations >100 bats, 54 (43 percent) are in public ownership or control, and most of the 46 (36 percent) that are gated or fenced are on public land. Although such conservation efforts have been successful in protecting Indiana bats from human disturbance, they have not been sufficient to reverse the downward

trend in many populations.

Status of the Species in Pennsylvania

Although known Indiana bat numbers appeared to have dropped significantly from the earliest known surveys (estimated population of 5000 in the 1930's) (Hall 1979), the hibernating population over the past several years appears to be stable or increasing. To date, seven hibernacula have been identified in Pennsylvania, including a limestone mine in Blair County (150 to 400 bats), two caves in Mifflin County (1 and 9 bats), two abandoned coal mines in Luzerne County (1-2 bats each), and an abandoned railroad tunnel (23 bats) and limestone mine (1 bat) in Somerset County. The biennial census at Canoe Creek mine in Blair County (Pennsylvania's largest known Indiana bat hibernaculum) has yielded the following Indiana bat counts: 297 in 1987, 267 in 1991, 353 in 1995, 158 in 1997, and 352 in 1999; these counts are conservative estimates because not all portions of the mine are accessible to surveyors.

The only known summer maternity record for Pennsylvania is the discovery of two lactating Indiana bats, amongst 14,500 (±2,500) little brown bats, in an abandoned, wood-frame church near the Canoe Creek hibernaculum in 1998 (Hassinger and Butchkoski, *in litt*. 1998).

Threats to the Species

Not all of the causes of Indiana bat population decline have been determined. Although several known human-related factors have caused declines in the past, they may not be solely responsible for recent declines. Several known and suspected causes of decline are discussed below.

Disturbance and vandalism. A serious cause of Indiana bat decline has been human disturbance of hibernating bats during the decades of the 1960s through the 1980s. Bats enter hibernation with only enough fat reserves to last until spring. When a bat is aroused, as much as 68 days of fat supply is used in a single disturbance (Thomas *et al.* 1990). Humans, including recreational cavers and researchers, passing near hibernating Indiana bats can cause arousal (Humphrey 1978, Thomas 1995, Johnson *et al.* 1998). If this happens too often, the bats' fat reserves may be exhausted before the species is able to forage in the spring.

Direct mortality due to human vandalism has been documented. The worst known case occurred in 1960 when an estimated 10,000 Indiana bats were killed in Carter Cave State Park, Kentucky by three youths who tore masses of bats from the ceiling and trampled and stoned them to death (Mohr 1972). Another documented incident was reported from Thornhill Cave, Kentucky, where at least 255 Indiana bats were killed by shotgun blasts in January 1987 (Anon. 1987).

Improper cave gates and structures. Some hibernacula have been rendered unavailable to Indiana bats by the erection of solid gates in the entrances (Humphrey 1978). Since the 1950's, the exclusion of Indiana bats from caves and changes in air flow are the major cause of loss in Kentucky (an estimated 200,000 bats at three caves) (U.S. Fish and Wildlife Service 1999). Other cave gates have so modified the climate of hibernacula that Indiana bats were unable to survive the winter because changes in air flow elevated temperatures which caused an increase in metabolic rate and a premature exhaustion of fat reserves (Richter *et al.* 1993; Merlin Tuttle, Bat

Conservation International, *in litt*., 1998).

Conversely, an Indiana bat population may be restored if an improper gate is replaced with one of appropriate design, or if air flow is restored. In Wyandotte Cave, Indiana, dramatic population increases followed gate replacement and restoration of traditional air flow (Richter *et al*. 1993). Improved air flow facilitated by the enlargement of an upper level entrance was apparently responsible for a three-fold increase in Indiana bat numbers in Ray's Cave, Indiana (Brack *et al*. 1991). The recovery of hibernating populations to historic levels, however, have not been as successful elsewhere. At Hundred Dome Cave, Kentucky, predicted population gains have never been realized, although air flow obstructions have been removed and gates suitable for the species installed (U.S. Fish and Wildlife Service 1999).

Natural hazards. Indiana bats are subject to a number of natural hazards. River flooding in Bat Cave, Mammoth Cave National Park, drowned large numbers of Indiana bats (Hall 1962). Other cases of hibernacula being flooded have been recorded by Hall (1962), DeBlase *et al*. (1965), and the U.S. Fish and Wildlife Service (1999). A case of internal cave flooding occurred when tree slash and debris (produced by forest clearing to convert the land to pasture) were bulldozed into a sinkhole, blocking the cave's rain water outlet and drowning an estimated 150 Indiana bats (U.S. Fish and Wildlife Service 1999). One case of flash flooding compounded by cave gates occurred in 1997: in early March, a severe flood occurred in Bat Cave at Carter Caves State Park, Kentucky. Debris that had accumulated on the gate at the upper entrance impounded rain water until pressure destroyed the gate, allowing a surge of water through the cave system where it was backed up again at the gate in the lower cave entrance. Water reached the ceiling in portions of the hibernation section of the cave and drowned an estimated 3,000 Indiana bats (U.S. Fish and Wildlife Service 1999).

Bats hibernating in mines are vulnerable to ceiling collapse (Hall 1962), and this is a concern at Pilot Knob Mine in Missouri, once the largest known Indiana bat hibernating population. To a lesser extent, ceiling collapse in caves is also possible.

Another hazard exists because Indiana bats hibernate in cool portions of caves that tend to be near entrances, or where cold air is trapped. Some bats may freeze to death during severe winters (Humphrey 1978, Richter *et al.* 1993). Indiana bats apparently froze to death in Bat Cave (Shannon County, Missouri) in the 1950s (U.S. Fish and Wildlife Service 1999). The population at this site was 30,450 in 1985, when the bats were observed roosting on a high ceiling, presumably to escape severe cold at their traditional roosting ledges 7-9 ft above the cave floor. In a subsequent 1987 survey, the population had plummeted to 4,150 bats, and the cave floor was littered with bat bones, suggesting that the bats died during hibernation, apparently freezing to death (U.S. Fish and Wildlife Service 1999).

At Missouri's Great Scott Cave, average mid-winter temperatures appear to have risen 8^{o} F (4.4^{o} C) from the mid-1980s through the present, compared to temperatures in the 1970s and early 1980s; a major population loss occurred between the mid 1980's and 1998. Preliminary analysis of fall and winter temperature data suggests that a similar trend has occurred in ambient temperature outside the cave, and thus appears to have played a role in these population losses (Clawson, pers. observ., July 1998). A much more detailed analysis is needed, along with

detailed temperature profiles of this and other hibernacula, to better understand the relationship(s) between climate, air flow, and hibernation microclimates within important hibernacula.

Indiana bats are vulnerable to the effects of severe weather when roosting under exfoliating bark during summer. For example, a maternity colony was displaced when strong winds and hail produced by a thunderstorm stripped the bark from their cottonwood roost and the bats were forced to move to another roost (U.S. Fish and Wildlife Service 1999).

Other. Other documented sources of decline include indiscriminate collecting, handling and banding of hibernating bats by biologists, and flooding of caves due to rising waters in reservoirs (Humphrey 1978).

Microclimate effects. Changes in the microclimates of caves and mines may have contributed more to the decline in population levels of the Indiana bat than previously estimated (Tuttle, *in litt*. August 4, 1998). Entrances and internal passages essential to air flow may become larger, smaller, or close altogether, with concomitant increases or decreases in air flow. Blockage of entry points, even those too small to be recognized, can be extremely important in hibernacula that require chimney-effect air flow to function. As suggested by Richter *et al*. (1993) and Tuttle (*in litt*. August 4, 1998), changes in air flow can elevate temperatures which can cause an increase in metabolic rate and a premature exhaustion of fat reserves.

Hibernacula in the southern portions of the Indiana bat's range may be either near the warm edge of the bat's hibernating tolerance or have relatively less stable temperatures. Hibernacula in the North may have passages that become too cold. In the former case, bats may be forced to roost near entrances or floors to find low enough temperatures, thus increasing their vulnerability to freezing or predation. In the North, bats must be able to escape particularly cold temperatures. In both cases, modifications that obstruct air flow or bat movement could adversely affect the species (U.S. Fish and Wildlife Service 1999).

Recent analysis of mid-winter temperature records obtained during hibernacula surveys, especially of Priority One caves, suggests that unacceptable deviations in roost temperatures may account for some of the overall population decline (Tuttle, *in litt*. August 4, 1998). Although scanty, the data suggest that when populations roost mostly at temperatures below 35° F or above 47° F (2° C and 8° C), they usually decline and when roosting between 37° F and 45° F (3° C and 7.2° C) they tend to grow.

To test the hypothesis that changes in the microclimates of Indiana bat hibernation sites may be contributing to the recent downward trend in this species, a project was initiated in the summer of 1998 to investigate the temperature and relative humidity of 13 of the major hibernacula in Indiana, Kentucky, Missouri, Tennessee, and Virginia. Each cave was surveyed and 37 data loggers were installed between July 19 and 29, 1998. Investigations revealed that crucial air flow had been interrupted at some sites and the air temperature had risen a few degrees above normal in others, providing additional initial evidence that changes in microclimates may be contributing to this species drastic decline (Tuttle, *in litt*. August 4, 1998). Additional years of monitoring at these sites will be necessary to further evaluate any changes in hibernation

conditions.

Land use practices. The Indiana bats' maternity range has changed dramatically since pre-settlement times (Schroeder 1981, Giessman *et al*. 1986, MacCleery 1992, Nigh *et al.* 1992). Most of the forest in the upper Midwest has been fragmented, fire has been suppressed, and native prairies have been converted to agricultural crops or to pasture and hay meadows for livestock. Native species have been replaced with exotics in large portions of the maternity range, and plant communities have become less diverse than occurred prior to settlement. Additionally, numerous chemicals are applied to these intensely cropped areas. The changes in the landscape and the use of chemicals (McFarland 1998) may have reduced the availability and abundance of the bats' insect forage base.

Conversely, regions surrounding hibernacula in the Missouri Ozarks and elsewhere are now more densely forested than they were historically (Sauer 1920, Ladd 1991, Nigh *et al.* 1992, Jacobson and Primm 1997). Consequently, the open, savanna-like conditions important to the species maternity habitat (Romme *et al.* 1995) is much less abundant today than occurred historically (U.S. Fish and Wildlife Service 1999).

In the eastern U.S., the area of land covered by forest has been increasing in recent years (MacCleery 1992), but is still young by historic standards. Whether or not this is beneficial to the Indiana bat is unknown. The age, composition, and size class distribution of the woodlands will have a bearing on their suitability as roosting and foraging habitat for the species outside the winter hibernation season. A clearer picture of the relationship between the Indiana bat and its summer habitat requirements is urgently needed. An understanding of the factor or factors responsible for the continued decline of the species is needed before it can accurately be determined whether the loss of roosting habitat is limiting to regional or range-wide populations of the species (U.S. Fish and Wildlife Service 1999).

Chemical contamination. Pesticides have been implicated in the declines of a number of insectivorous bats in North America (Mohr 1972; Reidinger 1972, 1976; Clark and Prouty 1976; Clark *et al*. 1978; Geluso *et al*. 1976; Clark 1981). The effects of pesticides on Indiana bats have yet to be studied. McFarland (1998) studied two sympatric species, the little brown bat and the northern long-eared bat, as surrogates in northern Missouri and documented depressed levels of acetylcholinesterase, suggesting that bats there may be exposed to sublethal levels of organophosphate and/or carbamate insecticides applied to agricultural crops. McFarland (1998) also demonstrated that bats in northern Missouri are exposed to significant amounts of agricultural chemicals, especially those applied to corn. BHE Environmental, Inc. (1999) collected tissue and guano samples from five species of bats at Fort Leonard Wood, Missouri and documented the exposure of bats to p,p'-DDE, heptachlor epoxide, and dieldrin.

Clubshell Mussel and Northern Riffleshell Mussel

Species Description

The clubshell was listed as endangered, without critical habitat, in 1993. This is a small to medium-size mussel, up to three inches long. The shell exterior is yellow to brown with bright

green blotchy rays. The shell interior is white. The shell is wedge-shaped and solid, with a pointed, and fairly high umbo.

The northern riffleshell was also listed as endangered, without critical habitat, in 1993. It is a small to medium-size mussel, up to three inches long. The shell exterior is brownish-yellow to yellowish-green with fine green rays. The shell interior is white, rarely pink. The species is sexually dimorphic; male shells are irregular ovate in outline, with a wide shallow sulcus just anterior to the posterior ridge. Female shells are obovate in outline, and greatly expanded post-ventrally.

Life History

The clubshell inhabits clean, packed or loose, coarse sand and gravel in runs, often just downstream of a riffle, in medium to small rivers and streams (Stansbery *et al*. 1982). It cannot tolerate mud or slack water conditions (U.S. Fish and Wildlife Service 1994). The clubshell typically burrows completely beneath the substrate two to four inches, apparently relying on water to percolate between the sediment particles (Watters 1990).

The northern riffleshell occurs in clean, packed, coarse sand and gravel in riffles and runs of small and large streams (Stansbery *et al*. 1982, Watters 1990). The species buries itself to the posterior margin of the shell, although females may be more exposed, especially during the breeding season (U.S. Fish and Wildlife Service 1994).

The clubshell has a life span of 20 years or more. It is a short term breeder (tachytictic); i.e., fertilization takes place in mid-spring and the embryos (glochidia) are discharged into the water column in mid-summer (Ortmann 1919). Many aspects of the life history of this rare mussel are not known. The northern riffleshell is a long-term breeder (bradytictic), with fertilization in the late summer and glochidial release the following spring or summer (Ortmann 1919).

Freshwater mussels are sedentary filter-feeders, filtering oxygen and food from the water column across their gills. The breeding season is initiated by changes in water temperature. Females hold unfertilized eggs in water tubes within specialized regions of the gills called marsupia. Males liberate sperm into the water and females lying downstream uptake the sperm with incoming water. The eggs are then fertilized in the water tubes within the marsupium. The fertilized eggs develop into minute bivalve larvae, or glochidia, which, in turn, develop over a period of days to months. While in the marsupium, developing glochidia are exposed to the adult's circulatory fluid, but not directly to the water column (Gardiner *et al*. 1991, Richard *et al*. 1991).

The glochidia of most unionids are believed to be obligate parasites, with fish serving as the host organism. Although many unionids are probably host-specific, the degree of host specificity and the host species for most unionid species, including the clubshell and northern riffleshell, are unknown (U.S. Fish and Wildlife Service 1994). However, preliminary data indicate that the following species may serve as hosts (Watters 1996, Watters and O'Dee 1997):

Clubshell	Northern riffleshell
striped shiner	banded darter
blackside darter	bluebreast darter
central stoneroller	brown trout
logperch	banded sculpin

Methods of host infestation depend on how glochidia are released. Some unionid species expel glochidia out the exhalant siphon. Host fishes either take in suspended glochidia and pass them over their gills, where they attach, or they contact them on the substrate, where they attach to fins or skin. Other unionids bind glochidia into long mucus conglutinates which resemble prey items. Gills become infested when fish eat the conglutinates (U.S. Fish and Wildlife Service 1994).

After encysting on the host fish, the glochidia transform into juveniles. They fall from their host and burrow into the substrate or attach to larger objects.

Status of the Species within Their Range

Historically, the clubshell mussel was once abundant throughout Ohio River tributaries in Illinois, Indiana, Kentucky, Michigan, Ohio, Pennsylvania, and West Virginia. It was widespread in Ohio River basin rivers such as the Ohio, Allegheny, Scioto, Kanawha, Little Kanawha, Licking, Kentucky, Wabash, White, Vermillion, Mississinewa, Tippecanoe, Tennessee, Green, and Salt Rivers. The clubshell was also located in the Maumee River basin, and tributaries of western Lake Erie such as the Huron River and the River Raison (Stansbery *et al*. l982). This species has declined drastically, with a greater than 95 percent range reduction. The largest remaining population is in the Tippecanoe River, Indiana. The mainstem Allegheny River supports what appears to be a sparse viable population, but with low numbers and a discontinuous distribution over 66+ miles (C. Bier, WPAC, *in litt*. 6 January 1994, *in* U.S. Fish and Wildlife Service 1994).

Clubshell populations are presently known to occur in the following streams:

State	River System	County	Reproducing?
Indiana	Tippecanoe River	Kosciusko, Fulton, Pulaskia, Tippecanoe	yes
Kentucky	Green River	Taylor, Green, Hart	probably
Michigan	East Fork of the West Branch of the St. Josephs River	Hillsdale	unknown
Ohio	Fish Creek	Williams	probably
	Little Darby Creek	Madison	yes
	Pymatuning Creek	Ashtabula	no
	St. Joseph River	Williams	possibly
	West Branch of the St. Joseph River	Williams	possibly
	Walhonding River	Coshocton	possibly
Pennsylvania	Allegheny River	Clarion, Forest, Warren, Venango	yes
	Conneaut Outlet	Crawford	unknown; nearly extirpated
	Conneauttee Creek	Crawford	unknown
	French Creek	Crawford, Erie, Mercer, Venango	yes
	LeBoeuf Creek	Erie	yes
	Muddy Creek	Crawford	possibly
West Virginia	Elk River	Kanawha	yes
	Hackers Creek of the West Fork River	Lewis	unknown
	Meathouse Fork	Doddridge	unknown

The historical range of the northern riffleshell was somewhat similar to that of the clubshell, but with extensions further north into Michigan and Ontario tributaries of Lake Erie, Lake St. Clair, and the Detroit and St. Clair Rivers (U.S. Fish and Wildlife Service 1994). Like the clubshell, the northern riffleshell has suffered a range reduction of over 95 percent.

The present range of the northern riffleshell has been reduced to:

State	River System	County	Reproducing?
Indiana/Ohio	Fish Creek	Dekalb, Williams	no, possibly extirpated
Kentucky	Green River	Edmonson, Hart	unknown
Michigan	Detroit River drainages	Sanilac	unknown
Ohio	Big Darby Creek	Franklin, Pickaway	no, near extirpation
Pennsylvania	Allegheny River	Clarion, Forest, Venango, Warren	yes
	French Creek	Crawford, Erie, Mercer, Venango	yes
West Virginia	Elk River	Kanawha	yes, but only 2 live young animals have been found

In 1992, a population of the northern riffleshell in the Detroit River in Michigan was found to be threatened by invasion of the exotic zebra mussel (*Dreissena polymorpha*). Divers collected 30 to 40 individuals which were relocated to the St. Clair River in Michigan. About a dozen individuals were kept in captivity. Conditions of the populations in the St. Clair and Detroit Rivers are unknown at this time (T. Weise, Michigan Department of Natural Resources 1995, pers. comm.). Zebra mussels have also been documented from the Maumee River.

The largest remaining northern riffleshell populations occur in the Allegheny River and in French Creek, Pennsylvania. In the Allegheny River, the sub-populations range from viable to those with apparently depressed vigor, with an overall known distribution scattered over 80 miles (C. Bier, WPAC, *in litt*., January 6, 1994, *in* U.S. Fish and Wildlife Service 1994).

Threats to the Species

Because mussels are sedentary, they are extremely susceptible to environmental degradation. The range reductions of these mussels are attributed to physical loss of habitat and degraded water quality related primarily to water impoundments, channelization, streambank clearing, and agriculture. Impacts associated with run-off from human waste, chemical outfalls, and coal mining have also affected many tributaries.

The greatest diversity and abundance of mussels are associated with clean-swept sand and gravel substrates. Chronic increases in turbidity and suspended sediments decrease the depth and amount of light penetration, affect primary productivity, decrease oxygen levels, increase water temperature, irritate or cause clogging of gills, and result in a blanket of silt on the substrate. Mussels may be directly affected by siltation through smothering. Siltation also affects mussels by smothering eggs or larvae of the fish host populations and by reducing food availability. Siltation also fills interstitial spaces, eliminating spawning and habitat critical to the survival of young fish.

Pollution from municipal, agricultural, and industrial waste discharges has decreased or eliminated mussel populations directly, and indirectly through elimination of significant species of fish hosts resulting in reproductive failures (U.S. Fish and Wildlife Service 1994).

Zebra mussels. The exotic, prolific zebra mussel, accidentally introduced to North America in the mid-1980's, poses a severe threat to all native mussel fauna through competition for space, food, and survival of glochidia. Presently, the zebra mussel, which was conveyed to the U.S. through ship ballast water from interior European ports, is abundant in the lower Great Lakes and is increasing in other portions of the known or historic range of these federally listed species. Zebra mussels have been documented to occur in the lower, impounded portions of the Allegheny River at Lock 4 (near Natrona) and Lock 7 (near Kittanning). They have also been found in Chautauqua Lake (New York), which flows into Conewango Creek and then into the Allegheny River at Warren (BA, p. 45). No zebra mussels, however, have yet been documented to occur in the Allegheny Reservoir, Conewango Creek, or those portions of the Allegheny River occupied by the clubshell or northern riffleshell (i.e., in the middle reach of the Allegheny River between Kinzua Dam and Lock and Dam 9).

Adult zebra mussels are found on hard substrates including rocks, native mussels, wood, aquatic plants, and other zebra mussels. They also attach to man-made materials including fiberglass, iron, plastic, concrete, and other surfaces (U.S. Army Corps of Engineers 1992).

Male zebra mussels release sperm directly into the water to fertilize eggs released by the females. Large females can release up to one million eggs per season (U.S. Army Corps of Engineers 1992). Eggs are released when water temperatures reach 52□ F (11□ C). Immature zebra mussels (veligers) spread via passive drift on water currents or attach to boat hulls; adults are spread by movable substrates, such as boat hulls. Zebra mussels affect other mussels by competing for food and by attaching to mussels in such numbers that infested mussels cannot travel or burrow. When infested by approximately 100 or more zebra mussels, native mussels cannot open their shells to properly respire, feed, burrow, or move, nor can they close their shells for protection. Zebra mussels can build up on native mussels in such numbers that waves and currents will dislodge native mussels from the substrate. There are also indications that infested native mussels may remove themselves from the substrate to escape zebra mussels. Any of these impacts or combination of impacts can lead to the death of the infested mussel. Presently, recreational and commercial water traffic are the main vectors spreading this species throughout inland waters, although passive drift of veligers and juveniles facilities downstream dispersal.

Zebra mussels use an epoxy-like glue to attach byssal threads to any hard surface. Although zebra mussels only reach a maximum length of four centimeters, hundreds of thousands can colonize a square meter. Up to 10,000 zebra mussels have been counted on a single mussel (U.S. Army Corps of Engineers 1992). In Lakes Erie and St. Clair, where zebra mussels have existed for several years, native mussel populations have been devastated, and in some areas eradicated (Masteller and Schloesser 1991, Gillis and Mackie 1991). Gillis and Mackie (1991) found a positive correlation between large increases in the average number of zebra mussels attached to unionid shells and a decline in unionid density in Lake St. Clair. They also found that approximately 2,000 zebra mussels on a shell occluded the siphon region completely,

affecting its ability to filter. Colonization rates of approximately 0.4 to 1.0 grams of zebra mussels per gram of unionid (dry mass) were recorded in unionids immediately before extirpation from the Canadian side of the Detroit River (Ohnesorg *et al*. 1993).

Zebra mussels appear to have greater impacts on some species than others. Haag et al. (1993), in a test of six species, found species in the Anodontinae subfamily to be the most sensitive to zebra mussels, followed by Lampsilinae and Ambleminae. The northern riffleshell is a member of the subfamily Lampsilinae, and the clubshell is a member of the subfamily Ambleminae.

ENVIRONMENTAL BASELINE

For the purposes of this biological opinion, the action area is defined as the Allegheny National Forest, as well as the Allegheny River and Allegheny Reservoir adjacent to the ANF (i.e., from the Pennsylvania/New York border south to the town of Tionesta). This fully encompasses the area where project-related direct and indirect effects to the bald eagle, Indiana bat, clubshell mussel and northern riffleshell mussel are likely to occur.

Bald Eagle

Two bald eagle nests are known to occur on the ANF on the side hills of the Allegheny Reservoir, and one additional nest is located within the ANF proclamation boundary on a private island in the Allegheny River near the town of Tionesta. The nests on the ANF are located in Management Areas 6.1 and 6.4, within which wildlife management and recreation are the primary management objectives.

The Kinzua nest site is situated on a steep hillside overlooking the Allegheny Reservoir. An old logging trail passes near the nest, and State Route 59 and two old oil and gas wells are located within 0.5 mile of the nest. No boat launches, picnic grounds, trails, or other structures, however, are located within 0.5 mile of the nest. The Cornplanter nest is located within 100 yards of the Allegheny Reservoir. An old, unmaintained trail passes within 0.5 mile of the nest, however, no roads, picnic grounds, boat launches, or other structures occur within 0.5 mile of the nest, and no timber harvest has occurred on federal lands for the past 50 years within 0.5 mile of the nest.

In northwestern Pennsylvania, bald eagles begin nesting as early as mid-January, with young hatching in late March or early April, and fledging in late June through July. The Kinzua, Cornplanter and Tionesta nests fledged two, one, and two eaglets, respectively, in 1998.

Bald eagles on the ANF rely heavily upon the Allegheny Reservoir and Allegheny River, and the surrounding uplands for nesting, foraging, and perching habitat. Eagles have also been observed foraging along some of the streams and impoundments on the ANF, including Tionesta Creek, Salmon Creek, Kinzua Creek, Clarion River, Millstone Creek, Big Mill Creek, Sugar Run, Willow Creek, Buzzard Swamp, Beaver Meadows, Twin Lakes Mead Run ponds and Owls Nest ponds (BA, p. 64). No winter roosting sites have yet been found on the ANF.

Indiana Bat

At this time, no Indiana bat hibernacula are known to occur on the ANF. Only one cave is known to exist within the ANF proclamation boundary -- it is located on State Game Lands in the vicinity of Hearts Content, south of Warren. This site was surveyed in 1996 and 1998, but no Indiana bats were found (BA, p. 22). In addition, some rock formations on the ANF may contain cave-like structures. When they are identified they will be examined for potential bat habitat (John Palmer, ANF, *in litt*., May 14, 1999). The hibernaculum closest to the ANF is located approximately 80 miles to the southeast at Canoe Creek State Park in Blair County. The Indiana bat population at this mine ranges from approximately 150 to 350 bats, based on a biennial census; this, however, is a conservative estimate since not all portions of the mine can be adequately surveyed.

The Forest Service, as part of a partnership agreement with Pennsylvania State University, Altoona Campus, conducted Indiana bat surveys on the ANF during the summer of 1998. The purpose of the study was to survey potential Indiana bat foraging sites to determine whether Indiana bats occur on the ANF. Twenty-five sites distributed throughout the ANF were sampled using traditional mist-netting techniques, and Anabat detectors. Indiana bats were detected (via Anabat detector) at seven sites, and one male Indiana bat was captured in a mist-net at one site. The number of calls recorded for the Indiana bat was 189 during the study, with the majority of those calls recorded at the same site where the Indiana bat was captured (site 5). For the Indiana bat, all calls classified as belonging to this species had a probability level of 80 percent or higher as being classified correctly, and most calls were in excess of 88 percent (Gannon 1999). This was the first evidence that Indiana bats occur on the ANF during summer months. To date, no female Indiana bats have been captured on the ANF.

Site 5 (the site where Indiana bats were captured and which also yielded the largest number of Indiana bat calls, i.e., 136) is located in Management Area 6.1 near the confluence of Big Mill and Red Mill Creeks in the vicinity of Ridgway. Habitat within 2 km of this site is comprised primarily of mixed hardwoods, with approximately two-thirds of the acreage characterized as forests 50+ years old and greater than or equal to 60 percent stocked.

The 1998 survey did not incorporate radio-telemetry, which may have assisted in the identification of specific foraging and roosting areas. Additional mist-netting and Anabat detector surveys are proposed for the 1999 field season.

Clubshell and Northern Riffleshell

As described above, the clubshell and northern riffleshell occur in low numbers and are discontinuously distributed in the Allegheny River in Clarion, Forest, Venango, and Warren Counties, Pennsylvania. The clubshell is known from over a 66-mile stretch of the Allegheny River (C. Bier, WPAC, *in litt*. 6 January 1994, *in* U.S. Fish and Wildlife Service 1994). The Allegheny River northern riffleshell populations range from viable to those with apparently depressed vigor, with an overall known distribution scattered over 80 miles (C. Bier, WPAC, *in litt*. 6 January 1994, *in* U.S. Fish and Wildlife Service 1994).

The clubshell and northern riffleshell are found at several locations in the Allegheny River within the action area, including in the vicinity of Tionesta, and most of the Allegheny Wilderness Islands adjacent to the ANF. Surveys of 10 Allegheny River tributaries on the ANF in 1997, however, did not reveal the presence of the clubshell or northern riffleshell (BA, p. 44).

EFFECTS OF THE ACTION

Forest Plan

Bald Eagle

The two known bald eagle nests on the ANF occur on the west side of the Allegheny Reservoir in Management Areas 6.1 and 6.4, within which the primary focus is wildlife management and a predominance of mature/overmature forest conditions. Implementation of the management objectives in these areas should help to ensure a continuing supply of suitable nest trees, nesting habitat, and foraging habitat. Access to the west side of the reservoir is limited to the Roper Hollow and Webbs Ferry boat launches and a few oil and gas roads (BA, p. 66).

No timber harvesting, road and trail construction, boat launches or campgrounds have occurred on federal lands within 0.5 mile of any bald eagle nest (BA, p. 66). Timber harvesting and road building, however, do occur within Management Area 6.1 (1000 acres harvested annually, and 8.4 miles of road constructed since 1986) (BA, p. 67), making eagles potentially vulnerable to activities of this nature conducted in proximity to nesting, foraging, roosting, or perching areas.

In addition, the Forest Plan only provides for seasonal (February 1 to July 31) buffer zones, not year-round buffer zones around bald eagle nests, which makes existing nest trees and the surrounding habitat vulnerable to alteration, and the eagles vulnerable to take (e.g., harm, harassment) due to habitat alteration and/or the presence of human activity in the vicinity of nests. Considering the lack of year-round buffers around eagle nests, eagles would be especially vulnerable if they nested in Management Areas whose primary objectives were timber harvesting and recreation.

Forest Plan guidelines also fail to provide for buffers around eagle foraging, perching, and roosting areas, thus making such habitat vulnerable to alteration and the eagles vulnerable to disturbance. Although surveys are periodically conducted to locate eagle use areas on the ANF, surveys to date have failed to identify foraging, perching and roosting areas that are consistently used by eagles (although potential areas do exist in Management Areas 6.1 and 6.4). Forest Plan guidelines provide for riparian buffers (e.g., for timber harvesting and road building), although these buffers would not be wide enough to prevent disturbance to foraging or perching eagles, and may not be wide enough to prevent habitat alteration precluding or minimizing eagle use of the area.

Indiana Bat

As mentioned earlier, there are no standards and guidelines designed specifically to identify, protect, maintain, or enhance summer or winter Indiana bat habitat, or prevent impacts to Indiana

bats roosting in trees. This makes Indiana bats and their habitat, particularly any maternity sites, vulnerable to take and habitat alteration due to implementation of land management activities, such as timber harvesting, oil and gas development, and road and trail construction. However, impacts to Indiana bats resulting from the implementation of these land management activities (e.g., timber harvesting), may be incidentally minimized through the implementation of standards and guidelines specific to those activities.

Clubshell and Northern Riffleshell

There are no standards and guidelines designed specifically to identify, protect, maintain, or enhance endangered mussel habitat. However, potential adverse effects to endangered mussels resulting from the implementation of various land management activities (e.g., timber harvesting, road building), may be incidentally minimized through the implementation of standards and guidelines specific to those activities, particularly standards and guidelines intended to reduce erosion and sedimentation.

Tree Harvesting and Removal Activities

Bald Eagle

Adverse effects to bald eagles could occur if timber harvesting or tree removal activities (e.g., associated with firewood harvest, road construction, trail construction, oil and gas development, or wildlife habitat improvement) occur near an active nest, foraging area, or roosting area. Direct mortality or injury to adults, embryonic young, nestlings, or fledglings could occur if a nest tree, or the area surrounding the nest tree, is harvested. The chances of this happening, however, would be minimized by implementation of the Forest Plan's seasonal buffer zone restrictions. Due to the lack of year-round buffers around eagle nests, degradation of nesting habitat could result from timber operations in the vicinity of nests, causing nest site abandonment and forcing the birds to relocate. Timber harvest/tree removal operations occurring adjacent to foraging or roosting areas could temporarily or permanently displace eagles (due to human presence and/or altered habitat conditions), resulting in increased energy expenditures and/or reduced food intake.

Indiana Bat

Adverse effects to the Indiana bat could occur as the ANF continues to implement its forest-wide management activities. Direct mortality or injury to individuals or small groups of roosting bats could occur when harvesting or removing trees that harbor undetected roosts, including occupied snags, live trees, shagbark hickories, or damaged or hollow trees. The likelihood of cutting a tree containing a maternity colony or individual roosting Indiana bat, however, is anticipated to be extremely low because of the large number of suitable roost trees present on the ANF, the rarity of the species, and the wide dispersal of Indiana bats and maternity colonies throughout the species' range. Other direct effects could result if large tracts of hardwood and hardwood/pine habitat are harvested, forcing the bats in a roosting or maternity colony to abandon a traditionally used site. Additional stress would be placed on pregnant females that are already expending energy. Lower reproductive success or lower survival of young could also result with forced

abandonment of lactating females from occupied roosts.

The main potential indirect effect to those Indiana bats using the ANF would be a potential reduction in the species' forage base due to the loss of foraging habitat. A loss in foraging habitat could occur during timber management or tree removal activities associated with timber harvesting, thinning, and salvage operations; road and trail construction; and oil and gas development. It is believed, however, that adverse impacts to the species due to indirect effects are unlikely for the reasons discussed below.

Standards and guidelines outlined in the Forest Plan for the ANF provide significant protection for riparian corridors; management activities in these areas are either limited or prohibited. The restriction of management activities within riparian corridors will enable the ecological integrity of these areas to be maintained into the foreseeable future. It is likely that impacts to upland foraging habitat will also be minimized due the implementation of Forest Plan standards and guidelines associated with timber harvesting.

Additionally, potential adverse effects to bats from the loss of foraging habitat are unlikely for the following reasons: 1) the species is considered a foraging generalist that will take advantage of prey from numerous types of forest conditions; 2) an abundance of insect prey is likely to be available throughout the ANF during the spring through fall periods for the few Indiana bats that have been documented on the ANF, and 3) the opening of the forest canopy in certain situations would undoubtedly increase habitat diversity and therefore insect abundance.

The incorporation of the timber harvesting standards and guidelines on the ANF may reduce the direct and indirect effects listed. Terms and conditions associated with reasonable and prudent measures requested by the Service below will further minimize any adverse direct and indirect effects.

Clubshell and Northern Riffleshell

Indirect adverse effects to the clubshell and northern riffleshell may occur from tree harvesting and removal activities through non-point source pollution on tributaries to the Allegheny River, primarily the introduction of fine sediment from the earth disturbance associated with tree harvesting. As outlined in the Forest Plan, the ANF applies various Standards and Guidelines to harvesting operations that "meet or exceed" Pennsylvania's Best Management Practices (BMPs). BMPs are designed to minimize, but do not completely prevent, soil and sediment from entering waterbodies. Although monitoring by the ANF indicates that little or no sediment reaches waterbodies, the standards and guidelines are not mandatory measures.

The tributaries that flow into the Allegheny River upstream of Allegheny Reservoir, or those that flow into the reservoir itself are unlikely to contribute fine sediment to the downstream segments of the Allegheny River that contain clubshell and northern riffleshell mussels. Rather, those tributaries whose water quality is most likely to affect mussels are those that flow directly into the Allegheny River downstream of Allegheny Reservoir. About 13 percent (65,271 acres and 161 miles of stream) of the Forest drains directly into the Allegheny River.

Road Construction, Maintenance and Operation

Bald Eagle

Adverse effects to bald eagles could occur if road construction or maintenance activities occur near an active nest, foraging area, or roosting area. Direct mortality or injury to embryonic young or nestlings could occur if adults abandon or are temporarily flushed from the nest due to human presence. Road construction or maintenance activities occurring adjacent to foraging or roosting areas could temporarily or permanently displace eagles (due to human presence and/or altered habitat conditions), resulting in increased energy expenditures and/or reduced food intake.

Although nesting and foraging eagles often become habituated to the presence of regular vehicular traffic on existing roads, they may be adversely affected by roads which are only open seasonally (e.g., a road opened in the vicinity of a nest during the breeding season), are subject to only occasional traffic, and/or are used for non-vehicular purposes (e.g., by pedestrians or all-terrain vehicles). The degree of vegetative screening and proximity to nesting, foraging, perching, or roosting areas will dictate to what extent eagles will be influenced by human activities.

Indiana Bat

The anticipated adverse impacts that would result from road construction and maintenance are limited to the tree cutting/harvesting activities associated with road construction and maintenance (as discussed above).

The presence and operation of roads is not anticipated to have significant adverse effects on the Indiana bat because: 1) many roads on the ANF are infrequently traveled logging roads, 2) Indiana bats using roost trees in the vicinity of existing roads may either acclimate to their presence or select alternate roosts, and 3) in some cases infrequently traveled roads in wooded areas may serve as travel routes and/or provide openings which make trees adjacent to the road more suitable as roost trees (e.g., by exposing heavily shaded, but otherwise suitable roost trees to some sunlight).

Clubshell and Northern Riffleshell

Through implementation of the Forest Plan, the ANF's activities regarding the construction, maintenance, and operation of roads may cause adverse effects to clubshell and northern riffleshell through introduction of fine sediment to tributaries of the Allegheny River. Again, the tributaries that are most likely to be affected by these activities are those that enter the Allegheny River downstream of the Allegheny Reservoir.

Trail Construction, Maintenance and Operation

Bald Eagle

Human presence on trails in the vicinity of nesting eagles may cause the adults to abandon a nest or leave it long enough for embryonic young or nestlings to be taken by predators or die of exposure. Eagles could also be harassed and temporarily or permanently displaced from preferred foraging, perching, or roosting areas due to the presence of humans on trails, leading to increased energy expenditures searching for other suitable habitats and/or reduced food intake. These effects could occur during trail construction, trail maintenance, or routine use of trails by pedestrians or motorized vehicles. The degree of vegetative screening and proximity to nesting, foraging, perching, or roosting areas will dictate to what extent eagles will be influenced by human activities.

Indiana Bat

The anticipated adverse impacts that would result from trail construction and maintenance are limited to the tree cutting/harvesting activities associated with trail construction and maintenance (as discussed above).

The presence and operation of trails is not anticipated to have significant adverse effects on the Indiana bat because: 1) Indiana bats using roost trees in the vicinity of existing trails may either acclimate to their presence or select alternate roosts, and 2) in some cases, trails in wooded areas may serve as travel routes and/or provide openings which make trees adjacent to the trail more suitable as roost trees (e.g., by exposing heavily shaded, but otherwise suitable roost trees to some sunlight).

Clubshell and Northern Riffleshell

Similar to tree harvesting activities and roads, trail construction, maintenance, and operation may introduce fine sediment to direct Allegheny River tributaries, and this may adversely affect the clubshell and northern riffleshell. The tributaries that are most likely to be affected by these activities are those that enter the Allegheny River downstream of Allegheny Reservoir.

Operation and Maintenance of Recreation Facilities (excluding trails)

Bald Eagle

Eagles at the Cornplanter and Tionesta nest sites are vulnerable to disturbance (harassment) from boaters and boaters who camp near the nest tree. This could result in nest failure and abandonment. To date, however, nesting has been fairly successful at the Cornplanter and Kinzua nest sites, perhaps indicating that the current levels of disturbance are tolerable. Eagles at the Tionesta nest, however, relocated from their previous nest site, apparently in response to continued harassment by curious people.

Eagles foraging on the Allegheny River, Allegheny Reservoir, and major Allegheny River

tributaries could be temporarily or permanently displaced from preferred foraging and perching areas by boating activity, leading to increased energy expenditures searching for other suitable habitats, reduced food intake, and/or starvation of nestlings. No monitoring, however, has been conducted to determine to what extent foraging or nesting eagles on the ANF may be affected by human disturbance.

Indiana Bat

The operation and maintenance of recreation facilities, including campgrounds, boat launches, canoe access sites, fishing access areas, picnic areas, beaches, and scenic overlooks, is not likely to adversely affect the Indiana bat. Land and tree clearing associated with these facilities has already taken place, and expansion of these facilities was not proposed in the BA (and is therefore not considered in this opinion). The removal of an occasional tree posing a threat to life or property would be expected to have insignificant and discountable effects on Indiana bats.

Clubshell and Northern Riffleshell

The Forest Service operates and maintains one marina, seven boat launches, and six canoe access sites, all but one of which provides access to the Allegheny Reservoir, Allegheny River, or Allegheny River tributaries. All of these recreational boating facilities represent potential sites for the introduction of zebra mussels into the upper and middle reaches of the Allegheny River, especially since no controls (e.g., requirements for boat decontamination) are in place to prevent or reduce the likelihood of zebra mussel transport and infestation. Zebra mussels are known to be transported on the hulls of boats, and it is very likely that some of the recreational boats frequenting the Forest Service marina, boat launches, and canoe access sites have previously been in regional recreational waters occupied by zebra mussels, including Lake Erie and the lower Allegheny River.

Numerous Federal, State and private entities have been monitoring the Allegheny Reservoir and Allegheny River since 1990 for signs of zebra mussel invasion. To date, no zebra mussels have been detected.

One of only two northern riffleshell populations known to be viable and reproducing occurs in the middle section of the Allegheny River (i.e., between Kinzua Dam and Lock and Dam 9). This portion of the Allegheny River also supports one of only six clubshell populations known to be viable and reproducing. If zebra mussels are introduced into and become established within the middle Allegheny River, significant adverse effects to both the clubshell and northern riffleshell would likely occur. Although no zebra mussels have been documented in the middle Allegheny River to date, it is likely that continued operation of the marina, boat launches, and canoe access sites, especially without the benefit of zebra mussel controls, would eventually result in the introduction and establishment of zebra mussels in the middle Allegheny River. The Forest Service has no measures currently in place, or proposed as part of this action, to screen, inspect, or decontaminate boats that may be carrying zebra mussels prior to these vessels entering the Allegheny Reservoir or Allegheny River. Considering the limited extent of reproducing northern riffleshell populations within the species' range, zebra mussel introduction and establishment within the middle Allegheny River due to Forest Service operation of boating

facilities without zebra mussel controls is likely to jeopardize the continued existence of the species by significantly impairing (via harm) one of only two known reproducing populations. This action would also result in significant adverse effects to the clubshell mussel.

Herbicide Application

Bald Eagle

The 1996 consultation on herbicide use on utility line rights-of-way concluded that bald eagles were not likely to be adversely affected. The use of the herbicides glyphosate (Accord®) and sulfometuron methyl (Oust®) for silvicultural activities, however, was not considered in that consultation. Their use is not expected to affect bald eagles from a toxicology (direct or indirect) standpoint, because neither herbicide is very toxic, and eagles' exposure to the herbicides will be low since eagles are unlikely to spend appreciable time in treated areas (approximately 1,800 acres of the 513,000 acre National Forest is treated annually). Neither herbicide is extremely persistent or accumulates in animal tissue to a great degree. In addition, Forest Plan standards and guidelines maintain riparian buffers (areas where herbicide spraying is prohibited) which should prevent herbicide movement into streams. Therefore, eagle prey are unlikely to be contaminated. Adverse effects are likely, however, from the disturbance (e.g., harassment, harm) to nesting or foraging bald eagles during herbicide application.

Indiana Bat

The 1996 consultation on herbicide use on utility line rights-of-way did not consider the Indiana bat. Based on information included in the risk assessment prepared for the environmental impact statement, however, it is unlikely that Indiana bats would be adversely affected by herbicide use on utility line rights-of-way. The herbicides used are generally not very toxic to mammals, although no toxicity data for any species of bat was included in the assessment. Also, Indiana bats' direct exposure to the herbicides is likely to be low for the following reasons: 1) aerial spraying is not conducted; 2) mature trees near utility line rights-of-way are to be protected from spraying (Final EIS, p. V-122); 3) herbicide use is limited to less than 300 acres per year and occurs in areas (rights-of-way) that will not contain mature trees; 4) herbicide application is restricted within riparian corridors; and 5) application of herbicides would impact a minute amount of vegetation that could serve as food for the larval stages of insects that in turn eventually mature and become flying insects (bat prey), so prey numbers are not likely to be reduced. In addition, the herbicides do not accumulate, so food chain effects are unlikely (i.e., it is unlikely that bats would consume a sufficient number of contaminated flying insects that would result in toxicity). The combination of low toxicity and low potential for exposure results in a very low risk to Indiana bats; any effects, therefore, are considered to be insignificant. Bats are also unlikely to be adversely affected by the disturbance caused by the application method.

Similarly, herbicides used in forest regeneration are not likely to adversely affect the Indiana bat. Although herbicide use in shelterwood cuts could result in Indiana bats being in areas where application takes place, it is unlikely that Indiana bats would be adversely affected by herbicide use. The herbicides that are used are generally not very toxic to mammals. Also, direct and indirect exposure of bats to the herbicides is likely to be very low for the following reasons: 1)

aerial spraying is not conducted (spraying is accomplished through air blast or hand-held equipment); 2) approximately 1,500 acres are planned to be treated annually (a small percentage of the 513,000-acre National Forest); 3) bats are likely to be shielded from exposure (under the bark of trees) during spraying; and 4) application of herbicides would impact a minute amount of vegetation that could serve as food for the larval stages of insects that in turn eventually mature and become flying insects (bat prey), so prey numbers are not likely to be appreciably reduced. In addition, the herbicides do not bioaccumulate, so food chain effects are unlikely (i.e., it is unlikely that bats would consume a sufficient number of contaminated flying insects that would result in toxicity). The combination of low toxicity and low potential for exposure results in a very low risk to the Indiana bat; any effects, therefore, are considered to be insignificant.

Clubshell and Northern Riffleshell

The 1996 consultation on herbicide use on utility line rights-of-way concluded that clubshell and northern riffleshell were not likely to be adversely affected. The use of the herbicides glyphosate and sulfometuron methyl for silvicultural activities, however, was not considered in that consultation. Nevertheless, their use is not likely to adversely affect clubshell or northern riffleshell for the following reasons. Neither herbicide is very toxic to animals, and Forest Plan guidelines for timber harvesting and herbicide application will ensure that neither silvicultural activities nor herbicide application will occur in riparian buffer zones, thus greatly minimizing or precluding herbicides from entering streams inhabited by endangered mussels. Even though Accord is labelled for use on water, no spraying of these herbicides on water is done on the ANF. Therefore, clubshell and northern riffleshell are not likely to be exposed to the herbicides in concentrations that would cause adverse affects.

Insecticide Application

Due to impacts to non-target organisms, diflubenzuron has not been used on the ANF since 1989, and its use is not contemplated in the future. Future control of forest pests is proposed to be achieved using *B.t.* when insect populations are documented or anticipated to present a threat to forest health. Any use of diflubenzuron will require a separate consultation.

Bald Eagle

The use of *B.t.* to control forest pests may adversely affect bald eagles through disturbance of the birds during insecticide application. Aerial application in the vicinity of an active bald eagle nest may cause the birds to temporarily or permanently abandon the nest, causing death or injury to embryonic young or nestlings due to predation, exposure, or starvation.

Indiana Bat

The use of *B.t.*, as outlined in the Forest Plan, may adversely affect the Indiana bat. Use of *B.t.* may reduce Indiana bat prey, since *B.t.* is not specific to gypsy moths, but also affects non-target lepidopterans (e.g., moths), which comprise a large percentage of the Indiana bat's diet. One study of the effects of *B.t.* indicates that a reduction in non-target lepidopteran abundance may occur after spraying (Sample *et al*. 1996). According to the ANF's 1994 Gypsy Moth

Environmental Assessment (Appendix A, p. A-1), spray blocks range in size from 66 to 2597 acres. It is possible that, in large spray blocks, numbers of non-target moths could be reduced to the point that Indiana bats would be forced to switch prey, or move to other foraging areas. Either result could come at a increased metabolic cost to the bats.

Clubshell and Northern Riffleshell

The use of *B.t.* to control forest pests is not likely to adversely affect the clubshell or northern riffleshell. Most *B.t.* applied will be intercepted by foliage, and any *B.t.* entering Allegheny River tributaries would result in very low concentrations of *B.t.* in the Allegheny River. Other formulations of *B.t.* are used to control certain aquatic insects (e.g., blackflies, mosquitos) and are relatively non-toxic to most non-target aquatic organisms.

Prescribed Burning

Bald Eagle

Prescribed burning is not likely to adversely affect bald eagles due to the small amount of acreage burned annually, and the restrictions placed on management activities within buffer zones around bald eagle nests (i.e., which would preclude conducting a burn in the vicinity of an eagle nest during the nesting season). A burn conducted near an eagle foraging area may cause birds to shift to a different foraging area while the burn is taking place, but due to the small amount of acreage affected and the short duration of the burn, effects to eagles would be insignificant.

Indiana Bat

Prescribed burning during the summer could result in Indiana bat mortality due to the actual roost tree being incinerated, or death or injury to bats being caused by smoke inhalation. The likelihood of this happening, however, is remote due to the small amount of acreage (30-40 acres) proposed for treatment annually, and the timing of burning (early spring or fall, during which time only volant bats would be present).

Clubshell and Northern Riffleshell

Prescribed burning will have no affect on the clubshell or northern riffleshell due to the small amount of acreage proposed for annual treatment (30-40 acres), and the negligible effect that burning this acreage will have on water quality.

Oil, Gas and Mineral Development (federal)

Development of additional wells on federally-owned mineral leases is not anticipated until after the Forest Plan is revised in 2003. However, the Forest Plan allows for the continued operation of existing wells. In addition, there are pipelines associated with the existing wells, and the possibility of a pipeline rupture exists. There are 321 miles of pipelines on the ANF under Special Use Permits, and one to two pipeline breaks occur each year.

Bald Eagle

No federally-leased oil, gas, or mineral sites are known to occur in the vicinity of the two bald eagle nests on the ANF; therefore, no adverse effects to these breeding pairs are anticipated. If a breeding pair establishes a territory in the vicinity of an existing federal oil and gas well(s), however, they could be adversely affected by human activities at the well site(s). In addition, eagles could also be disturbed by remediation activities, or exposed to oil (e.g., through ingestion of carrion), if a pipeline rupture occurs.

Indiana Bat

The presence and operation of oil and gas wells is not anticipated to have significant adverse effects on the Indiana bat because: 1) Indiana bats using roost trees in the vicinity of existing oil and gas pads, and their associated road networks are likely to either acclimate to their presence or select alternate roosts; and 2) in some openings in wooded areas may serve as travel routes and/or provide openings which make trees adjacent to the opening more suitable as roost trees (e.g., by exposing heavily shaded, but otherwise suitable roost trees to some sunlight).

Clubshell and Northern Riffleshell

The clubshell and northern riffleshell could be adversely affected by existing or proposed federal oil and gas leases. Development of additional wells on federally-owned mineral leases, however, is not anticipated until after the Forest Plan is revised in 2003. Use and weathering of roads associated with existing Federal mineral leases could result in sedimentation of Allegheny River tributaries. Also, the possibility exists that clubshell and northern riffleshell would be adversely affected if a pipeline break occurred near an Allegheny River tributary and could not be remediated before oil reached the Allegheny.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this opinion. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Endangered Species Act.

<u>Oil, Gas and Mineral Development (non-federal)</u>

While the ANF has more direct control over extraction of federally-owned minerals, the ANF, as steward of the surface rights, and through the Forest Plan, ensures that extraction of privately-owned minerals is compatible with surface management goals and objectives (BA, p. 12). The Forest Plan is the basis of the ANF's administration of oil, gas, and mineral development, and the Plan is the subject of this consultation.

About 93 percent of the subsurface minerals on the ANF are privately-owned, and the Forest Service has indicated that they have no control over extraction of these minerals (including oil

and gas). Their administrative authority appears to be limited to: 1) reviewing site development plans; 2) making recommendations (e.g., about road placement) to minimize impacts to surface values (e.g., water quality, terrestrial resources); 3) monitoring oil and gas development on the ANF to identify potential problems (e.g., pipeline breaks, leaking wells or brine tanks); and 4) reporting problems to the appropriate authorities for resolution and remediation.

There are about 6,000 producing wells on the ANF, with another 80 to 200 (mostly private) new wells drilled annually. A well normally produces for 20 to 25 years. From 1999 to 2003, the Forest Service anticipates that 150 new wells will be drilled annually, affecting 112 acres annually. Associated with these wells will be approximately 40 miles of new road construction annually.

Bald Eagle

Two old oil and gas wells are located within 0.5 mile of the Kinzua nest, and additional oil and gas development could occur in the vicinity of this and other bald eagle nests due to lack of Forest Service control over the extraction of privately-owned minerals on the ANF.

Adverse effects to bald eagles could occur if oil and gas development occurs near an active nest, foraging area, or roosting area. Direct mortality or injury to adults, embryonic young, nestlings, or fledglings could occur if the nest tree, or the area surrounding the nest tree, is harvested (e.g., during clearing of oil and gas pads and their associated road network). Degradation of nesting habitat could result from oil and gas operations in the vicinity of nests, causing nest site abandonment and forcing the birds to relocate. Oil and gas development occurring adjacent to foraging or roosting areas could temporarily or permanently displace eagles (due to human presence and/or altered habitat conditions), resulting in increased energy expenditures and/or reduced food intake. Bald eagles could also be disturbed by remediation activities (especially in the vicinity of an active nest) if a severe pipeline rupture would occur, or be exposed to oil residues through ingestion of waterfowl or other prey that become oiled and die, and are eaten as carrion.

Indiana Bat

Direct mortality or injury to individuals or small groups of roosting bats could occur when harvesting or removing trees during oil and gas development (e.g., while clearing land for oil and gas pads, and the associated road network). The likelihood of cutting a tree containing a maternity colony or individual roosting Indiana bat, however, is anticipated to be extremely low because of the large number of suitable roost trees present on the ANF, the limited acreage affected by oil and gas development, the rarity of the species, and the wide dispersal of Indiana bats and maternity colonies throughout the species' range.

Clubshell and Northern Riffleshell

The clubshell and northern riffleshell could be adversely affected by existing or proposed private oil and gas leases. Use and weathering of roads associated with existing and proposed private mineral leases could result in sedimentation of Allegheny River tributaries. Also, the possibility

exists that clubshell and northern riffleshell would be adversely affected if a pipeline break occurred near an Allegheny River tributary and could not be remediated before oil reached the Allegheny.

Operation of Boating Facilities

In addition to Forest Service boat launches and canoe access sites, other State, local, and private boating access sites occur on the Allegheny River between Kinzua Dam and Tionesta (i.e., within the action area). The Pennsylvania Fish and Boat Commission operates and maintains the Starbrick, Bonnie Brea, West Hickory, and Tionesta boat ramps at river miles 184, 169, 158, and 153, respectively. The Boro of Tidioute operates and maintains the boat ramp at Tidioute (river mile 167) (Allegheny National Wild and Scenic River Draft River Management Plan, 1995, p. 23). In addition, several private boat launches exist along the Allegheny River within the action area. No state or federal regulations require boats to be decontaminated before entering the Allegheny River watershed; therefore, all of these boat access sites represent a potential for introducing and spreading zebra mussels into the middle reach of the Allegheny River. This poses a substantial threat to the clubshell and northern riffleshell, as discussed previously in this opinion.

Although non-federal entities are also subject to the takings prohibition of section 9 of the Act, it is more difficult to provide measures to prevent zebra mussel introduction since these activities do not fall under a specific Federal agency. However, the interaction of these entities with Federal agencies undertaking measures to prevent or control the spread of zebra mussels may be instrumental in providing increased awareness of the potential hazard and ways to reduce it.

CUMULATIVE IMPACT OF INCIDENTAL TAKE ESTIMATED BY THE SERVICE IN PREVIOUSLY ISSUED BIOLOGICAL OPINIONS - INDIANA BAT

In reaching a decision whether the continued implementation of activities outlined in the Forest Plan for the ANF is likely or not likely to jeopardize the continued existence of the Indiana bat, the Service must factor into its analysis previous biological opinions issued involving the species, especially for those opinions where incidental take was presented as the number of acres affected. Although there have been a few previously issued opinions that involve the loss of riparian corridors or foraging and roosting habitat for the Indiana bat (e.g., construction of a reservoir involving the Army Corps of Engineers in Marion, Illinois; John Blankenship, USFWS, Fort Snelling, Minnesota, *in litt*. 1995), most involve activities implemented from Land and Resource Management Plans on National Forests in the eastern U.S. Additionally, such opinions also involve the potential impact to the largest acreage of Indiana bat roosting and foraging habitat. All previously issued Service opinions involving the Indiana bat have been non-jeopardy. In assessing the potential cumulative effects of such previously issued opinions, the following must be included in the analysis:

- the annual removal (in acres) of potential roost trees and/or foraging habitat on the National Forest under review,
- an estimate of the number of Indiana bats likely to be affected within the action area, and

- the acreage of suitable roosting and foraging habitat remaining for Indiana bats following removal. Such habitat must be of sufficient age (usually >50-70 years, depending on growth rates, site characteristics, etc.), size (9-16 inches + d.b.h.), tree species composition (have those tree species which have been proven to consistently be suitable for roosting), and canopy closure suitable for foraging (as summarized in Romme *et al*. 1995).

To date, the Service has issued final non-jeopardy biological opinions for the following National Forests: Cherokee, Daniel Boone, George Washington/Jefferson, and Ozark/St. Francis. Two others (Quachita and Mark Twain) are in draft stage (Steve Hensley, USFWS, Tulsa, Oklahoma, pers. comm., February 1999; Dr. Paul McKenzie, USFWS, Columbia, Missouri, pers. comm., April 1999).

Results mentioned above for the four National Forests where final biological opinions have been issued are provided in Table 5.

The cumulative impact of an annual allowable incidental take of bats within 29,300 acres on these four National Forests and its potential impact to Indiana bat must be estimated within the context of: 1) the remaining surrounding landscape that provides suitable foraging and roosting habitat for the species; 2) the conservation measures incorporated into a particular Forest's management plan to minimize the impact of tree removal; 3) the terms and conditions associated with the reasonable and prudent measures provided by the Service in its non-jeopardy biological opinions for each forest that minimize the impact of incidental take; and 4) what percent of the rangewide population is predicted to be affected by the proposed actions.

The degree that the remaining surrounding landscape provides suitable foraging and roosting habitat for the Indiana bat must be analyzed by estimating the average number of suitable roost trees per acre [i.e., the number of snags, dead or dying trees with exfoliating or defoliating bark with a d.b.h. of 9-16 inches or greater, Class 1 or Class 2 trees as summarized by Romme *et al.* (1995), den or cull trees, lightning-struck or otherwise injured trees, and live shell bark and shagbark hickories (if these are exempt from harvest)], and the number of acres of suitable foraging habitat. Based on information from several sources (e.g., Shifley *et al.* 1997; Houf, pers. comm., March 1999; MacGregor, pers. comm., March 1999; Randy Jensen, MDC, Ellington, Missouri, *in litt*., March 8, 1999), it has been estimated that the average forest in the eastern United States greater than 50 years old would contain at least 20 trees per acre that provide suitable roosting habitat for the Indiana bat.

The 3,100 Indiana bats estimated (actual numbers are much lower -- this estimate was determined based on predictions made by MacGregor, pers. comm., March 3, 1999) in Table 5 would constitute approximately 0.87 percent of the entire population in the eastern United States. Although a much smaller percentage of the 3,100 individuals would be present during the summer, many of these bats could be present on these National Forests during spring and fall migration. Assuming that the bats listed above are possibly dispersed throughout the four National Forests for which final opinions have been issued, and in the absence of any conservation measures provided by the Forest Service or reasonable and prudent measures provided by the Service, the 3,484,624 acres alone could supply each bat with approximately

1,124 acres of roosting and foraging habitat. Given an average of at least 20 suitable roost trees per acre, the 1,124 acres of habitat would provide a minimum of 22,480 suitable roost trees per individual bat. A much greater number than this, however, would be provided to each bat because of the additional measures outlined in each biological opinion. Additionally, the 3,484,624 acres used in the analysis would provide an abundance of suitable foraging habitat.

Table 5. Annual estimated incidental take (acres), estimated number of Indiana bats potentially affected, and acres of suitable roosting and foraging habitat remaining following tree removal as identified in biological opinions previously issued by the Service involving four National Forests in the eastern United States.

National Forest	Incidental Take (acres)	Estimated Number of Indiana Bats Potentially Affected	Acres of Suitable Habitat Remaining
Cherokee	1,300	~200[1]	513,250
Daniel Boone	4,500	~1,600[1]	~675,000
George Washington/Jefferson	4,500	~300[2]	1,433,974
Ozark-St. Francis	19,000[3]	~1,000	862,400[3]
TOTALS	29,300	~3,100	3,484,624

[1] MacGregor, pers. comm., March 3, 1999
[2] Estimate based on MacGregor's predictions for the number of Indiana bats that may occur on the Cherokee and Daniel Boone National Forests.
[3] This includes hardwoods, pines, and pine/hardwoods -- all of which can provide suitable roosting habitat for the Indiana bat.

Additional conservation measures provided by the Forest Service or reasonable and prudent measures provided by the Service in its biological opinion to minimize the impact of the annual allowable take for each National Forest are summarized below.

Cherokee: The annual incidental take of 1,300 acres identified in the Service's opinion issued in February 1997, is 0.25 percent of the total area of the Cherokee National Forest (CNF) that is suitable for timber harvest. Although there are no documented records of either wintering or summering individuals on the CNF, the Forest is within the migrational range of colonies that hibernate in nearby caves and there is an abundance of suitable roosting habitat that could be used by Indiana bats during the spring-fall period. Consequently, MacGregor believes that as many as 200 Indiana bats are possibly distributed throughout the Forest (MacGregor, pers. comm., March 3, 1999).
The following activities outlined by the CNF's biological assessment of September 3, 1996, provide additional suitable roosting habitat for Indiana bats within areas scheduled for management: 1) the primary harvest technique is a two-aged shelterwood method that leaves

a typical residual basal area of 15 to 35 square feet per acre, or approximately 40-60 trees per acre in a size class equal to or greater than 9" inches d.b.h.; 2) 12,664 acres previously considered for harvest were designated as old growth to benefit the black bear; 3) at least 20 percent of harvestable timber 61 years or older must be retained within each compartment scheduled for management; and 4) the retention of at least two snags, preferably large-diameter hardwood snags, in areas harvested.

The primary term and condition associated with reasonable and prudent measures outlined in the Service's opinion that ensures additional roosting habitat on the CNF is the retention of 20 to 40 Class 1 or Class 2 trees (as identified by Romme *et al.* 1995) per acre (of two-aged shelterwood method).

Daniel Boone: The annual incidental take of 4,500 acres provided in the Service's opinion issued on April 4, 1997, constitutes approximately 0.75 percent of the total area of the Daniel Boone National Forest (DBNF) that is suitable for timber production. MacGregor (pers. comm., March 3, 1999) estimates that as many as 1,600 Indiana bats may occur on the DBNF. In their biological evaluation (Forest Service *in litt*. October 6, 1996), which was the basis for initiating formal consultation with the Service, the DBNF agreed to implement several prudent measures that would provide roosting and foraging habitat for the Indiana bat. Included in these were: 1) the retention of all dead and dying potential Class 1 or Class 2 trees (after Romme *et al.* 1995) of 16 inches d.b.h. or greater; 2) the retention of all shagbark and shellbark hickory, and all hollow or cull trees of other species where possible; 3) the retention of at least 16 Class 1 and/or Class 2 trees with a d.b.h. greater than 9 inches; 4) allowance of no more than 40 acres per square mile per decade of regeneration harvest within a one-mile radius of each significant cave or hibernaculum; and 5) the retention of residual trees with a basal area of 50 in strips or clumps.

Terms and conditions associated with reasonable and prudent measures in the Service's opinion included: 1) the retention of at least three natural or created snags with a d.b.h. greater than 9 inches in each harvest area; 2) appropriate numbers of live trees will be left within a 25-foot radius of one-third of all large snags with a d.b.h. greater than 12 inches to provide shading for potential roosts; 3) clumps of trees are to be left in the harvest area along with irregular strips of trees extending into the harvest area to maintain forest travel corridors between the harvest area and surrounding areas; 4) retention of all shagbark and shellbark hickories; and 5) the retention of all additional reserve trees that have developed exfoliating bark as the result of natural or man-made damage.

George Washington and Jefferson: The annual incidental take of 4,500 acres provided in the Service's opinion issued on September 16, 1997, constitutes approximately 0.30 percent of the total area of the George Washington/Jefferson National Forests (GWJNFs) that is suitable for timber production. Although to date only seven summer males have been located away from hibernacula on the GWJNFs, one was a juvenile male captured on July 28, 1992, suggesting the possibility of a maternity colony on or adjacent to National Forest land. Recently, only 70 to 90 Indiana bats have been documented at hibernacula on the GWJNFs, but a number of hibernacula are adjacent to National Forest land. Thus, it is possible that as many as 300 Indiana bats could use the GWJNFs during the spring-fall period.

In an attempt to address new information collected on this species' habitat requirements during the spring-fall non-hibernating period, the GWJNFs developed an Indiana Bat Recovery Strategy (IBRS) (John Wolflin, USFWS, Annapolis, MD, *in litt*., September 16, 1997). In their IBRS, the GWJNFs agreed to provide the following: 1) a no disturbance primary buffer of at least 0.5 mile will be placed around each Indiana bat hibernaculum; 2) a limited disturbance buffer of at least 1.5 miles will be placed around each Indiana bat hibernaculum -- within this buffer either a) a minimum of 20 trees per acre in the 10-16 inches d.b.h. class and 15 trees per acre with a d.b.h. of 20 inches or greater must be retained, or b) 60 percent of the area must be maintained in an age class of 70 years or older, and 40 percent of oaks, hickories, and yellow poplar (*Liriodendron tulipifera*) must be maintained in an age class of 80 years of age or older; 3) a 0.25-mile no disturbance buffer would be placed around all located roost trees; 4) all shagbark hickory and snags will be retained on the GWJNFs for non-cave roosts; 5) 40 percent of oaks, hickories, and yellow poplar must be maintained in an age class of 80 years of age or older for non-cave roosts forest-wide; and 6) a minimum of 60 percent of the acreage of all forest types combined on the GWJNFs will be maintained over 70 years of age.

Terms and conditions associated with reasonable and prudent measures in the Service's opinion above and beyond those agreed to by the GWJNFs included: 1) the retention of at least six snags or cavity trees per acre with a d.b.h. of 9 inches or greater for all timber activities; and 2) the retention of all shagbark hickories throughout the GWJNFs.

Ozark-St. Francis: The annual incidental take of 19,000 acres (8,000 acres of hardwoods and 11,000 acres of pine and pine/hardwood forest types) provided in the Service's opinion issued on June 25, 1998, constitutes approximately 8.7 percent of the total area of the Ozark-St. Francis National Forest (OSFNF) that is suitable for timber production.

The following activities outlined by the Forest Plan for the OSFNF and the biological assessment of October 28, 1997, provide additional suitable roosting habitat for Indiana bats within areas scheduled for management: 1) at least two dead snags greater than 12 inches d.b.h. (when possible) per acre are retained in all harvested areas; 2) all standing dead trees with exfoliating or defoliating bark and den trees are retained within riparian corridors; and 3) approximately 147,364 acres are designated old growth (~13 percent) that have more than 10 individual live trees per acre over 120 years old or over 22 inches d.b.h..

The primary term and condition associated with reasonable and prudent measures in the Service's opinion that ensures the availability of suitable roost trees above and beyond those agreed to by the OSFNF is the retention of at least six snags or cavity trees (Class 1 or Class 2 trees as identified in Romme *et al.* 1995) per acre with a d.b.h. of 9 inches or greater for all timber activities.

Given: 1) the conservation measures outlined in these National Forest Land and Resource Management Plans, biological assessments, biological evaluations, or recovery strategies developed for the Indiana bat; 2) the additional terms and conditions associated with the Service's biological opinions; 3) the abundance of available roost trees on the National Forests discussed above; and 4) the small percentage of the overall population of the species likely to be affected from the annual, estimated level of incidental take, the Service believes that potential impacts to

the species have been sufficiently minimized to prevent a significant, cumulative reduction in population numbers of the Indiana bat.

CONCLUSION

After reviewing the current status of the northern riffleshell, the environmental baseline for the action area, the effects of the proposed actions, and cumulative effects, it is the Service's biological opinion that continued operation of Forest Service marinas, boat launches and canoe access sites on the Allegheny Reservoir, Allegheny River and Allegheny River tributaries is likely to jeopardize the continued existence of the northern riffleshell. Failure to incorporate measures to prevent or reduce the risk of zebra mussel introduction at these boating facilities can be reasonably expected to reduce appreciably the likelihood of both the survival and recovery of the northern riffleshell by reducing the reproduction, abundance and distribution of the species, since one of only two known reproducing and viable populations occurs within and downstream of the action area. It is also the Service's biological opinion that implementation of the Allegheny National Forest Land and Resource Management Plan, and other projects predicated upon it through the year 2003 (with the exception of the operation of boating facilities, as noted above), is not likely to jeopardize the continued existence of the northern riffleshell.

After reviewing the current status of the bald eagle, Indiana bat, and clubshell mussel; the environmental baseline for the action area; the effects of the proposed actions; and cumulative effects; it is the Service's biological opinion that implementation of the Allegheny National Forest Land and Resource Management Plan, and ongoing projects and projects predicated upon it through the year 2003, as proposed in the Biological Assessment, is not likely to jeopardize the continued existence of these species.

No critical habitat has been designated for the bald eagle, clubshell or northern riffleshell; therefore, none will be affected. Critical habitat for the Indiana bat has been designated at hibernacula in Illinois, Indiana, Kentucky, Missouri, Tennessee and West Virginia; however, this action does not affect these areas, and no destruction or adverse modification of critical habitat is anticipated.

REASONABLE AND PRUDENT ALTERNATIVES

Regulations (50 CFR §402.02) implementing section 7 of the Act define reasonable and prudent alternatives as alternative actions, identified during formal consultation, that: 1) can be implemented in a manner consistent with the intended purpose of the action; 2) can be implemented consistent with the scope of the action agency's legal authority and jurisdiction; 3) are economically and technologically feasible; and 4) would, the Service believes, avoid the likelihood of jeopardizing the continued existence of listed species or resulting in the destruction or adverse modification of critical habitat.

The Service is providing the Forest Service with three reasonable and prudent alternatives. If any alternative is implemented fully and in a timely manner, it will significantly reduce the Forest Service's potential to cause zebra mussel infestation of the middle Allegheny River and, therefore, avoid the likelihood of jeopardizing the continued existence of the northern riffleshell

and violation of section 7(a)(2) of the Act. The Service has discussed these alternatives with the Forest Service, and concludes that implementing all of the components of the reasonable and prudent alternative is necessary to ensure that the operation of Forest Service boating facilities is not likely to jeopardize the continued existence of the northern rifflesheIl.

Reasonable and Prudent Alternative 1: The Forest Service must reduce significantly the risk of zebra mussel introduction due to operation of its boating facilities.

The following components of Reasonable and Prudent Alternative 1 are necessary to ensure that the operation of Forest Service boating facilities reduces, to the maximum extent possible, the introduction of zebra mussels within the middle Allegheny River:

1. By July 1, 1999, the following measures shall be implemented:

    a. Educational materials (e.g., brochures) regarding the threats posed by zebra mussels, the means of zebra mussel transport, and procedures for decontaminating vessels shall be made available to persons using the marina and boat launches on the Allegheny Reservoir and Allegheny River, and

    b. Signs shall be posted at the marina and boat launches on the Allegheny Reservoir, and at the boat launch on the Allegheny River (at Buckaloons) prohibiting the launching of vessels that may be carrying zebra mussels, unless such vessels have been decontaminated.

2. By August 1, 1999, the Forest Service shall begin conducting spot-checks of boat owners to ensure compliance with the signage posted as part of measure 1b above.

3. By April 1, 2000, the following measures shall be implemented:

    a. Prior to using the Forest Service marina or boat launches on the Allegheny Reservoir, boats shall be screened for potential zebra mussel contamination, and all boats found through screening to be at risk shall be decontaminated using a Service-approved decontamination method. These same procedures shall apply to commercial use of the boat launch at the Buckaloons Recreation Area on the Allegheny River. The screening method(s) and procedures (e.g., written questionnaire, visual inspection by qualified, trained personnel); decontamination method(s) and procedures; and decontamination facility location(s) are subject to review and approval by the Fish and Wildlife Service.

    b. Administrative procedures for operation of the marina and/or boat launches on the Allegheny Reservoir by a private entity (e.g., via a Forest Service special use permit) shall include the stipulation that zebra mussel screening and decontamination procedures be followed; significant penalties shall be imposed if procedures are not followed. Periodic checks by Forest Service personnel on the entity administering the marina and boat launches will be conducted to ensure compliance.

c. Zebra mussel educational materials (subject to review by the Service) shall continue to be made available to boaters using the marina and boat launches on the Allegheny Reservoir, and the signs put in place as part of measure 1b shall remain in place.

d. At canoe access sites and the boat launch at Buckaloons, the Forest Service shall establish educational displays and/or provide educational materials explaining: a) the risk (e.g., economic, ecological) posed by zebra mussels, b) methods of zebra mussel transport, c) how to tell if a boat poses a risk (i.e., might be carrying zebra mussels), d) a list of known zebra mussel infested waters (e.g., Lake Erie), and e) methods and availability of decontamination. The Forest Service shall also make the decontamination station(s) at the Allegheny Reservoir and/or elsewhere on the ANF available to entities using these boating facilities. Educational displays and materials will be subject to review and approval by the Service, and will be in place by April 1, 2000.

4. Because several zebra mussel monitoring stations are already located on the Allegheny Reservoir and Allegheny River, but are run by other agencies or entities, the Forest Service will only be required to conduct monitoring if monitoring efforts by these agencies/entities are discontinued or significantly curtailed.

5. The Forest Service shall, in cooperation with the Fish and Wildlife Service and others (e.g., the U.S. Army Corps of Engineers, Pennsylvania Fish and Boat Commission, etc.) assist in developing and implementing contingency plans and protocols for zebra mussel control and/or native mussel species protection in the event of zebra mussel incursions.

Reasonable and Prudent Alternative 2: The Forest Service must significantly reduce the likelihood of zebra mussel introduction due to operation of its boating facilities by closing all of its boating facilities located on the Allegheny River, Allegheny Reservoir, and Allegheny River tributaries until such time as all of the measures under Reasonable and Prudent Alternative 1 have been implemented.

Reasonable and Prudent Alternative 3: The Forest Service must avoid the possibility of zebra mussel introduction due to operation of its boating facilities by permanently closing all of its boating facilities located on the Allegheny River, Allegheny Reservoir, and Allegheny River tributaries.

Because this biological opinion has found jeopardy, the Forest Service is required to notify the Service of its final decision on the implementation of the reasonable and prudent alternatives.

INCIDENTAL TAKE STATEMENT

Section 9 of the Endangered Species Act and federal regulations pursuant to section 4(d) of the Act prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or

collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of sections 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the Act, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the Forest Service so that they become binding conditions of any grant, permit or contract issued to any applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Forest Service has a continuing duty to regulate the activities covered by this Incidental Take Statement. If the Forest Service 1) fails to assume and implement the terms and conditions; or 2) fails to require applicants to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to permits, contracts and/or grant documents, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Forest Service must report the progress of the action and its impact on the species to the Service as specified in the Incidental Take Statement [50 CFR §402.14(I)(3)].
AMOUNT OR EXTENT OF TAKE

Bald Eagle

The Service anticipates that up to one bald eagle could be taken annually as a result of implementation of the ANF Forest Plan, and projects predicated upon it through the year 2003, as described in the BA (see *Description of the Proposed Action,* Table 2). This incidental take is expected to be primarily in the form of harassment (but might also be in the form of harm, hunting, shooting, wounding and/or killing) resulting from one or more of the following activities occurring in the vicinity of nesting, foraging or roosting eagles: timber harvesting/tree removal; road and trail construction, maintenance and operation; federal and private oil and gas development; hunting; aerial application of insecticides; and operation and maintenance of boat launches, marinas and fishing areas.

The Service will not refer the incidental take of any bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

Indiana Bat

The Service anticipates incidental take of the Indiana bat will be difficult to detect and quantify for the following reasons: 1) individuals are small; 2) Indiana bats form small (i.e., 50 or fewer, to 100 individuals), widely dispersed colonies under loose bark or in cavities of trees; 3) finding

dead or injured specimens is unlikely; and 4) the areal extent and density of the species' summer population on the ANF is unknown.

Any incidental take of Indiana bats is expected to be in the form of killing, harming, or harassing. Cutting trees during the non-hibernation season for harvest or in preparation for other activities may result in mortality to females and young, or to individually roosting Indiana bats, if a particular tree which is cut contains a maternity colony or roosting bats. If the bats are not killed, the colony (or roosting individuals) will be forced to find an alternate roost or may be forced to abandon a roost in the area, possibly leading to lower reproduction or survival. Tree harvesting or removal (e.g., associated with road and trail construction, or oil and gas development) may also result in alteration of roosting and/or feeding activities by the bats (i.e., the bats may have to fly farther to forage, seek alternate roosts, or they may be forced to abandon the area altogether). In addition, growing-season prescribed fires may result in burning of occupied roost trees. Smoke generated during prescribed burns could also cause roosting bats discomfort or death. Burning may cause a maternity colony or individual roosting bat to abandon a traditionally used roost tree. Finally, spraying of large blocks of forested habitat with *B.t.* may reduce prey and cause individual bats to have to travel inordinate distances to forage.

Monitoring to determine take of individual bats within an expansive area of forested habitat is a complex and difficult task. Unless every individual tree that contains suitable roosting habitat is inspected by a knowledgeable biologist before timber harvest begins, it would be impossible to know if a maternity colony or roosting Indiana bats are present in an area proposed for harvest. It would also be impossible to evaluate the amount of incidental take of Indiana bats unless a post-harvest inspection is immediately made of every tree that has been cut or disturbed. Inspecting individual trees is not considered by the Service to be a practical survey method and is not recommended as a means to determine incidental take. However, the level of take of this species can be anticipated by the areal extent of potential roosting habitat affected. Although, to the best of our knowledge, no Indiana bat maternity colony or individually roosting Indiana bats have been incidentally taken on the ANF during tree removal or other habitat modifying activities conducted to date, incidental take of this species can be anticipated due to the loss of active roost trees. The Service believes if a maternity colony or roosting individuals are present in an area proposed for timber harvest or other disturbance, loss of suitable roosting habitat would result in incidental take of Indiana bats. However, implementation of the terms and conditions associated with the reasonable and prudent measures provided below by the Service will significantly reduce the potential for incidental take.

This incidental take statement anticipates the taking of Indiana bats from activities (e.g., tree removal associated with timber harvest; road and trail construction and maintenance; oil and gas development) conducted on the ANF that result in an annual removal of, or disturbance to, no more than 7,489 acres of potential Indiana bat habitat in 1998; 7,453 acres in 1999; 14,287 acres in 2000; and 8,393 acres annually in 2001, 2002, and 2003 (Table 6).

The annual incidental take, as measured indirectly by acreage, ranges from 7,456 to 14,287 acres, and constitutes approximately 1.6 to 3.0 percent of the total forested area (476,735 acres) on the ANF. The potential for loss of suitable habitat, and consequent incidental taking of Indiana bats, however, is significantly reduced through the implementation of Forest Plan standards and

guidelines and the terms and conditions associated with the reasonable and prudent measures provided below by the Service. Forest Plan standards and guidelines require that an average of 5 to 10 snags, and 3 to 6 den trees, per acre be left in areas subject to timber harvesting.

Consequently, the annual removal or disturbance of up to 13,984 acres per year (maximum acreage subject to timber harvest in 2000) would still provide 55,936 potential roost trees, if we assume that only some (e.g., 50 percent) of the 5 snags and 3 den trees per acre provide suitable roosting conditions. If we assume that most or all of Pennsylvania's estimated hibernating population of 400 bats occurs on the ANF at some time during the spring-fall period (a very conservative assumption, considering the extensive forest lands available to this species in the State), a minimum of 140 potential roost trees per bat per year would be provided in those areas where habitat alterations occur. Within a 5-year period (1999 to 2003), the disturbance of 45,594 acres would still leave 182,376 potential roost trees available to the species.

Table 6. Annual estimated incidental take (as measured indirectly by acreage) due to the removal or disturbance of Indiana bat habitat on the Allegheny National Forest, Pennsylvania.

Activity	**Number of Acres Removed or Disturbed**			
	FY 1998	**FY 1999**	**FY 2000**	**FY 2001-2003/yr**
Trail Construction				
Pedestrian	0	8	2	2
Motorized - winter	4	0	4	4
Motorized - summer	0	0	4	4
Timber management				
Clearcut	220	220	420	220
Shelterwood seed/prep	1640	1640	4000	2000
Shelterwood removal	1864	1864	1864	1864
Thinning	3225	3225	7000	3225
Selection cut	334	334	700	800
Wildlife Habitat Management	10	10	10	10
Prescribed burning	40	40	40	40
Roads				
Construction	1	0	73	55
Reconstruction/betterment	0	0	55	55
Restoration	2	3	3	3
Oil and Gas Development[2]	149	~112	~112	~112
TOTALS	7489	7456	14,287	8394

[1] Adapted from information provided in the 1998 Biological Assessment for Threatened and Endangered Species on the Allegheny National Forest; April 1, 1999, revision to the Biological Assessment; and supplementary information provided by the Forest Service

[2] Acres for private mineral development depends on market conditions and may exceed these numbers.

Additionally, the potential impact to the species must be examined in the context of how many potential roost trees are likely to be available in the remaining acreage that is not disturbed each year. In a 5-year period (1999-2003), up to 45,594 acres would be disturbed by timber harvesting. However, there are 402,520 acres of forest 60 years of age that would produce trees that provide suitable roosting (i.e., trees 9-16" d.b.h.) and foraging habitat for Indiana bats. (Actually, forests 50 years of age would produce trees that provide suitable roosting and foraging habitat for Indiana bats, but we could not separate out the 50-59 year age class from the 20-59 year age class data presented in the BA.) If we subtract the 45,594 acres that are disturbed within the same time frame, the difference is 356,926 acres, a conservative estimate because it does not account for the additional acreage that will grow into the 60 year age class during that time frame.

Multiplying 356,926 acres by the number of suitable roost trees per acre (~20) yields 7,138,520 roost trees available to the species. If we add the number of potential roost trees from disturbed areas within the 5-year period (i.e., 182,376) to the number of potential roost trees from undisturbed areas within the same 5-year period (i.e., 7,138,520), the total is 7,320,896. Dividing the total number of potential roost trees by the maximum number of Indiana bats that might use the ANF (i.e., 400, and assuming that this number remains stable) suggests that a minimum of 18,302 potential roost trees would be available for each Indiana bat on the National Forest. Although several assumptions must be factored into such an analysis, it does suggest that there will be an abundance of suitable roost trees for bats on the ANF and that the impacts of the incidental take outlined above will be reduced.

If levels of incidental take associated with any one of the above-listed activities (except private oil and gas development) (see Table 6) are exceeded, as measured by the total amount of habitat disturbance, such incidental take represents new information requiring review of the reasonable and prudent measures provided, and may require reinitiation of formal consultation.

Clubshell and Northern Riffleshell

The Service anticipates incidental take of the clubshell and northern riffleshell resulting from potential water quality degradation will be difficult to detect for the following reasons: 1) these species usually represent a very small component of the mussel community; 2) individuals (juveniles and adults) of both species are small, and often buried in the substrate, making them difficult to locate; and 3) finding dead or injured specimens is unlikely. However, take of these species can be indirectly estimated or measured by monitoring water quality conditions in the Allegheny River main stem and tributaries downstream of the Allegheny Reservoir because significant water quality degradation, especially when a physical pollutant such as sediment is concerned, equates to a loss of habitat, and a take of mussels, although direct relationships are extremely difficult to determine.

The Service does not anticipate any incidental take as a result of Forest Service operation of boating facilities, provided the Forest Service implements one of the reasonable and prudent alternatives intended to substantially minimize the likelihood of zebra mussel introduction at its marina, boat launches, and canoe access sites.

EFFECT OF THE TAKE

In the accompanying biological opinion, the Service determined that the level of take associated with the operation of Forest Service marinas, boat launches, and canoe access sites is not likely to result in jeopardy to the northern riffleshell when one of the reasonable and prudent alternatives is implemented. The Service has also determined that the levels of anticipated take associated with the implementation of other Forest Service activities are not likely to result in jeopardy to the bald eagle, Indiana bat, clubshell or northern riffleshell, or destruction or adverse modification of critical habitat.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the bald eagle, Indiana bat, clubshell mussel, and northern riffleshell mussel:

Bald Eagle

1. Bald eagle buffer zones and restrictions associated with those zones shall be implemented to ensure the protection of active nests and nesting eagles.

2. The Forest Service shall continue its efforts to identify bald eagle roosting areas on the ANF, and shall implement measures to protect such areas.

3. The Forest Service shall implement measures to reduce the likelihood of accidental take of bald eagles due to recreational activities.

4. The Forest Service shall further consult with the Fish and Wildlife Service on specific activities which may affect bald eagles.

Indiana Bat

1. Proposed management activities shall be planned, evaluated, and implemented consistent with measures developed to protect the Indiana bat including those recognized to maintain, improve, or enhance its habitat. These non-discretionary measures include, but are not limited to, current standards and guidelines found in the Allegheny National Forest Land and Resource Management Plan and amendments, and terms and conditions outlined in this opinion.

2. The Forest Service shall monitor timber sales and other activities on the ANF to determine if Forest Plan standards and guidelines, and the terms and conditions of this opinion are being implemented.

3. The Forest Service shall determine use of the ANF by Indiana bats during the hibernation, summer roosting, maternity, and pre-hibernation seasons.

Clubshell and Northern Riffleshell

1. Proposed management activities shall be planned, evaluated, and implemented consistent with measures developed to protect the clubshell and northern riffleshell including those recognized to maintain, improve, or enhance their habitat. These measures include, but are not limited to, implementing current standards and guidelines found in the Allegheny National Forest Land and Resource Management Plan and amendments, and terms and conditions outlined in this opinion.

2. Within the portion of the ANF that drains into the Allegheny River, the Forest Service will

monitor timber sales, oil and gas activity, and other activities that could possibly degrade water quality to determine if these measures are being implemented and if water quality degradation occurs.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the Act, the Forest Service must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. Many of the items below were proposed by the Forest Service for inclusion as terms and conditions in this opinion (BA, pp. 75-79).

Bald Eagle

1. To minimize the likelihood of take of nesting eagles, the following buffer zones and time-of-year restrictions shall apply to bald eagle nests, including those abandoned for 3 years.

    a. Year-round, all activities that may disturb eagles or significantly alter habitat, including, but not limited to, timber harvesting; land clearing; federal oil and gas development; road construction and operation; and trail construction and operation; shall be prohibited within a zone extending at least 660 feet from the nest (except when implemented in compliance with Term and Condition 4a, below). This prohibition does not apply to the implementation of measures which are necessary to protect or monitor the nest.

    b. From January 15 to July 31 of each year, people and aircraft should not be allowed within 660 feet of the nest. This distance should be increased if topography and/or vegetation permit a direct line-of-sight from the nest to potential activities. This prohibition does not apply to qualified persons conducting necessary eagle research and management.

    c. From August 1 to January 14 of each year, hunting, fishing, and other recreational activities are allowable within 660 feet of the nest; however, these activities should be restricted within 330 feet of the nest.

2. To minimize the likelihood of take of roosting bald eagles, the Forest Service shall continue its efforts to identify and protect bald eagle roosting areas on the ANF. Activities that may result in the take of roosting eagles or degradation of roosting habitat shall be restricted within 0.25 mile (1,320 feet) of identified roosting sites (except when implemented in compliance with Term and Condition 4a, below).

3. The Forest Service shall implement measures to reduce the likelihood of bald eagle death or injury due to hunting and fishing-associated activities.

    a. Discarded fishing line and lures shall be cleaned up monthly from May through September at developed fishing access sites on and near the Allegheny Reservoir.

b. Signs and/or news releases shall be displayed or distributed to educate hunters not to shoot eagles.

4. Ongoing and proposed activities which could potentially affect bald eagles, and are therefore subject to further consultation, include the following:

a. Activities within a 0.5-mile radius of bald eagle nests (including those abandoned 3 years), and activities within a 0.25-mile radius of identified bald eagle roosting areas. Such activities include, but are not limited to: timber harvesting; road construction, maintenance and operation; trail construction, maintenance and operation; aerial application of herbicides or pesticides; federal oil and gas development; and construction and operation of boat launches.

b. The proposed installation and operation of any new access sites (e.g., recreational, boating) within the Allegheny Wild and Scenic River corridor. Bald eagle use of habitat within one mile of each proposed access site shall be assessed, and the potential direct and indirect effects of the access site on the eagle(s) evaluated.

c. Recreational use of the Allegheny Reservoir. Determine the levels of activity (particularly boating-associated activity) on and near the Allegheny Reservoir and the effects on nesting and foraging bald eagles (particularly the Cornplanter and Kinzua nests). If any adverse effects are noted or suspected, remedial actions shall be implemented by the Forest Service, the Fish and Wildlife Service will be contacted, and further consultation will be required to determine if recreational access should be restricted.

Indiana Bat

1. Timber harvesting and other management activities shall be implemented in accordance with Forest Plan standards and guidelines, and the terms and conditions of this opinion. In addition to Forest Plan standards and guidelines, the following terms and conditions apply to timber management on the ANF:

    a. Retain all shagbark and shellbark hickories (live, dead, and dying), regardless of size, in partial and final harvest cutting units (green and salvage units).

    b. For both partial and final harvests in green units (harvested material consists primarily of live, healthy trees) retain all snags. Retain at least 8-15 live trees 9 inches d.b.h. per acre in final harvest units, and at least 16 live trees 9 inches d.b.h. per acre in partial harvest units.

    c. For both partial and final harvests in salvage units (dead or dying trees make up 50 percent or more of the harvested volume), and clearcuts, retain at least 5-10 snags 9 inches d.b.h. per acre, and of these one snag 16 inches d.b.h. per two acres. Also retain at least 16 live trees 9 inches d.b.h. per acre, and 3 live trees 20 inches d.b.h. per acre in partial harvest units; and retain at least 8-15 live trees 9 inches d.b.h. per acre, and 1 live tree 20 inches d.b.h. per acre in final harvest units and clearcuts.

    d. For partial/intermediate harvests (e.g., thinnings, shelterwood seed/prep, selection cuts) in healthy stands (stands where volume being removed is predominantly healthy, living trees), reduce canopy closure to 54 percent.

    e. Designate and retain living residual trees in the vicinity of about 1/3 of all large diameter (12 inches d.b.h.) snags with exfoliating bark to provide them with partial shade in summer.

    f. Live residual trees to be retained under these terms and conditions shall, where available, be Class 1 or Class 2 trees (as identified by Romme *et al.* 1995), or other trees exhibiting or likely to develop characteristics preferred by Indiana bats (e.g., exfoliating bark).

2. In order to minimize incidental take of roosting bats, all known roost trees on the ANF will be protected until such time as they no longer serve as a roost (e.g., loss of exfoliating bark or cavities, blown down, or decay). In the event that it becomes absolutely necessary to remove a known Indiana bat roost tree, such a removal will be conducted through consultation with the Service, during the time period when the bats are likely to be in hibernation (November 15 through March 31). Trees identified as immediate threats to public safety may, however, be removed at any time following consultation with the Fish and Wildlife Service. Such removal, however, will be as a last resort, after other alternatives (such as fencing the area, etc.) have been considered and deemed unacceptable.

3. Activities within a 1.5 mile radius of Indiana bat maternity sites shall be subject to further consultation. Such activities include those which may affect the Indiana bat or alter its habitat (e.g., by removing potential roost trees or altering percent canopy closure), such as timber harvesting, road construction, trail construction, and federal oil and gas development. In addition, if an Indiana bat maternity site is found on ANF, the Forest Service shall consult with the Fish and Wildlife Service to determine/develop standards and guidelines and/or a conservation plan to protect and manage the site.

4. Monitoring of timber sales and other activities will be implemented as follows:

   a. Timber sale administrators or biologists will conduct and report the results of inspections of all timber sales on the ANF to ensure that terms and conditions related to timber harvesting have been implemented. Timber sale administrators will conduct inspections of all timber sales to administer provisions for protecting residual trees. (Residual trees are those trees not designated for cutting under provisions of the timber sale contract.) Damage to residual trees will be documented in inspection reports and proper contractual or legal remedies will be sought. The ANF will include this information in their annual monitoring reports. The ANF will make these reports available to the Fish and Wildlife Service, if requested.

   b. Monitor percent canopy closure pre- and post-harvest, and the number of residual trees (i.e., snags, den trees, and live trees) per acre remaining on at least 10 final harvest units and 10 partial harvest units per year (including some green units and some salvage units) and report these data to the Fish and Wildlife Service. These data shall be collected within 3-6 months following harvest, and shall be reported to the Fish and Wildlife Service within 3 months of collection.

   c. Determine the longevity of snags, den trees, shagbark hickories (live and dead), and other live residual trees remaining within 10 final and 10 partial harvest units (including both green and salvage units) by monitoring the number of each remaining per acre at intervals of 1, 3, 5, 7, and 10 years post-harvest. For the purposes of this monitoring study, the same harvest units shall be monitored during each time interval. These data shall be reported to the Fish and Wildlife Service within 3 months of collection.

5. The Forest Service will continue its efforts to determine use of the ANF by Indiana bats during the hibernation, summer roosting/maternity, and pre-hibernation seasons by implementing the following monitoring procedures. Selection of sites for future monitoring and surveys will be left to the discretion of the ANF biologists. The Service believes that implementation of the following terms and conditions is necessary to evaluate the underlying assumptions made about Indiana bat presence and use of the ANF. Implementation of these terms and conditions will, in turn, provide a more site-specific measure of the protective adequacy of Forest Plan standards and guidelines and the terms and conditions of this opinion for the Indiana bat on the ANF.

a. Hibernacula. Continue working with universities, the Pennsylvania Game Commission, and local forest users to locate and survey caves that may contain Indiana bats. If Indiana bats are present, surveys shall continue biennially following the protocol of the Indiana Bat Recovery Team. After any gating of a hibernaculum, yearly surveys shall be conducted to determine the effects of the gate(s) on all bat species. This effort will be conducted for the first three years and then continue with the biennial monitoring recommended by the Indiana bat Recovery Team. In addition, if an Indiana bat hibernaculum is found on the ANF, consult with the Fish and Wildlife Service to determine standards and guidelines necessary to protect and manage the hibernaculum.

b. Continue survey efforts to determine the extent of use of the ANF by Indiana bats; such surveys should include the employment of techniques to determine the distribution of the species on the National Forest, habitat use and movements of Indiana bats during the spring-fall periods, etc. Comparative evaluations of the effectiveness of mist net surveys and Anabat Detectors are strongly encouraged. If any Indiana bats (male or female) are netted, we recommend tracking them using radio-telemetry to identify and characterize roost trees and foraging habitat. These habitat parameters will be used to develop management strategies for the protection, maintenance, and promotion of foraging areas.

c. Conduct surveys to identify if and where Indiana bat maternity sites are located on the ANF. Surveys efforts should be focused on those areas which, based on habitat characteristics (e.g., percent canopy closure, presence of suitable roost trees, proximity to water, etc.) and/or previous survey results (e.g., Anabat detection), appear to be conducive to maternity colonies. Surveys should be done using the latest Fish and Wildlife Service-approved survey protocol and qualified surveyors. If any Indiana bats are netted, they should be tracked using radio-telemetry to identify roost trees and foraging habitat. The habitat at identified maternity sites will be characterized and quantified, and these habitat data will then be used to assist in identifying additional sites. Survey results shall be reported to the Fish and Wildlife Service.

   Some of these surveys shall be conducted in proposed timber harvest areas, especially in those areas where canopy closure will be reduced to <54 percent (e.g., final harvests such as clearcuts and shelterwood removal cuts). This is consistent with the Forest Service's requirement to "assess the occurrence of animal and plant species in all areas to be affected by land adjustment or resource management activities, and design action to avoid, minimize, or mitigate potential adverse effects" (Forest Plan, p. 4-37). The documented presence of Indiana bats within a project area shall subject that project to further consultation with the Fish and Wildlife Service.

d. Habitat at all sites where Indiana bats are documented on the ANF should be characterized and quantified at both local and landscape levels using GIS and other

advanced computer software.

e. Upon completion of each survey, provide the results (within six months of survey/ study completion) to the Fish and Wildlife Service's State College, Pennsylvania Ecological Services Field Office.

f. The amount of incidental take (both total and categorical levels, as measured indirectly by acreage) as identified in this opinion must be monitored on an annual basis. This information is to be provided to the Fish and Wildlife Service's State College, Pennsylvania Ecological Services Field Office no later than six months following the end of the previous year's activities.

6. The ANF will consult with the Service on any plans to use *B.t.* to control gypsy moth or other forest pest insects. Reduction in non-target lepidopteran abundance will be considered when developing spraying plans, especially when determining the size and configuration of spray blocks.

Clubshell and Northern Riffleshell

1. Consult with the Fish and Wildlife Service regarding the proposed installation and operation of any new access sites (e.g., recreational, boating) to be authorized, funded, or constructed by the Forest Service on the Allegheny River. Clubshell and northern riffleshell use of habitat in the vicinity of such access sites shall be assessed, and the potential effects of the access site on the mussels shall be evaluated.

2. A potential threat to the clubshell and northern riffleshell is water pollution from activities that may be occurring or will occur on the Forest. Because the pollutants that may effect endangered mussels are similar in nature, but the result of a number of different activities, the logical way to monitor and minimize the effects of the these activities is to assess specific projects or types of projects, monitor water quality of tributaries to the Allegheny River, and remediate suspected causes of sedimentation through implementation of the terms and conditions below. Efforts should be focused on erosion and sedimentation problems occurring, or likely to occur, within the 13 percent of the ANF that drains directly into the Allegheny River.

   a. Existing trails shall be surveyed to determine which trails or trail segments are contributing sediment to perennial or intermittent streams. Appropriate erosion and sedimentation controls shall be implemented to correct identified problem areas. A progress report shall be submitted to the Fish and Wildlife Service annually.

   b. Existing roads shall be surveyed to determine which road segments are contributing sediment to perennial or intermittent streams. Appropriate erosion and sedimentation controls (as identified in the BA, p. 77) shall be implemented to correct identified problem areas. A progress report shall be submitted to the Fish and Wildlife Service annually.

c. Tree harvesting/removal activities shall continue to be monitored to ensure that standards and guidelines are in fact implemented and do in fact result in only insignificant amounts of transported sediment compared to areas where no earth disturbance takes place.

d. Oil and gas development activities (including individual Pollution Prevention and Spill Response Plans) shall continue to be monitored to ensure that guidelines for federally-owned leases are adhered to, and guidelines for privately-owned rights are adhered to. Appropriate action (e.g., reporting known or suspected violations to the Environmental Protection Agency and/or the Pennsylvania Department of Environmental Protection) will be taken when guidelines are not followed.

e. The Forest Plan shall be revised to state that the standards and guidelines intended to protect water quality are mandatory and minimum requirements that are enforceable by the Forest Service. At a minimum, these standards and guidelines must be equivalent to State guidelines applicable in High Quality and Exceptional Value watersheds, and should reflect the best available measures for controlling erosion and sedimentation.

f. Water quality monitoring stations (i.e., locations) shall be established on several tributaries to the Allegheny River immediately before those tributaries empty into the Allegheny River, with emphasis on determining sediment budgets for watersheds with varying degrees of activities. The design of the study and placement of the stations should be coordinated with the Fish and Wildlife Service.

<u>All Federally listed Species</u>

1. Care must be taken in handling dead specimens of listed species that are found in the project area to preserve biological material in the best possible state. In conjunction with the preservation of any dead specimens, the finder has the responsibility to ensure that evidence intrinsic to determining the cause of death of the specimen is not unnecessarily disturbed. The finding of dead specimens does not imply enforcement proceedings pursuant to the ESA. The reporting of dead specimens is required to enable the Service to determine if take is reached or exceeded and to ensure that the terms and conditions are appropriate and effective. Upon locating a dead, injured, or sick specimen of an endangered or threatened species, prompt notification must be made to the Fish and Wildlife Service's Region 5 Division of Law Enforcement, 300 Westgate Center Drive, Hadley, Massachusetts 01035-9589 (telephone: 413-253-8343).

2. When reviewing an operating plan for the development of private oil and gas rights on the ANF, the Forest Service will inform the operator of any federally listed species known or likely to be present within the project area. If federally listed species are known or likely to occur within the project area, the Forest Service shall, in cooperation with the Fish and Wildlife Service, work with the developer to avoid or minimize potential adverse effects

to federally listed species.

3. The Forest Service, as steward of the surface rights on the ANF, shall periodically monitor private oil and gas developments (abandoned and active) on the ANF to determine whether or not pollutants (e.g., oil, gas, brine, sediment, etc.) are being properly contained to avoid contamination of the soil, water or air. If any contamination is detected, suspected, or likely to occur, the Forest Service shall work with the developer who will remediate the situation; and/or report the incident to the appropriate federal and State authorities (i.e., Environmental Protection Agency, Pennsylvania Department of Environmental Protection). Any known or suspected take of federally listed species resulting from such activities shall be immediately reported to the Fish and Wildlife Service.

The Service believes that: 1) no more than one bald eagle annually, 2) an indeterminate number of Indiana bats (as measured indirectly by the acreages presented in Table 6), and 3) an indeterminate number of clubshell and northern riffleshell mussels will be incidentally taken as a result of the proposed action. The reasonable and prudent measures, with their implementing terms and conditions, are designed to minimize the impact of incidental take that might otherwise result from the proposed action. If, during the course of the action, this level of incidental take is exceeded, such incidental take represents new information requiring reinitiation of consultation and review of the reasonable and prudent measures provided. The federal agency must immediately provide an explanation of the causes of the taking, and review with the Service the need for possible modification of the reasonable and prudent measures.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Endangered Species Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Bald Eagle

1. In cooperation with the Pennsylvania Game Commission (PGC), install predator guards on bald eagle nest trees.

2. In cooperation with the Pennsylvania Game Commission, monitor known eagle nests and search for new ones. Provide monitoring data to the Fish and Wildlife Service annually, at the end of each breeding season. Notify the Fish and Wildlife Service and Pennsylvania Game Commission of the presence of any new eagle nests or failure of existing nests upon discovery.

3. In order to assist the Service and the Pennsylvania Game Commission in monitoring the status of the bald eagle on the ANF during the five years following delisting according to requirements outlined in the ESA, monitor the numbers and reproductive success of

nesting and wintering bald eagles using the ANF and report the results of such surveys to the Service's State College, Pennsylvania Ecological Services Field Office and to the PGC.

Indiana Bat

1. Follow interagency working group and/or Recovery Plan recommendations for inventory and monitoring Indiana bat habitat and populations across the forest.

2. Pursue additional funding and partnership opportunities to complete needed inventory and monitoring work.

3. Where opportunities exist, work with landowners, general public, and other agencies to promote education and information about endangered bats and their conservation.

4. The ANF hosts many visitors each year; therefore, the Service encourages the installation of informational/educational displays regarding all bats occurring on the ANF. The Service believes that such information would be invaluable in informing the public about the value of this misunderstood group of mammals. We also encourage the Forest Service to develop an educational slide program on the status of the Indiana bat and threats to its existence.

5. Provide training for appropriate ANF employees on bats (including Indiana bat) occurring on the ANF. Training should include sections on bat identification, biology, habitat requirements, and sampling techniques (including instructions on applicability and effectiveness of using mist net surveys vs. Anabat detectors to accurately determine the presence of various bat species). The proper training of ANF biologists on bat identification and reliable methods for counting roosting bats will enable the Forest Service to monitor the status of this species.

6. Demolition or removal of buildings or other man-made structures that harbor bats should occur while bats are hibernating. If public safety is threatened and the building must be removed while bats are present, a bat expert should examine the building to determine if Indiana bats are present.

Clubshell and Northern Riffleshell

1. Cooperate with the Service, Pennsylvania Fish and Boat Commission, and others to conduct mussel surveys of the Allegheny River and its tributaries to further knowledge about the distribution and status of the clubshell and northern riffleshell.

2. Design (in coordination with the Fish and Wildlife Service), produce, and install an educational display about the aquatic resources (including endangered mussels) of the Allegheny River and threats to their existence, at the Forest Service's Buckaloons boat launch on the Allegheny River.

3. Continue to assess various standards and guidelines to determine their effectiveness in minimizing nonpoint source pollution. Periodically revise and update Forest Plan standards and guidelines to reflect the best available measures for controlling erosion and sedimentation.

4. Encourage and work with other federal, state and private entities operating boat launches and marinas on the Allegheny Reservoir and Allegheny River to develop and implement education, outreach, and decontamination procedures and facilities to reduce the likelihood of zebra mussel introduction.

All Federally Listed Species

1. Secure subsurface rights (e.g., mineral, oil and gas rights) within areas on the ANF identified as important endangered and threatened species habitats.

In order for the Fish and Wildlife Service to be kept informed of actions minimizing or avoiding adverse effects, or benefitting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION NOTICE

This concludes formal consultation on the actions outlined in the Forest Service's December 17, 1998, initiation request. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary federal agency involvement or control over the action has been retained (or is authorized by law), and if: 1) the amount or extent of incidental take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

APPLICABILITY OF BIOLOGICAL OPINION TO SITE-SPECIFIC PROJECTS

The Service believes that the scope of effects for specific ongoing projects and projects developed through the continued implementation of the Forest Plan on the ANF falls under the umbrella of this consultation for the following reasons:

1. The terms and conditions associated with the reasonable and prudent measures outlined in this opinion will minimize the impact of the incidental take identified for the bald eagle, Indiana bat, clubshell and northern riffleshell on both a programmatic and site-specific level; accordingly the protective measures outlined herein for the entire ANF are applicable to individual ongoing projects and projects yet to be identified.

2. If after complying with the Forest Plan's standards and guidelines and the terms and conditions associated with the reasonable and prudent measures provided in this opinion,

the Forest Service determines that activities on a project level are likely to adversely affect the bald eagle, Indiana bat, clubshell or northern riffleshell in a manner or to an extent not considered or evaluated in the Biological Assessment and this opinion, further consultation will be necessary.

3. Any individual project that results or would result in incidental take that exceeds the level identified in this opinion would require the reinitiation of formal consultation.

4. The Forest Service will continue to conduct site-specific project analyses to ensure that each individual action follows recommendations set forth in this opinion.

5. The Service will review site-specific projects, as appropriate, to ensure that there is strict adherence to the terms and conditions associated with the reasonable and prudent measures outlined in this opinion and that incidental take levels identified in this opinion are not exceeded.

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Ronald E. Lambertson
Regional Director

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