ENDANGERED FRESHWATER FISHES OF THE SOUTHEASTERN UNITED STATES

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Abstract: Endangered native freshwater fishes are catalogued for 16 southeastern states. The status of each of the 356 species is included at the national, regional, or state levels. A standardized list of categories (endangered; threatened; special concern - national; special concern - state; extirpated) and definitions are suggested for use in state programs. Further recommendations are made to base programs on the state level on sound and manageable endangered species checklists.

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While the importance of all fish and wildlife species was recognized by early American naturalists, virtually all emphasis was shifted to game and commercial species as the professions of wildlife and fisheries biology became formalized and institutionalized during the twentieth century. However, interest in endangered species blossomed in the late 1960's in association with the environmental movement. Evaluation and inventory of endangered, threatened, and special concern species (hereafter termed "endangered" unless otherwise specified) by committees established within scientific societies, conservation groups, and state and federal government agencies resulted in a plethora of national, regional, and state endangered species checklists. The purpose of our paper is to review and compile all lists of endangered fishes in the Southeast and to formulate guidelines for state endangered species checklists.

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METHODS

For purposes of this report, the Southeast was defined as the 16 member states (Alabama, Arkansas, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, Missouri, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, and West Virginia) of the Southeastern Association of Fish and Wildlife Agencies. Only freshwater, anadromous, or catadromous species were considered with the exception of euryhaline species that penetrate upstream into the interior states (e.g. *Mugil cephalus*, striped mullet) or are recognized in national or regional lists (e.g. *Menidia conchorum*, Key silverside). The arrangement of families and the usage of scientific and common names followed Bailey et al. (1970), with the exception of undescribed forms or species described, redesignated, or resurrected since 1970.

Questionnaires were sent to each southeastern state fish and game agency for information on fishes officially recognized as endangered at the state level. Where necessary, follow-up correspondence or telephone calls were made. Each state fish and

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game agency protects many species but we included only those designated as endangered through legislative act or specific agency proclamation prior to April, 1978. Game species subject only to possession, gear and size limits, all-inclusive lists of species covered under a blanket protection policy, or species recognized only because of compliance with federal statutes, were not included.

National, regional, and unofficial state (i.e., those not sanctioned by state agencies) lists of endangered species were located through a review of the literature and through consultation with other biologists. The American Fisheries Society list was recommended in the final report of the Endangered Species Committee. Species proposed by the U.S. Fish and Wildlife Service prior to April, 1978 also were included in our listing.

RESULTS

All southeastern fishes considered endangered by various agencies, committees, and individuals are listed in Table 1. With each species is presented a notation of its status nationally (U.S. Fish and Wildlife Service, American Fisheries Society), regionally (Hillestad et al. in press), and on the state level (various authorities), where applicable. A total of 356 separate species was included on at least 1 national, regional, or state listing.

Table 1. Checklist of endangered fish in the Southeast. [FWS = U.S. Fish and Wildlife Service; *proposed FWS species; AFS = American Fisheries Society; SEW = Southeastern Workshop on Endangered and Threatened Species (Hillestad et al., in press) AL = Alabama; AR = Arkansas; FL = Florida; GA = Georgia; KY = Kentucky; LA = Louisiana; MD = Maryland; MS = Mississippi; MO = Missouri; NC = North Carolina; OK = Oklahoma; SC = South Carolina; TN = Tennessee; TX = Texas; VA = Virginia; WV = West Virginia; X = extinct of extirpated; E = endangered; T = threatened; R = rare; L = limited; S = special concern; D = depleted; V = vulnerable; N = protected nongame; U = undetermined; I = indeterminate; M = in need of management; P = peripheral; 1 = Ramsey (1976); 2 = Robison (1974); 3 = Buchanan (1974); 4 = Gilbert and Committee (1978); 5 = Fla. Game and Fresh Water Fish Comm.; 6 = Ga. Dept. Nat. Res.; 7 = McCollum (1974); 8 = Ky. Dept. Fish and Wildl. Res.; 9 = Babcock (1977); 10 = Miller (1972); 11 = Md. Dept. Nat. Res.; 12 = Lee (in press); 13 = Miss. Game and Fish Comm.; 14 = Clemmer et al. (1974); 15 = Miss. Nat. Heritage Prog.; 16 = Mo. Dept. Cons.; 17 = Bailey and Committee (1977); 18 = Schwartz et al. (1977); 19 = N. Car. Wildl. Res. Comm.; 20 = Robison et al. (1974); 21 = Hubbs and Pigg (1976); 22 = S. Car. Wildl. and Res. Dept.; 23 ⩾ Loyacano and Gilbert (in press); 24 = Tenn. Game and Fish Comm.; 25 = Anonymous (1976); 26 = Hubbs (1976); 27 = Tex. Parks and Wildl. Dept.; 28 = Jenkins (in press); 29 = proposed West Virginia list].

PETROMYZONTIDAE

Ichthyomyzon bdellium: VA - S(28); WV - U(29); *I. castaneus*: AR - (3); KY - I(9); MS - U(14), S(15); TX - P(26); *I. fossor*: KY - I(9); *I. gagei*: Ar - U(3); MO - R(16); OK - I(21); TN - M(24); *I. greeleyi*: KY - I(9); WV - U(29); *I. hubbsi*: GA - R(7); *I. unicuspis*: KY - I(9); MS - P/R(14), R(15); TN - M(24); WV - U(29); *Lampetra aepyptera*: AR - R(2); NC - S(17); *L. lamottei*: AL - E(1); AR - R(2), V(3); KY - I(9); MO - R(16); *Petromyzon marinus*: FL - R(4).

ACIPENSERIDAE

Acipenser brevirostrum: E(FWS); E(AFS); E(SEW); FL - E(4,5); GA - E(6), U(7); MD - E(11), E or X(12); NC - X(18,19), E(19); SC - E(22,23); VA - E(28); *A. fulvescens*: T(AFS); AL - X(1); AR - R(2), E(3); GA - U(7); KY - R/E(9); MS - P/U(14), P(15); MO - E(16); NC - X?(17); TN - E(24); WV - U(29); *A. oxyrhynchus*: AL - T(1); FL - T(4,5); GA - U(7);

(Table 1. continued)

MS - E(13,14,15); NC - S(17), D(18); SC - T(23); VA - T(28); *Scaphirhynchus albus*: T(AFS); AR - R(2), E(3); KY - R(9); LA - R(10); MS - P(15); MO - E(16); TN - M(24); *S. platorynchus*: T(AFS); AR - E(3); KY - D(9); OK - R/E(20), R(21); TX - T(25), D(26), E(27); WV - U(29); *S.* sp. (Tombigbee sturgeon): E(AFS); E(SEW); AL - E(1); MS - E(13,14,15).

POLYDONTIDAE

Polydon spathula: T(AFS); AR - E(3); MS - U(14), S(15); NC - E(17); OK - I(21); TX - T(25), D(26); E(27); VA - S(28); WV - U(29).

LEPISOSTEIDAE

Atractosteus spatula: AR - E(3); KY - D(9); MO - R(16); OK - I(21); TN - M(24); *Lepisosteus oculatus*: KY - I(9).

AMIIDAE

Amia calva: OK - I(21).

ANGUILLIDAE

Anguilla rostrata: KY - D(9); OK - I(21); TN - M(24).

CLUPEIDAE

Alosa aestivalis: NC - D(17); SC - S(23); *A. alabamae*: GA - U(7); KY - I(9); MO - R(16); OK - R(20); D(21); TN - M(24); *Alosa chrysochloris*: OK - I(21); TX - L(26); *A. mediocris*: SC - S(23); *A. pseudoharengus*: NC - D(18); *A. sapidissima*: NC - D(18); SC - S(23).

HIODONTIDAE

Hiodon alosoides: AR - R(2); MS - P/U(14), P(15); OK - I(20,21); TX - P(26); WV - U(29); *H. tergisus*: GA - R(7); NC - E(17); OK - R(20), D(21); WV - U(29).

SALMONIDAE

Salvelinus fontinalis: SC - S(23).

UMBRIDAE

Umbra limi: AR - R(2), V(3); KY - I(9); *U. pygmaea*: FL - R(4).

ESOCIDAE

Esox americanus: OK - I(21); WV - U(29); *E. masquinongy*: KY - D(9); NC - X?(17); TN - E(24); *E. niger*: OK - I(20,21); TX - P(26).

CYPRINIDAE

Campostoma anomalum: LA - R(10); SC - P(23); *C. ornatum*: S(AFS); TX - P(25), P/D(26), N(27); *Clinostomus elongatus*: KY - I(9); WV - U(29); *C. funduloides*: KY - I(9); MS - P/U(14), P(15); *Dionda diaboli*: T* (FWS); T(AFS); TX - T(25), R/D(26), N(27); *Ericymba buccata*: TN - T(24); *Exoglossum laurae*: NC - S(17); WV - U(29); *E. maxillingua*: NC - S(17); WV - U(29); *Gila pandora*: TX - R(26), N(27); *Hemitremia flammea*: AL - S(1); GA - T(7); TN - M(24); *Hybognathus hayi*: AR - U(3); FL - T(4,5); KY - I(9); MO - X?(16); TX - P(26); *H. placitus*: AR - V(3); TN - M(24); *Hybopsis aestivalis*: FL - T(4,5); *H. amblops*: OK - R(20), D(21); *H. cahni*: T(FWS); T(AFS); T(SEW); TN - T(24); *H. dissimilis*: AL - X(1); VA - S(28); *H. gelida*: MS - P/U(14), P(15); MO - R(16); TN - M(24); *H. gracilis*: AR - R(2), V(3); KY - I(9); MS - P/U(14), P(15); OK - I(20); TX - P(26); WV - U(29); *H. hypsinotus*: VA - S(28); *H. insignis*: AL - S(1); GA - R(7); KY - I(9); VA - S(28); *H. labrosa*: VA - S(28); *H. lineapunctata*: TN - M(24); *H meeki*: MS - P/U(14), P(15); MO - R(16); TN - M(24); *H. monacha*: T(FWS); T(AFS); T(SEW); AL - X(1); GA - U(7); NC - E/X?(17); TN - E(24); VA - E(28); *H. rubrifrons*: NC - S(17); *H. x-punctata*: OK - I(21); *H.* sp. (thinlip chub): NC - S(17); SC - T(23); *H. sp: NC-S(17); Nocomis asper*: OK - I(21); *N. biguttatus*: KY - R(9); *N. leptocephalus interocularis*: NC - S(17) *N. micropogon*: SC - P(23); *N. platyrhynchus*: NC - S(17); WV -

(Table 1. continued)

U(29); *Notropis alborus*: VA - U(28); *N. amnis*: AR - U(3); KY - I(9); MO - X?(16); OK - R(20), D(21); *N. ardens*: MS - P/U(14); P(15); *N. ariommus*: AL - X(1); GA - U(7); KY - D(9); VA - S(28); WV - U(29); *N. atherinoides*: VA - S(28); *N. atrocaudalis*: AR - R/E(2), V(3); LA - R(10); OK - R(20), D(21); *N. bairdi*: AR - R(2); V(3); *N. bifrenatus*: NC - E/X?(17); *N. blennius*: KY - D(9); OK-R(20), D(21); WV - U(29); *N. boops*: AL - S(1); LA - R(10); MS - P/U(14), P(15); *N. buchanani*: WV - U(29); *N. caeruleus*: AL - S(1); GA - R(7); *N. callistius*: MS - P/U(14), P(15); *N. callitaenia*: T(AFS); T(SEW); AL - S(1); FL - T(4,5); GA - T(7); *N. camurus*: AR - R(2), V(3); LA - R(10); OK - R(20), D(21); *N. chalybaeus*: AR - R(2), V(3); MS - P/U(14), P(15); OK - R/E(20), R(21); TX - P(26); *N. chihuaha*: TX - P(25,26), N(27); *N. chiliticus*: SC - P(23); *N. chrysocephalus*: OK - I(21); *N. coccogenis*: AL - S(1); KY - I(9); SC - P(23); *N. cummingsae*: AL - S(1); FL - S(4); *N. dorsalis*: TN - M(24); WV - U(29); *N. emiliae*: MO - E(16); OK - I(21); *N. euryzonus*: AL - S(1); GA - T(7); *N. fumeus*: KY - I(9); OK - I(21); *N. galacturus*: SC - P(23); WV - U(29); *N. girardi*: AR - R(2), V(3); TX - P(26); *N. heterolepis*: S(SEW); KY - I(9); MO - E(16); TN - M(24); *N. leedsi*: FL - R(4); *N. leuciodus*: SC - P(23); *N. lutrensis*: KY - I(9); *N. maculatus*: AR - R(2), V(3); KY - R(9); MO - E(16); OK - R(20), D(21); TX - P(26); *N. mekistocholas*: S(AFS); T(SEW); NC - S(17); *N. ortenburgeri*: AR - R(2), E(3); OK - R(20), D(21); TX - R(26), N(27); *N. perpallidus*: T(AFS); T(SEW); AR - R(2), E(3); OK - R(20), D(21); *N. petersoni*: MS - P/U(14), P(15); *N. potteri*: AR - V(3); MS - P/U(14), P(15); NC - S(17); TN - M(24); *N. sabinae*: AR - V(3); MO - R(16); TX - L(26); *N. scabriceps*: NC - S(17); WV - U(29); *N. semperasper*: T(AFS); VA - S(28); *N. shumardi*: KY - I(9); *N. simus*: E*(FWS); E(AFS); TX - P(25), E(26,27); *N. spectrunculus*: SC - P(23); *N. spilopterus*: AR - R(2), V(3); MS - P/U(14), P(15); OK - R(20), D(21); *N. stramineus*: AL - X(1); VA - S(28); *N. telescopus*: GA - U(7); KY - I(9); *N. venustus*: KY - I/P(9); *N. welaka*: FL - S(4); GA - R(7); LA - R(10); MS - R(14,15); *N. whipplei*: LA - R(10); MS - P/U(14), P(15); VA - S(28); *N. zonistius*: FL - R(4); GA - U(7); *N.* sp. (Pond Creek shiner): T(SEW); FL - T(4); *N.* sp. (Ouachita Mountain shiner): AR - V(3); *N.* sp. (silver shiner): MS - P/U(14), P(15); *N.* sp. (Cahaba shiner): E*(FWS); E(AFS); E(SEW); AL - E(1); *N.* sp. (sawfin shiner): AL - S(1); *N.* sp. (palezone shiner): T(AFS); T(SEW); TN - M(24); *Phenacobius crassilabrum*: GA - R(7); VA - S(28); *P. mirabilis*: AR - R(2), V(3); LA - R(10); MS - P/U(14), P(15); TX - L(26); WV - U(29); *P. teretulus*: T(AFS); NC - T(17); WV - U(29); *P. uranops*: AL - S(1); KY - I(9); *Phoxinus erythrogaster*: AL - S(1); MS - E(13,15), P/E(14); OK - I(21); WV - U(29); *P. oreas*: WV - U(29); *P.* sp. (blackside dace): T(SEW); TN - M(24); *Pimephales notatus*: LA - R(10); NC - S(17); *P. tenellus parviceps*: MO - R(16); *P. vigilax*: WV - U(29); *Rhinichthys atratulus*: MS - P/U(14), P(15); *R. cataractae*: OK - I(21); TX - L(26); *Semotilus atromaculatus*: OK - I(21); *S. lumbee*: NC - S(17); SC - T(23); *S. margarita*: VA - S(28); WV - U(29).

CATOSTOMIDAE

Carpoides carpio: NC - S(17); *C. velifer*: KY - I(9); OK - R(20), R(21); TN - M(24); *Catostomus catostomus*: S(SEW); MD - T(12); WV - U(29); *C. commersoni*: AR - V(3); OK - I(21); *Cycleptus elongatus*: AL - T(1); AR - R(2), U(3); GA - U(7); KY - I(9); OK - R(20), D(21); MS - U(14), S(15); TN - T(24); TX - D(26), N(27); WV -U(29); *Erimyzon oblongus*: TX - D(26); *E. sucetta*: AR - R(2), U(3); MO - R(16); *Hypentelium nigricans*: OK - I(21); *H. roanokense*: NC - S(17); *Ictiobus cyprinellus*: KY - I(9); *I. niger*: MS - P/U(14), P(15); *Lagochila lacera*: AL - X(1); AR - X(2,3); KY - X(9); TN - M(24); VA - X(28); *Moxostoma anisurum*: AR - R(2), V(3); *M. ariommum*: NC - S(17); *M. atripinne*: S(AFS); KY - R(9); TN - M(24); *M. carinatum*: FL - T(4,5); GA - R(7); LA - R(10); OK - I(21); VA - S(28); WV - U(29); *M. congestum*: TX - L(26); *M. duquesnei*: MD - E or X(12); MS - P/U(14), P(15); OK - I(21); WV - U(29); *M. erythrurum*: TX - P(26); *M. hamiltoni*: T(AFS); T(SEW); VA - S(28); *M. macrolepidotum*: AR - R(2); U(3); KY - I(9); MS - P/U(14), P(15); OK - R(20), D(21); *M. poecilurum*: AR - V(3); TX - L(26); *M. robustum*: VA - S(28); *M.* sp. (greyfin redhorse): FL - T(4,5).

(Table 1. continued)

ICTALURIDAE

Ictalurus brunneus: FL - R(4); *I. nebulosus*: MO - R(16); OK - R(20), D(21); *I. serracanthus*: FL - R(4); *Noturus baileyi*: S(SEW); TN - M(24); *N. elegans*: AL - S(1); *N. eleutherus*: GA - U(7); MO - R(16); NC - X(17); OK - R(20), D(21); *N. exilis*: MS - P/U(14), P(15); OK - I(21); *N. flavipinnis*: T(FWS); T(AFS); T(SEW); GA - U(7); TN - E(24); VA - T(28); *N. flavus*: T(SEW); AL - S(1); AR - R(2), V(3); MD - T(12); MS - P/R(14), R(15), OK - I(21); *N. funebris*: GA - R(7); *N. furiosus*: S(AFS); NC - S(17); *N. gilberti*: T*(FWS); T(AFS); T(SEW); NC - T(17); VA - T(28); *N. lachneri*: E*(FWS); T(AFS); T(SEW); AR - R/E(2), E(3); *N. miurus*: AL - S(1); OK - I(21); *N. munitus*: T(AFS); T(SEW); AL - E(1); MS - E(13,14,15); TN - T(24); *N. phaeus*: AR - R(2), V(3); KY - I/P(9); *N. placidus*: T(AFS); MO - E(16); OK - R(20), D(21); *N. stigmosus*: KY - I(9); MS - P/R(14), R(15); *N. taylori*: T(AFS); T(SEW); AR - R/E(2), E(3); *N.* sp. (broadtail madtom): T(SEW); NC - S(17); SC - T(23); *N.* sp. (Tennessee madtom): T(AFS); T(SEW); TN - T(24); *Satan eurystomus*: T(AFS); TX - T(25), R(26), N(27); *Trogloglanis pattersoni*: T(AFS); TX - T(25), R(26), N(27).

AMBLYOPSIDAE

Amblyopsis rosae: T(AFS); AR - R(2), E(3); MO - R(16); OK - R(20), I(21); *A. spelaea*: T(AFS); KY - I(9); *Chologster agassizi*: T(AFS); MO - E(16); *Speoplatyrhinus poulsoni*: T(FWS); E(AFS); T(SEW); AL - E(1); *Typhlichthys subterraneus*: AL - S(1); AR - R/E(2), V(3), GA - E(6,7); KY - I(9); OK - R(20), I(21); TN - M(24).

APHREDODERIDAE

Aphredoderus sayanus: KY - I(9); OK - I(21).

PERCOPSIDAE

Percopsis omiscomaycus: KY - R/E(8,9); MD - E or X(12); VA - X(28).

GADIDAE

Lota lota: KY - I(9); MO - R(16).

CYPRINODONTIDAE

Cyprinodon bovinus: T*(FWS); T(AFS); TX - T(25,26), E(27); *C. elegans*: E(FWS); E(AFS); TX - E(25,26,27); *C. eximius*: T(AFS); TX - P(25), P/D(26), N(27); *C. variegatus hubbsi*: FL - T(4,5); *Fundulus albolineatus*: E(AFS); AL - X(1); *F. catenatus*: GA - R(7); OK - I(21); *F. chrysotus*: KY - I/P(9); MO - X?(16); TN - M(24); *F. cingulatus*: AL - S(1); *F. dispar*: AR - U(3); KY - I/P(9); OK - I(21); *F. kansae*: MO - R(16); *F. sciadicus*: OK - R(20), D(21); *F. waccamensis*: E*(FWS); T(AFS); NC - E(17); *F.* sp. (Barrens topminnow): E*(FWS); TN - E(24); *Leptolucania ommata*: AL - S(1); MS - P/R(14), R(15); *Lucania goodei*: AL - S(1); GA - R(7); *Rivulus marmoratus*: FL - T(4,5).

POECILIIDAE

Gambusia amistadensis: E*(FWS); E(AFS); TX - E(25,26,27); *G. gagei*: E(FWS); E(AFS); TX - E(25,26,27); *G. georgei*: E(AFS); TX - E(25,26,27); *G. heterochir*: E(FWS); T(AFS); TX - T(25,26), E(27); *G. nobilis*: E(FWS); S(AFS); TX - T(25), R/D(26), E(27); *G. senilis*: TX - P(25,26), N(27).

ATHERINIDAE

Labidesthes sicculus: VA - S(28); *Menidia conchorum*: E(AFS); E(SEW); FL - E(4,5); *Menidia extensa*: E*(FWS); T(AFS); NC - E(17).

PERCICHTHYIDAE

Morone mississippiensis: OK - R(20); *M. saxatalis*: MS - P/R(14), R(15).

CENTRARCHIDAE

Acantharchus pomotis: FL - R(4); *Ambloplites cavifrons*: T(AFS); NC - S(17); VA - S(28); *A. rupestris*: OK - I(21); *Centrarchus macropterus*: KY - I(9); OK - I(21);

(Table 1. continued)

Enneacanthus chaetodon: FL - R(4); GA - R(7); VA - S(28); *E. gloriosus*: MS - P/U(14), P(15); *Elassoma zonatum*: KY - I/P(9); OK - I(21); *E.* sp. (spring pygmy sunfish): E*(FWS); E(AFS); E(SEW); AL - E(1); *E.* sp.: SC - S(23); *Lepomis gibbosus*: MO - R(16); *L. marginatus*: AR - U(3); OK - I(21); *L. punctatus*: KY - R(9); OK - I(21); TX - R(26); *Micropterus coosae*: NC - S(17); *M. dolomieui*: MS - P/U(14), P(15); OK - I(21); *M. notius*: FL - R(4); GA - U(7); *M. punctulatus*: NC - S(17); *M. treculi*: S(AFS); TX - T(25), D(26); *M.* sp. (shoal bass): S(AFS); T(SEW); AL - S(1); FL - T(4,5); GA - T(7).

PERCIDAE

Ammocrypta asprella: T(AFS); T(SEW); AL - T(1); AR - U(3); FL - T(4,5); KY - I(9); MS - E(13,14,15); OK - R(20), D(21); TN - M(24); *A. beani*: TN - M(24); *A. clara*: S(SEW); AR - U(3); MS - P/U(14), P(15); OK - I(21); TX - L(26), N(27); *A. pellucida*: T(AFS); T(SEW); KY - D(9); WV - U(29); *A. vivax*: KY - R(9); TN - M(24); *Etheostoma asprigene*: KY - R/E(8,9); OK - I(21); TX - P(26); *E. acuticeps*: T(AFS); T(SEW); NC - X(17); VA - E(28); *E. barbouri*: TN - M(24); *E. bellum*: TN - M(24); *E. blennius*: AL - S(1); *E. blennioides gutselli*: TN - M(24); *E. blennioides newmani*: MS - P/U(14), P(15); *E. boschungi*: T(FWS); T(AFS); T(SEW); AL - T(1); TN - T(24); *E. caeruleum*: LA - R(10); *E. camurum*: VA - S(28); *E. chlorobranchium*: VA - S(28); *E. cinereum*: AL - X(1); GA - R(7); KY - R(9); TN - M(24); VA - U(28); *E. collis*: NC - S(17); SC - T(23); VA - U(28); *E. cragini*: OK - R/E(20), R(21); *E. ditrema*: T(AFS); T(SEW); AL - T(1); GA - R(7); TN - T(24); *E. flabellare*: MS - P/U(14), P(15); OK - I(21); *E. fonticola*: E(FWS); E(AFS); TX - T(25,26), E(27); *E. fusiforme*: AR - R(2), V(3); OK - R/E(20), R(21); TX - P(26); *E. grahami*: TX - P(25), D(26), N(27); *E. histrio*: FL - T(4,5); KY - R/E(8,9); MO - E(16); OK - I(21); TX - P(26); *E. inscriptum*: NC - S(17); *E. jessiae*: GA - R(7); NC - E(17); VA - S(28); *E. jordani*: GA - R(7); *E. juliae*: AR - U(3); *E. kanawhae*: T(AFS); NC - T(17); WV - U(29); *E. kennicotti*: MS - P/U(14), P(15); *E. luteovinctum*: TN - M(24); *E. longimanum*: WV - U(29); *E. maculatum*: KY - D(9); NC - X/S(17); *E. mariae*: NC - S(17); *E. microlepidum*: KY - I(9); TN - M(24); *E. microperca*: AR - R(2); V(3); OK - R(20), D(21), *E. moorei*: T(AFS); T(SEW); AR - R/E(2), E(3); *E. nianguae*: T(AFS); MO - R(16); *E. nuchale*: E(FWS); E(AFS); E(SEW); AL - E(1); *E. okaloosae* - E(FWS); E(AFS); E(SEW); FL - E(4,5); *E. olmstedi*; FL - T(4,5); *E. osburni*: T(AFS); WV - U(29); *E. pallididorsum*: T(AFS); T(SEW); AR - R/E(2), E(3); *E. parvipinne*: AR - V(3); FL - T(4,5); MO - E(16); OK - R(20), D(21); TX - P(26); *E. perlongum*: E*(FWS); T(AFS); NC - E(17); *E. podostemone*: NC - S(17); *E. proeliare*: FL - T(4,5); *E. punctulatum*: OK - I(21); *E. rubrum*: T(FWS); T(AFS); T(SEW); MS - E(13,14,15); *E. rufilineatum*: MS - P/U(14), P(15); *E. sagitta*: KY - D(9); TN - M(24); *E. saludae*: SC - S(23); *E. sellare*: E(FWS); E(AFS); E(SEW); MD - E(11); E or X(12); *E. simoterum*: NC - X(17); *E. spectabile fragi*: AR - R(2); *E. squamiceps*: MS - P/U(14), P(15); *E. stigmaeum*: OK - I(21); *E. thalassinum*: NC - S(17); *E. tippecanoe*: KY - R/E(8,9); TN - M(24); VA - T(28); WV - U(29); *E. trisella*: T(AFS); T(SEW); AL - X(1); GA - T(7); TN - T(24); *E. tuscumbia*: T(AFS); T(SEW); AL - T(1); TN - M(24); *E. variatum*: VA - U(24); *E. vitreum*: MD - T(12); *E. whipplei*: MO - R(16); *E. whipplei montanus*: AR - R(2); *E. zonale*: AL - S(1); OK - I(21); SC - P(23); *E.. sp.* (Duck River darter): *T(AFS); TN - M(24); E.* sp. (Yazoo darter): MS - R(14,15); *E.* sp. (duskytail darter): T(AFS); E(SEW); TN - T(24); VA - T(28); *E.* sp. (coppercheek darter): TN - T(24); *E.* sp.(dirty darter): TN - M(24); *E.* sp. (splendid darter): TN - M(24); *E.* (*Doration*) sp.: TN - M(24); *E.* (*Ulocentra*) sp.: AL - S(1); GA - R(7); *E.* (*Ulocentra*) sp.: GA - R(7); *E.* (*Ulocentra*) sp: MS - P/U(14), P(15); *Percina antesella*: T(AFS); T(SEW); GA - T(7); TN - T(24); *P. aurantiaca*: GA - R(7); NC - S(17); TN - M(24); VA - S(28); *P. aurolineata*: E*(FWS); T(AFS); T(SEW); AL - E(1); GA - T(7); *P. burtoni*: AL - S(1); NC - E/X(17); TN - M(24); VA - S(28); *P. caprodes*: MD - E or X(12); MS - P/U(14), P(15); NC - T(17); *P. copelandi*: KY - R(9); VA - S(28); WV -

(Table 1. continued)

U(29); *P. crassa*: VA - S(28); WV - U(29); *P. cymatotaenia*: S(AFS); MO - R(16); *P. evides*: AR - U(3); KY - R(9); MS - P/U(14), P(15); *P. lenticula*: T(AFS); T(SEW); AL - T(1); GA - R(7); LA - R/E(10); MS - R(14,15); *P. macrocephala*: T(AFS); T(SEW); KY - R/E(8,9); NC - E/X(17); TN - T(24); VA - S(28); WV - U(29); *P. macrolepida*: TX - L(26); *P. maculata*: NC - S(17); OK - R(20), D(21); TX - P(26); VA - U(28); *P. nasuta*: MO - R(16); OK - R(20), D(21); *P. notogramma*: MD - E or X(12); MO - R(16); WV - U(29); *P. ouachitae*: FL - T(4,5); KY - R(9); *P. oxyrhyncha*: NC - S(17); WV - U(29); *P. pantherina*: T(FWS); E(AFS); T(SEW); AR - R/E(2), E(3); OK - R/E(20), R(21); *P. phoxocephala*: AR - R(2), V(3); KY - R(9); MS - P/U(14), P(15); TN - M(24); WV - U(29); *P. rex*: T*(FWS); T(AFS); T(SEW); VA - T(28); *P. sciera*: NC - S(17); WV - U(29); *P. shumardi*: GA - R(7); KY - R(9); OK - I(21); TX - L(26), N(27); *P. squamata*: KY - R/P(9); NC - T/S(17); *P. tanasai*: E(FWS); E(AFS); E(SEW); TN - E(24); *P. uranidea*: AR - U(3); *P.* sp. ssp. (Warrior muscadine darter): T(AFS); T(SEW); AL - T(1); *P.* sp. (Pearl channel darter): T(AFS); T(SEW); *P.* sp. (reticulate logperch): T(SEW); GA - T(7); TN - T(24); *P.* sp. (blackfin darter): TN - M(24); *Stizostedion canadense*: KY - I(10); MS - P/U(14), P(15); TX - P(26); *S. vitreum*: KY - D(10); MS - P/U(14), P(15).

COTTIDAE

Cottus bairdi: AL - S(1); *C. carolinae*: MS - P/U(14), P(15); OK - I(21); *C. cognatus*: VA - S(28); *C. pygmaeus*: E*(FWS); E(SEW); AL - E(1).

MUGILIDAE

Agonostomus monticola: FL - R(4); *Mugil cephalus*: AR - R(2), V(3); OK - I(21).

GOBIIDAE

Awaous tajasica: FL - R(4).

The numbers of endangered, threatened, and special concern fishes, respectively, on a national or regional level are as follows: U.S. Fish and Wildlife Service, 21, 11, and 0; American Fisheries Society, 20, 54, and 8; Hillestad et al. (in press), 11, 38, and 4. It should be noted that the last publication did not include 2 states (Texas and Oklahoma) incorporated in our definition of the Southeast; consequently, the totals from this source probably would have been higher. The collective total for the Southeast from these 3 national and regional sources is 90 different species.

The geographical distribution of fishes from the above national and regional checklists is summarized in Table 2. Pooling species from these 3 sources, Tennessee had the most species with 28, followed by Texas (23), Alabama (22), Virginia (19), and North Carolina (16). Every state surveyed had at least 2 national or regional endangered indigenous species. South Carolina and Maryland had the fewest known endangered species with 2 and 4, respectively.

On the state level, a combined total of 129 different species was given legal protection by state fish and game agencies whereas a collective total of 318 different species was recognized by conservation groups, scientific groups, or individuals. This disparity may be attributed to the more conservative (or even absence of) listings by state agencies as compared to unofficial lists. A combined total of 356 separate species was categorized with some degree of endangerment in all state compilations.

The number of state endangered species is summarized by category per state in Table 2. Obviously, it is difficult to compare rankings and sub-totals because of the wide assortment of terms and categories used to classify various degrees of endangerment. Consequently, cumulative species totals were derived for each state checklist to enable

Table 2. Summary of endangered fishes by state according to indicated authority [X = extirpated or extinct; E = endangered; T = threatened; R = rare; V = vulnerable; D = depleted; P = peripheral; L = limited; M = in need of management; U = undetermined; I = indeterminate; N = nongame protected; FWS = U.S. Fish and Wildlife Service; AFS = American Fisheries Society; SEW = Hillestad, et al., (in press)].

Alabama: FWS = E(5), T(3); AFS = E(7), T(13), S(1); SEW = E(5), T(14); Ramsey (1976) = X(9), E(9), T(8), S(24).

Arkansas: FWS = E(1), R(2); AFS = E(1), T(11); SEW =E(1), T(4), S(1); Buchanan (1974) = X(1), E(8), V(26), U(15); Robison (1974) = X(1), R/E(7), R(29).

Florida: FWS = E(2); AFS =E(3), T(2), S(1); SEW =E(3), T(4); Gilbert and Committee = E(3), T(16), R(11), S(2); Game and Fresh Water Fish Commission = E(3), T(15).

Georgia: FWS = E(2), T(2); AFS = E(1), T(11), S(1); SEW = E(1), T(11); McCollum (1974) = E(1), T(8), R(20), U(11); Department of Natural Resources = E(2).

Kentucky: AFS = T(10), S(1); SEW = T(4), S(2); Babcock (1977) = X(1), R/E(6), R(12), D(10), R/P(1), I(33), I/P(6), U(1); Fish and Wildlife Resources = R/E(5).

Louisiana: AFS = T(8); SEW = T(4), S(1); Miller (1972) = R/E(1), R(12).

Maryland: FWS = E(2); AFS = E(2), T(1); SEW =E(2), S(1); Lee (in press) = E or X(6), T(6); Department of Natural Resources = E(2).

Mississippi: FWS = T(1); AFS =E(1), T(9); SEW = E(1), T(5), S(1); Clemmer et al. (1974) = E(5), P/E(1), R(3), P/R(5), U(3), P/U(37); Natural Heritage Program = E(6), R(8), S(3), P(38); Game and Fish Commission = E(6).

Missouri: AFS = T(9), S(1); SEW = T(1), S(2); Dept. Cons. = X(3), E(9), R(20).

North Carolina: FWS = E(4), T(1); AFS = E(2), T(11), S(2); SEW = E(1), T(6); Bailey and Committee (1977) = X(5), X/E(4), X/S(1), E(6), T(4), T/S(1), S(31); Schwartz et al (1977) = X(1), D(4); Wildlife and Resources Commission = E(1).

Oklahoma: FWS = T(1); AFS =E(1), T(6); SEW =T(2), S(1); Robison et al (1974) = R/E(5), R(26), I(2); Hubbs and Pigg (1977) = R(5), D(22), I(46).

South Carolina: FWS = E(1); AFS = E(1); SEW = E(1); Loyacano and Gilbert (in press); E(1), T(5), S(6), P(8); Wildlife and Marine Resources Commission = E(1).

Tennessee: FWS = E(2), T(4); AFS = E(2), T(21), S(1); SEW = E(1), T(16), S(3); Game and Fish Commission = E(6), T(13), M(42).

Texas: FWS = E(7), T(2); AFS =E(6), T(10), S(3); SEW = S(1); Hubbs (1976) = E(5), T(3), R/D(2), P/D(2), R(5), D(7), L(9), P(17); Anonymous (1975) = E(4), T(10), P(6); Parks and Wildlife Department = E(11), N(14).

Virginia: FWS = E(1), T(5); AFS = E(1), T(14); SEW =E(1), T(9); Jenkins (in press) = X(2), E(3), T(5), S(29), U(5).

West Virginia: AFS = T(6); SEW =T(2), S(1); Unofficial proposed list = U(42).

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interstate comparisons. The total number of species officially listed by state agencies is as follows: Tennessee, 61; Missouri, 32; Texas, 25; Florida, 18; Mississippi, 6; Kentucky, 5; Georgia, 2; Maryland, 2; North Carolina, 1; and South Carolina, 1. Fish and game departments in the states of Alabama, Arkansas, Louisiana, Oklahoma, Virginia, and West Virginia did not recognize, according to our criteria, any state endangered fishes. Insofar as other non-official state lists (i.e., those sponsored by conservation groups, scientific committees, or individuals) are concerned, Oklahoma, (75), Kentucky (70), Arkansas (59), North Carolina (56), Mississippi (55), Alabama (50), and Texas (50) had the most species. Tennessee, Missouri, and Louisiana lacked recent unofficial checklists.

Three southeastern fishes have become extinct within historic times: *Noturus baileyi* (Smokey madtom), *Fundulus albolineatus* (whiteline topminnow), and *Lagochila lacera* (harelip sucker). Many other species have become extirpated from various states. Excluding the above three species, Alabama, North Carolina, Missouri, Tennessee, and Virginia had 6, 6, 3, 3, and 2 extirpated species, respectively.

DISCUSSION

With 356 separate southeastern fishes on one or more variously defined endangered species lists, adequate protection and rehabilitation of all species far exceeds the capabilities of available manpower and money. Through the enumeration and categorization of species presented in this paper we have identified several shortcomings in endangered species designations which may obscure species management priorities or hinder state programs. The remainder of this discussion is devoted to pointing out these frailties and making suggestions to rectify them; hopefully, this will assist in the allocation of resources to species most endangered and provide basic guidelines for effective state programs.

First, the mixture of conservative federal (Fish and Wildlife Service) and liberal stae endangered species lists may lead to a misallocation of preservation efforts. The process of listing species with the Federal Endangered Species Program is excruciatingly slow. Thus, a number of proposed critical species are not yet on the official Federal list. Conversely, some state lists include an excess of species because of the inclination of some workers (especially by non-state conservation groups and individuals) to include many locally rare species into the sphere of active concern. For example, Hubbs and Pigg (1976) recorded 75 endangered Oklahoma fishes, totaling 44% of the states fauna. Similarly, 35% of the native ichthyofauna of Kentucky was included in Babcock's (1977) list of 70 endangered species. The end result of these generally liberal non-official state checklists is a cumulative total of 356 different species, an overwhelming 64% of the total southeastern fauna of approximately 550 species. Discounting the 90 species tabulated in national and regional listings, a total of 265 separate species was recognized only on the state level, many of which are peripheral with respect to state boundaries. Peripheral species are often naturally rare, restricted in habitat, or occur as isolated populations; consequently, they are often included on state endangered species checklists while being common throughout most of their range. The inclusion of other state species may be partly rationalized by the supposition that species not yet endangered should be protected. Regardless of the reasoning, such overemphasis on these locally endangered populations may dissipate efforts on behalf of nationally recognized forms and lead to criticism of the basic "endangered species philosophy".

Unrealistic and untenable lists proposed by some conservation or preservationist groups or individuals may also lead to internal management conflicts in state fish and game agencies, thus hindering development of endangered species programs. To avoid this confrontation, McCollum (1977) concluded that state endangered species lists should be rational and manageable. Emotional pleas such as Vladykov's (1973) recommendation to place all North American non-parasitic lampreys on the Federal endangered species list act as a deterrent to more realistic attempts to identify species truly threatened with extinction.

We do not oppose the philosophy of species preservation at the state level. Indeed, focus on local populations is desirable. The many instances of extirpation of species from various states vividly illustrates the need for management at the state level. Instead, we wish to point out that state endangered species lists should be manageable and that the categorization of locally rare peripheral species as endangered or threatened as a protective mechanism may not be "philosophically" appropriate. Rather, where possible, existing or additional environmental laws and regulations should be used to preserve habitats (and associated species) from degradation. Individual species protection,

management, and rehabilitation applied through endangered species programs, could then be allocated first to species recognized nationally.

Endangered species management is also encumbered by inconsistent terminology. Over 20 endangered species definitions, categories, and classifications based on rarity, distribution, and future survival have been devised for use by various southeastern groups, state agencies, and individuals. These terms included extinct, extirpated, extirpated/special concern, endangered/extirpated, endangered, rare/endangered, peripheral/endangered, threatened, threatened/special concern, rare, peripheral/rare, rare/depleted, vulnerable, depleted, special concern, nongame protected, species in need of management, limited, limited/peripheral, peripheral, peripheral/depleted, undetermined. Three publications each had 7 or 8 levels of classification (Babcock 1977; Bailey and Committee 1977; Hubbs 1976), and, in 1 instance, different rankings were used on 1 species for separate drainages (Bailey and Committee 1977). Combination of terms by many individuals and committees to categorize levels of endangerment further complicates terminology.

One reason for classifying species with various degrees of endangerment is to provide management priorities in overall species preservation efforts throughout the country. However, discontinuity among various state endangered species checklists makes this goal difficult to attain. First, there are semantic difficulties because of the wide variety of categories that are used and because their interpretations vary among different agencies or individuals. Second, species grouped under the same heading or category in 2 different states may vary considerably in abundance and potential for survival.

Terms used to classify endangerment should be reasonably clear, self-explanatory, and inclusive (Schreiner 1973). They should also lend themselves to further subdivision and the development of subdivisional criteria where necessary. Priority and intensity of actions needed to effect the recovery of the species in question should also be evident. To meet the above criteria and to simplify, unify, and instill continuity among state endangered species checklists, we recommend the following classifications, along with their definitions. A species should be listed in the first category for which it meets the criteria.

(1) Endangered - a species or subspecies whose existence and prospects for survival throughout all or a significant portion of its range are in immediate jeopardy because of man-made or natural factors;

(2) Threatened - a species or subspecies likely to become endangered throughout all or a significant portion of its range should present trends continue;

(3a) Special Concern (national level) - a species or subspecies which warrants special recognition because it may meet criteria for a threatened species but conclusive data is limited or lacking, has suffered long term populations declines, or is vulnerable to certain types of exploitation or environmental changes;

(3b) Special Concern (state level) - a species or subspecies which warrants special recognition because it is endangered or threatened in the State but is common elsewhere; and

(4) Extirpated - a species or subspecies which has been extirpated from the State.

Using the above scheme, a system of priorities is more easily established. The categories are in order of priority for attention. The highest level of classification for a species recognized only on the state level is special concern unless recognized as endangered or threatened nationally; we feel this approach will eliminate some criticism directed toward state endangered species lists. At this time, the Florida Game and Fresh Water Fish Commission is revising its endangered species designations within the guidelines suggested above.

Another deficiency of state checklists is the tendency of some individuals to act independently to publish endangered species catalogues. Consequently, several states

(Arkansas, Texas, Oklahoma) have 2 "unofficial" lists with divergent classification schemes and individual species rankings. This may hinder species preservation efforts because of the absence of a sound data base to initiate state programs. Any endangered species checklist should revolve around coordination and corroboration rather than individualism.

The emphasis placed by southeastern fish and game agencies and other scientific or conservation groups on the promotion of national and state endangered fishes is commendable. However, in some cases, these efforts have been misdirected to the extent that endangered species management has been hampered and the philosphy of the endangered species movement questioned. We recommend that state programs be based on sound and manageable endangered species listings, using categories and definitions suggested in this paper. State fish and game agenies lacking endangered species legislation should attempt to incorporate such laws into their official rules and regulations. Finally, it should be realized that classifying species as "endangered" is not the fundamental objective of effective endangered species programs; rather, it is to remove species from the list by coordinated efforts to acquire data, preserve habitat, and protect and manage individual species.

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