United States Department of the Interior

FISH AND WILDLIFE SERVICE
Washington, D.C. 20240

In Reply Refer To:
FWS/AES/DCHRS/032435

FEB 11 2008

Arthur-Jean B. Williams, Associate Director
Environmental Fate and Effects Division
Office of Pesticide Programs (7507P)
U.S. Environmental Protection Agency
Washington, DC 20460

RE: Informal Consultation on the Effects of Atrazine Re-registration on the Endangered Alabama Sturgeon and Endangered Dwarf Wedgemussel

Dear Ms. Williams:

This responds to the Environmental Protection Agency's (EPA) request for concurrence that the proposed reregistration of pesticides under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) containing the active ingredient atrazine is not likely to adversely affect the endangered Alabama sturgeon (*Scaphirhynchus suttkusi*) in the Alabama River watershed and the endangered dwarf wedgemussel (*Alasmidonta heterodon*) in the Chesapeake Bay watershed pursuant to section 7 of the Endangered Species Act of 1973, as amended (ESA). The U.S. Fish and Wildlife Service (Service) received your August 31, 2006, request on September 4, 2006. The Service received your March 21, 2007, amendments to the assessments on March 27, 2007. EPA's assessments were based upon the process outlined in the January 2004 *Overview of the Ecological Risk Assessment Process in the Office of Pesticide Programs, U.S. Environmental Protection Agency* (Overview Document).

We have reviewed the information provided with your request, the relevant scientific and commercial literature available on the toxicity of atrazine, and the ecology of the listed species, and do not concur that the proposed action is not likely to adversely affect the Alabama sturgeon and the dwarf wedgemussel.

Studies of the effects of atrazine have documented potential adverse effects to fish and bivalves at exposure concentrations below those predicted by EPA and recorded through monitoring. The documented effects include observations of organ tissue damage, disruption to endocrine and olfactory systems affecting important behavioral functions related to survival and reproduction, and effects to host fish species and food sources. As described in the assessments, the end of the reregistration process is an EPA-approved label on a pesticide product. An evaluation of the effects of atrazine alone is incomplete because the labels approved by EPA include "inert" ingredients, additional active ingredients, and recommend tank mixtures for specific approved uses. Although we found effects of atrazine exposure at concentrations below levels anticipated by EPA's models, we believe the models are not conservative enough to predict a reasonable worst case exposure to listed species. The models produced exposure estimates well below levels detected in field samples. Two models used for the assessments were not previously considered in the Overview Document, and other models used physiographic data from disparate locations that may not be representative of high-input scenarios in the action areas. Finally, our effects determination for the mussel or any species reflects the species geographic range and the action area defined by the effects of the action. Below, we discuss in more detail our reasons for not concurring with your determination and recommend alternative approaches we believe would meet both our agencies' needs.

**Description of the Proposed Action**

Our agencies discussed the proposed action at the interagency meetings December 10-12, 2007. We collectively determined that the proposed action is more complex than simply the re-registration of the active ingredient atrazine, and that it includes the authorization for its use or uses as described in labeling of pesticide products containing the active ingredient. EPA registers separately each pesticide product containing the active ingredient atrazine and approves the labels accompanying the products. Each label represents a legal document that describes the product formulation (including inert ingredients, additional active ingredients, and other adjuvants) and stipulates how and where a given pesticide may be used. Thus, the effects to listed species and their critical habitats from exposure to atrazine is the result of a suite of EPA actions: approvals of products containing the active ingredient atrazine, which includes the label instructions defining the legal use of those products.

It is our understanding that pesticide products containing atrazine are used widely throughout the United States and may affect numerous listed species and critical habitats. We further understand that EPA requests to build section 7 consultation compliance through a series of consultations, and that the request for consultation on the dwarf wedgemussel in the Chesapeake Bay watershed and the Alabama sturgeon in the Alabama River watershed represent the first of many consultations on the effects of pesticide products containing atrazine.

*Products containing more than one active ingredient and recommended tank mixes*
We listed the products we are aware of that contain atrazine as an active ingredient in Table 1. Some of these products contain only atrazine as an active pesticide ingredient (sometimes with minor amounts of related triazine compounds), while others contain one or more additional active pesticide ingredients. In addition, atrazine product labels frequently suggest tank mixes with other pesticide products for control of certain pest species.

While the relative effects of mixing multiple active ingredients are often unknown, there are some cases in which data exist to conclude that active ingredients can have either an additive or synergistic effect. The chlorinated triazine group, including the pesticides atrazine, simazine, and propazine, in addition to the chlorinated degradates desethyl-s-atrazine, desisopropyl-s-atrazine, and diaminochlorotriazine, share a common mode of chemical action and toxicity. As detailed in Appendix A of the subject effects determinations, these active ingredients were consistently found to exhibit additive effects upon animals exposed concurrently. In contrast, active ingredients such as metolachlor and alachlor that can be bought pre-packaged in a formulation with atrazine or combined with atrazine as the result of a recommended tank mix have been shown to produce synergistic effects in organisms exposed concurrently. Specifically, the combination of atrazine with metolachlor, a pesticide included on at least 10 current labels, was found to have a synergistic effect in retarding amphibian growth, resulting in potential ecological consequences to overwintering, fecundity, mate selection, food acquisition, and predator avoidance (Hayes 2006). When atrazine was combined with the pesticide alachlor in a 50:50 mixture, 96-hour LC50's for rainbow trout (*Onchoryhnchus mykiss*) and two amphibian species (*Rana pipiens* and *Bufo americanus*) were significantly lower than would be additively predicted (Howe et al., 1998). These data are suitable for making inferences about potential additive and synergistic effects to the aquatic species considered in this assessment.

EPA's assessments lack sufficient information on the fate and effects of formulated mixtures of active ingredients or recommended tank mixtures for the Service to conclude that use of such products are not likely to adversely affect the Alabama sturgeon or dwarf wedgemussel. At a minimum, when data do not exist to evaluate the effects of chemicals in mixture, EPA should provide an evaluation of the effects of other labeled ingredients separately, and discuss whether additive, synergistic, or antagonistic effects would be expected.

*Inert Ingredients and/or Ingredients with Unknown Toxicity*
EPA's assessments include comprehensive toxicity data for atrazine, but more limited data on whole-formulation toxicity. Table 2 lists inert ingredients, as they are presented on labels, for those products that contain atrazine as the sole active ingredient. Among these products, the only EPA-recognized hazardous "inert" was ethylene glycol. Of greater concern are the surfactants and unidentified proprietary inerts contained in some products which have not been identified and/or assessed for effects by EPA for the purposes of section 7 consultation. The Service lacks sufficient information on inert products contained in atrazine formulations to conclude that pesticide products approved by EPA are not likely to adversely affect the Alabama sturgeon or dwarf wedgemussel. In order to properly assess the effects of the action, the Service requests that EPA provide a list of inert ingredients present in atrazine-containing products, and any known toxicity data for these chemicals. Service staff have been trained and authorized to handle proprietary data that have been classified as Confidential Business Information and are prepared to do so, as appropriate.

**Exposure Assessment**

EPA's consultation request for the dwarf wedgemussel was not framed in a way the Service could respond affirmatively. EPA requested the Service's concurrence that the re-registration of atrazine is not likely to adversely affect the dwarf wedgemussel in the Chesapeake Bay watershed and the Alabama sturgeon in the Alabama River watershed. While the exposure assessment for the Alabama sturgeon addresses the range of the species in the action area, the Chesapeake Bay watershed represents only a portion of the wedgemussel's known range in the action area, and therefore represents only a portion of the information needed to complete section 7 consultation.

Pesticide products containing the active ingredient atrazine are applied in significant quantities throughout the United States and its territories in agricultural and urban settings. Atrazine is persistent and mobile in surface and groundwater and is commonly detected in waterbodies sampled for its presence in areas where it is applied. Many listed species and designated critical habitats occur in waterbodies containing measurable levels of atrazine. Given the current widespread use and expected continued use of atrazine, the dwarf wedgemussel is presently exposed and likely to continue to be exposed to atrazine throughout its entire range.

Section 7 of the ESA requires federal agencies, in consultation with the Service, to insure their actions are not likely to jeopardize the continued existence of any listed species or destroy or adversely modify critical habitat. The regulations implementing section 7 (50 CFR part 402) establish the procedures for meeting the statutory requirements. Whether consultation is concluded through informal or formal consultation, compliance with the statute can be demonstrated only by basing conclusions on all effects of the action on the species or critical habitat as a whole.

The Chesapeake Bay watershed represents only a portion of the dwarf wedgemussel's range affected by the proposed action. While a partial effects analysis may be adequate to conclude formal consultation is necessary, a full effects analysis is needed to conclude an action is "not likely to adversely affect" a listed species or critical habitat.

As a point of clarification, the Service sometimes focuses its section 7 analyses at the scale of a recovery unit or critical habitat unit. In such cases the Service has already articulated its rationale in the recovery plan or final rule designating critical habitat that each unit is essential to the conservation of the species as a whole. Thus, the determination ultimately applies to the species and critical habitat as a whole.

Based on our discussions the week of December 10, 2007, we understand the proposed action to be the registration of pesticide products containing atrazine and the approval of labels describing product uses and limitations. Therefore, it is possible to consult on effects to the dwarf wedgemussel only in the Chesapeake Bay watershed if the pesticide product labels EPA submits for consultation include a limitation on usage to the geographic boundaries of the Chesapeake Bay watershed. Given we also have outstanding requests from EPA to consult on the effects of atrazine use in the Southeast and Midwest, we anticipate the atrazine products and labeled uses subject to consultation will have broad geographic usage and that the whole of the wedgemussel's range will fall within this broad action area. If this is the case, we recommend submitting information in support of a consultation on the wedgemussel that reflects accurately the geographic scope of the action and its effect to the wedgemussel.

*Environmental Mixtures*

The effects of the action on a species or critical habitat can not be accurately characterized without first establishing the physical, chemical, and biological conditions in which the species occurs without the proposed action. By establishing the environmental conditions we can understand and explain what happens when chemicals in products containing atrazine are added to the chemicals in the waters supporting the dwarf wedgemussel and Alabama sturgeon. The basis of comparison, under section 7, is environmental conditions without the proposed action (without approval of atrazine products) and environmental conditions with the proposed action (with approval of atrazine products). It is often the presence of an existing stressor that, when combined with a new stressor, triggers an adverse effect that otherwise may not occur. Alternatively, the new stressor may exacerbate existing adverse effects or even diminish the influence of existing stressors.

The list of existing chemical components in the water column should include, as appropriate, other pesticide products presently sold and used in the action area. Although EPA's approval of these pesticide products may not have undergone section 7 consultation, it is a fact they are presently available and are being used and many of them will co-occur in the water column with atrazine at least until they have undergone FIFRA review and separate section 7 consultation.

For listed species and critical habitats that are wholly aquatic in nature, exposure to environmental mixtures can be characterized by assessing the chemical loads that occur in the water column regardless of their mode of transport (e.g., direct application or drift, overland runoff, and atmospheric or groundwater transport). In this way, we would capture the effects to listed species when exposed to mixtures of pesticides irrespective of whether the source was a mixture of ingredients in a formulated product, a tank mixture, or the application of separate pesticide products on adjacent areas within a watershed. Available data can be utilized to develop assumptions about exposure to other constituents in the water column focusing on those constituents for which atrazine is suspected of having additive, synergistic, or antagonistic effects (e.g. other triazine pesticides, organophosphorus insecticides, metolachlor).

The Service typically considers a consultation package to be "incomplete" if the action agency fails to address an important part of the problem in its effects analyses. In our December 10-12, 2007, interagency meetings, EPA asserted that its assessments were complete and represented the "best available scientific and commercial data," even though environmental mixtures were not factored into the analyses of effects of the action. At the December meeting the Service offered to develop this analysis as part of its first Biological Opinions with the expectation that EPA would incorporate consideration of environmental mixtures into future assessments and consultation requests.

*PRZM – EXAMS model inputs and Variable Volume Water Model*

In the absence of monitoring programs designed to capture peak and chronic pesticide concentrations in the action area, EPA has developed models to estimate the range of atrazine concentrations to which species and critical habitats are likely to be exposed. These models are intended to estimate the worst-case exposure likely to occur as a result of the proposed action to enable EPA and the Service to determine whether listed species or designated critical habitats were likely to be adversely affected. If the worst-case exposure could reasonably be expected to adversely affect a listed species or critical habitat, then it would be useful to further characterize the range, frequency, and duration of various exposure concentrations in order to determine whether anticipated adverse effects would likely jeopardize listed species or adversely modify critical habitat.

The Service is concerned that EPA's modeling efforts are not likely to estimate reasonable worst case exposure concentrations. The modeling often begins with conservative assumptions, but the additional modeling conducted and the values selected for variable inputs reduce or remove the conservatisms built into the modeling effort. When screening level estimates of exposure exceeded Levels of Concern (LOCs) based on GENEEC2 modeling, EPA used the PRZM/EXAMS models previously reviewed by the Service to refine estimated exposure concentrations (EECs) based on site-specific conditions. However, rather than developing EECs based on model inputs specific to the action area, the EECs EPA reported were based on inputs developed for other geographic areas that may not be representative of the action area. For example, EECs representing atrazine use on corn in the action area were estimated based on physiographic variables from Pennsylvania, sorghum from Kansas, and forestry from Oregon. These scenarios were expected to output high-end concentrations of atrazine in the action area based on soil and slope input parameters for generating runoff. However, examples from monitoring data in the Chesapeake Bay show that peak concentrations may be greater than those generated by modeling. For example, stream monitoring at areas of intense agricultural activity in the Choptank River watershed of Chesapeake Bay detected atrazine concentrations as high as 98 ug/L in a small stream, significantly higher than the peak EEC of 55 ug/L predicted using PRZM/EXAMS modeling (Hall et al., 1999). EPA's Overview Document stipulates that if monitoring data shows higher detections than estimated by modeling, those values may be used in risk assessment, and model input parameters re-evaluated.

Furthermore, when PRZM/EXAM modeling exceeded LOCs, EPA further refined EECs by incorporating an element of flow to its static pond model to account for pesticide dissipation. The model used for this purpose, the variable volume water model (VVWM) was developed for the Probabilistic Risk Assessment process and is thus outside the scope of the Overview Document and those models that have been previously evaluated by the Services for their appropriateness in assessing the effects of pesticides to listed species. In the subject assessment, use of the VVFM resulted in EECs that were lower than those predicted by the static pond model alone. However, the Service has concerns that this model may not reliably predict worst-case scenarios for species inhabiting shallow waters or those with particularly low flow. While the Alabama sturgeon is a large river species, the dwarf wedgemussel and its host fish can live in small streams with low flow where water depths may be only a few inches. To estimate flow in headwater streams occupied by the dwarf wedgemussel, EPA reviewed data from three occupied streams with known flow, and incorporated values from the stream with the lowest average rate. However, there was no indication that this stream is representative of the lowest flow area occupied by the species in the Chesapeake Bay. In addition, the flow rate used in the model represented the median daily rate based on 30 to 70 years of data. By relying on median or average flow rates, the assessment fails to adequately characterize the range of conditions that can influence the wedgemussel's exposure to atrazine, which includes periods of low flow. The only monitoring data available to assess the accuracy of the values being modeled - a single sample collected from this stream in 1994 - was insufficient to draw conclusions as to the accuracy of the model. However, subsequent assessments performed in geographic areas in which recent monitoring data exists have found that use of the VVFM, and at times even the unadjusted PRZM-EXAMS model, under-predicts atrazine concentrations in low-flow streams when compared to monitored concentrations (USEPA 2007a). In these assessments, modeling under-predicted atrazine concentrations in streams with a flow of 175 $ft^3/s$ or lower when compared to site-specific monitoring data. These flow rates are within the parameters of streams where the dwarf wedgemussel may reside.

**Effects Assessment**

*Consideration of sublethal effects*

To determine direct effects of atrazine use upon listed species, EPA compared concentrations of atrazine expected in water against adverse effect thresholds in fish and invertebrates using a risk quotient methodology. An adverse effect threshold was determined by performing a search of the open literature and selecting the most sensitive endpoint based on data derived from those studies and registrant submitted data. However, EPA discounted data from several studies in which adverse sublethal effects were reported, citing that "it is not possible to quantitatively link the sublethal effects to the selected assessment endpoint for the [listed species] (i.e., survival, growth, and reproduction of individuals)."

Several studies have identified sublethal effects to fish and mussels at concentrations below the peak (15.8 ug/L) EEC for the Alabama River and both peak (55 ug/L) and flow-adjusted peak (33 ug/L) EECs for the Chesapeake Bay (flow-adjusted aggregate EECs not provided for the Alabama River). The sublethal effects included direct evidence of damaged organ tissue and disruption of the endocrine system. An effect such as damaged organ tissue corresponds well with the concept of "harm" and thus, "take." If an action causes take, then that is sufficient to conclude a species is likely to be adversely affected and request formal consultation. In formal consultation we can assess in greater detail what those adverse effects mean to the fitness of individuals, population(s), and the species as a whole. The Service concludes that these sublethal effects represent adverse effects to the species.

*Effects to Olfaction*: Several studies have reported olfactory effects to fish exposed to atrazine concentrations less than EECs predicted by EPA in the subject assessments. In a series of studies on Atlantic salmon *(Salmo salar L.)*, effects to olfactory function were detected in males exposed to atrazine concentrations as low as 0.5 ug/L (Moore and Waring 1998; Moore and Lower 2001). Atrazine inhibited the male's ability to detect and respond to the female priming hormone. The resulting reduction of expressible milt may ultimately result in either an enhancement or delay in reproductive status. Though these studies focused on a specific behavioral response, atrazine was believed to be having a general effect to the olfactory system, and may actually affect many olfactory-mediated behaviors. In goldfish (*Carassius auratus*), exposure to atrazine concentrations as low as 0.5 ug/L had significant effects on burst swimming, grouping, and surfacing behaviors (Saglio and Trijasse 1998). Burst swimming, part of the alarm reaction in schooling fish, is dependant on olfactory perception of an alarm pheromone, and effects to swimming orientation further implicate disruption of the olfactory system. The mechanism of action was not characterized for altered swimming behavior in zebrafish (*Bachydanio rerio*) exposed to as little as 5 ug/L atrazine, but was thought to be attributable to general effects to the sensory organs and/or the nervous system (Steinberg et al. 1995). The authors hypothesized that behaviors displayed by zebrafish could increase susceptibility to predators via alterations to competitive capabilities and avoidance reactions.

Though specific data are not available for Alabama sturgeon, the role of olfaction has been studied in other sturgeon of the Acipenseridae family. Olfaction in fish is integral to feeding, mating, homing, and predator avoidance behaviors. Sturgeon, which have poorly developed vision, are generally more reliant on olfactory performance than other fish taxa (Kasumyan and Kazhlayev, 1993; Kasumyan 2004). Unlike most species of fish that rely on vision for food searching behavior, sturgeon are unable to orient, make distant or near searches for food, or discover approaching objects based on visual cues and must rely on the olfactory system as the primary sensory system for feeding (Kasumyan and Kazhlayev, 1993). For reproductive behavior, the involvement of chemical signalization in both finding a partner for spawning and determining their readiness is well studied and universal for all fish (Kasumyan 2004). Studies examining sturgeon specifically have documented male reactions to female sexual pheromones that suggest that males use olfaction to detect ripe females at spawning sites (Kasumyan 1999). In general, fish have been found to possess an array of pheromones to regulate both priming and releaser effects of sexual behavior, triggering complex chains of behavioral and physiological changes associated with ripening and spawning (Kasumyan 2004). Because of their reliance on olfaction, sturgeon are likely to exhibit a more pronounced response than other fish taxa to pesticides that adversely affect olfactory performance.

*Histology*: Morphological alterations to the renal system were found to occur in rainbow trout *(Oncorhynchus mykiss)* experimentally exposed to atrazine concentrations below expected EECs for the Alabama River (Fischer-Scherl et al., 1991; Oulmi et al., 1995). Fischer-Scherl et al. demonstrated that atrazine levels as low as 5 ug/L produced significant histological changes in the renal corpuscle. Specifically, a proliferation of podocytes almost completely occluded the area of filtration inside Bowman's capsule and a thickening of the glomerular basement membrane was observed. In the renal tubules, mitochondrial myopathy was also seen in trout exposed to 10 ug/L atrazine. In the study by Oulmi et al., a broad spectrum of effects occurred in proximal tubule segments exposed to atrazine concentrations as low as 10 ug/L atrazine and distal segments as low as 20 ug/L, increasing in variability and intensity in a dose-dependant manner. For freshwater fish, the constant inflow of water into the body must be properly regulated to avoid osmotic water loading and salt depletion. Glomerular filtration in the kidney functions as a major contributor to osmoregulation by delivering large volumes of extracellular fluid to the urinary space for excretion, while filtered salts are reabsorbed without water. Alterations to filtering processes that effect water and electrolyte balance in the organism could ultimately lead to mortality.

Histological effects to the hepatopancreas, were found in zebra mussels (*Dreissena polymorpha* Pallas) exposed to atrazine concentrations as low as 3 ug/L, with increasing intensity at higher concentrations and durations of exposure (Zupan and Kalafatic, 2003). The hepatopancreas has a significant role in digestion, as well as general metabolism and detoxification processes. Alterations to the ovaries and testes were also seen at concentrations as low as 50 ug/L, including damage to loose connective tissue and interstitial cells in both gonads.

*Effects to the endocrine system:*
Recent research has found effects to endocrine-mediated functions in both fish and mussels. In fish, the U.S. Geological Survey's Columbia Environmental Research Center has found that exposure of medaka (*Oryzias latipes)* to concentrations of atrazine as low as 0.5 ug/L resulted in direct reproductive effects, including reduced egg production and abnormal spermatogenesis (Papoulias et al., 2006a; Papoulias et al., 2006b).

A series of experiments on the freshwater mussels *Elliptio complanata* revealed significant effects to burrowing behavior and spatial distribution in individuals exposed to 1.5, 15 or 150 ug/L atrazine for up to 72 hours (Belopolsky et al., 2006; Spellman and Flynn 2006; Hines et al., 2006). Results were similar to those found in mussels exposed to estradiol, suggesting atrazine has the ability to disrupt endocrine-mediated behaviors in these species (Powers et al., 2006). In a related experiment, atrazine was found to increase citric acid cycle activity in a manner similar to estradiol at concentrations as lows as 1.5 ug/L (Ciummo 2006). Data gathered from several of these experiments suggest a biphasic dose-response curve, indicative of endocrine disruption.

These data on endocrine effects to fish and mussels were presented at the 27$^{th}$ Annual Meeting of the Society for Environmental Toxicology and Chemistry and are currently in review for publication. However, there exists a large body of published literature to support the hypothesis that atrazine is capable of altering endocrine-mediated functions at concentrations comparable to those found in these studies. Numerous studies on endocrine-related effects in amphibians have been summarized by EPA in its 2003 and 2007 "White Papers" and Appendix A of the subject assessments (USEPA 2003a; 2007b). These studies have found developmental effects in amphibians exposed to atrazine concentrations as low as 0.01 ug/L. In 2003, EPA convened a FIFRA Scientific Advisory Panel (SAP) on Potential Developmental Effects of Atrazine on Amphibians (June 17-20, 2003) which found that the existing lines of evidence support the hypothesis that atrazine interferes with anuran gonadal development at a threshold concentration between 0.01 and 25 ug/L – thresholds consistent with those found to cause effects in fish and mussels - and subsequently requested additional data to further delineate the concentration-response relationship (USEPA 2003b). In 2007, based on the results of these new data, EPA concluded that atrazine does not affect amphibian gonadal development at environmentally relevant concentrations and that no further testing is required to address the issue (USEPA 2007b). However, EPA's 2007 FIFRA SAP on the Potential for Atrazine to Affect Amphibian Gonadal Development (October 9-12, 2007) concluded that current data were not sufficient to refute the hypothesis that atrazine affects amphibian gonadal development at these concentrations (USEPA 2008). The Service agrees with this conclusion and believes that the existing data provide sufficient lines of evidence to suggest that atrazine exposure can result in endocrine disruption in amphibians and other wildlife. The Service also believes that EPA should expand its hypothesis to include potential sublethal effects of atrazine beyond the narrow scope of gonadal development.

*Effects to aquatic plant communities*
Phytoplankton is believed to be the primary component of the dwarf wedgemussel's diet. To assess risk from atrazine exposure for these and other primary producers, effects to aquatic plant communities were evaluated using the Comprehensive Aquatic Systems Model (CASM). CASM outputs adverse effect thresholds that predict changes in community structure in response to atrazine exposure over time, which are compared to flow-adjusted EECs to estimate risk. This model was not referenced in the Overview Document and therefore has not been previously reviewed by the Service for its suitability in assessing effects to listed species. Based on our current understanding, this model may not be conservative enough in its estimation of adverse effects thresholds to thoroughly predict effects to listed species.

In populating the CASM model, EPA describes a large body of community microcosm and mesocosm data demonstrating effects to communities at atrazine concentrations of 20 ug/L and below - thresholds that several authors have employed as adverse effect levels for aquatic communities and thresholds that are surpassed by monitored concentrations in the Chesapeake Bay (e.g., Solomon et al., 1996; Hall et al., 1999). CASM uses the data derived from these studies to output threshold concentrations (12 – 38 ug/L based on 14-, 30-, 60-, and 90-day intervals of exposure to atrazine) which are higher than those reported in the literature. EPA's own verification of these threshold values, based on the actual data which populated the model, resulted in an 8% rate of false negatives when predicting adverse effects. That is, 8% of the time, the model predicts no change in community structure for a study in which a significant change was known to occur. Furthermore, where the model failed to predict these known changes, the actual effects were in the two most severe levels of effects as parameterized by EPA's model (scores of 4 and 5 on the 5-point scale developed by Brock et al., 2000; specifically "significant effect without return to control levels during an observation period of less than 56 days" and "significant effect without return to control levels for more than 56 days".) In addition, studies characterized with a score of 2 ("slight effect") were not considered as having any adverse effect at all for the purposes of this assessment, accounting for an additional 16% of the data in which effects that actually occur are not predicted by this model.

As noted above in reference to PRZM/EXAMS modeling, EPA parameterized CASM with input variables that are not specific to geographic areas currently being assessed. In this case, CASM was populated with data specific to 2nd and 3rd order Midwest streams. It is unclear from the assessment how site-specific inputs related to landscape and soil differ between these locations and the action areas, and to what extent CASM-derived EECs would be influenced by incorporating data that is reasonably expected to occur within the action area.

**Recommendations**

We recommend initiating formal consultation on the effects of atrazine products on the Alabama sturgeon and dwarf wedgemussel and implementing a strategy that builds section 7 compliance for the proposed action over time. Additional consultations will be necessary for other listed species and designated critical habitats that occur in the action area and may be affected by the approval of atrazine products. Section 7 compliance for a particular pesticide product could be achieved when all of the relevant ingredients (e.g. atrazine, metolachlor, "inerts," etc.) have been evaluated for all of the listed species likely to be exposed to the use of that product.

To request formal consultation, all we require at this time is a list of all atrazine products for which consultation is being requested, including a description of the ingredients contained in each product and any known toxicity data for the ingredients, labeled uses and restrictions, and the other ingredients in recommended tank mixtures. We understand your biological evaluation will not include a characterization of the chemical environment the dwarf wedgemussel and Alabama sturgeon occur in as a basis for estimating the effects of adding atrazine to this environment. We will attempt to develop the model for addressing "environmental mixtures" in our first consultations in order to move the consultation process forward. Once we establish a working model for addressing environmental mixtures, we will expect EPA to adopt the model for future consultation requests, or apply their own model that meets the information requirements of the ESA. We have begun drafting biological opinions for the dwarf wedgemussel and Alabama sturgeon and will continue our work on them as we await your request for formal consultation.

Also, as planned at our interagency meetings of December 10-12, 2007, we look forward to meeting to address our concerns about the modeling. We think that with some adjustments the models can help reliably predict whether the action is likely to adversely affect listed species and, if so, what the scope and magnitude of effects are likely to be.

In future biological evaluations EPA should include an exposure analysis that both predicts a reasonable worst case scenario for the assessed action areas and, if necessary, supports formal consultation. In an informal consultation, we determine whether the listed species is likely to be adversely affected and base the determination upon the most extreme exposure estimated to occur to any individuals in the action area. This enables the Service to assist the action agency in complying with not only section 7, but also the section 9 prohibitions on "take." This extreme exposure estimate typically would not be expected to occur uniformly across the range of a listed species or its critical habitat. For a formal consultation, we attempt to characterize the range of exposures likely to occur to individuals of the various populations of the listed species or units of critical habitat, or portions thereof. This latter analysis would allow us to characterize the proportion of the species or critical habitat exposed to the "worst-case" concentration of atrazine, and the proportion exposed to more moderate concentrations.

We look forward to working together to achieve compliance with the Endangered Species Act on your FIFRA actions. If you have any questions about our comments or recommendations, please contact Dan Buford or Nancy Golden at (703) 358-2106 or via e-mail at Daniel_Buford@fws.gov or Nancy_Golden@fws.gov.

Sincerely,

Marjorie A. Nelson, Chief
Branch of Consultation & HCPs
Division of Consultation, Habitat
Conservation Planning, Recovery and
State Grants

Enclosures

**Table 1. Atrazine Products Currently Labeled for Use in the U.S. Data from this table were derived from www.cdms.net, www.greenbook.net, and MeisterPro's Crop Protection Handbook 2007.**

| Manufacturer | Trade Name | Active Ingredients (%) | | |
|---|---|---|---|---|
| Syngenta | Aatrex 4L | 42.6% atrazine | | |
| Syngenta | Aatrex Nine-O | 88.2% atrazine | | |
| TenKoz | Atrazine 4F | 40.8% atrazine | | |
| TenKoz | Atrazine 90DF | 88.2% atrazine | | |
| UAP-Loveland | Atrazine 4L | 42.2% atrazine | 0.8% other triazine[a] | |
| UAP-Loveland | Atrazine 90 WDG | 85.5% atrazine | 4.5% other triazine[a] | |
| UAP-Loveland | Cadence ATZ | 24.4% atrazine & related compounds | 32.6% acetochlor | |
| UAP-Loveland | Cadence Lite ATZ | 16.3% atrazine & related compounds | 43.4% acetochlor | |
| Drexel | Atra-5 | 52.5% atrazine | 0.98% other triazine[a] | |
| Helena | Atrazine 4L | 48.0% atrazine | N/A | |
| MANA-Makhteshim Agan | Atrazine 4L | 42.9% atrazine | 0.7% other triazine[a] | |
| MANA-Makhteshim Agan | Atrazine 90DF | 88.5% atrazine | | |
| Helena | Atrazine 90WSP | 85.5% atrazine | 5.5% other triazine[a] | |
| Drexel | Atrazine 90DF | 88.4% atrazine | 1.5% other triazine[a] | |
| Micro Flo | Banvel-K+Atrazine | 22.23% atrazine | 13.42% dicamba (K salt) | |
| Syngenta | Bicep II Magnum | 33.0% atrazine | 26.1% S-metolachlor | |
| Syngenta | Bicep II Magnum FC | 33.0% atrazine | 26.1% S-metolachlor | |
| Syngenta | Bicep Lite II Magnum | 28.1% atrazine | 35.8% S-metolachlor | |
| Syngenta | Expert | 22.9% atrazine | 18.6% metolachlor | 10.8% glyphosate |
| Syngenta | Lumax | 11% atrazine | 29.4% S-metolachlor | 2.94% mesotrione |
| Sipcam Agro USA | Stalwart Xtra | 33.7% atrazine and related triazines | 26.1% S-metolachlor | |
| Bayer CropScience | Buctril+Atrazine | 21.62% atrazine | 15.74% bromoxynil octanoate | |
| Tenkoz | Brawl II ATZ | 33.0% atrazine | 26.1% S-metolachlor | |
| Tenkoz | Establish ATZ | 35.3% atrazine | 18.2% dimethenamid | |
| Tenkoz | Establish Lite | 29.5% atrazine | 24.1% dimethenamid-P | |
| Tenkoz | Triangle | 28.6% atrazine | 34.5% metolachlor | |
| Tenkoz | Volley ATZ | 24.4% atrazine | 32.6 % acetochlor | |
| Tenkoz | Volley ATZ Lite | 16.3% atrazine | 43.4% acetochlor | |
| Agriliance | Atrazine 90DF | 86.5% atrazine | 3.5% other triazine | |
| Agriliance | Agrisolutions Atrazine 4L | 40.8% atrazine | 2.2% related triazine | |
| Agriliance | Confidence Xtra | 18.3% atrazine | 46.3% acetochlor | |
| Agriliance | Sterling Plus | 22.23% atrazine | 13.42% dicamba (K salt) | |
| Tenkoz | Atrazine 4L | 42.6% atrazine | | |

| | | | | |
|---|---|---|---|---|
| Helena | Pro-Mate Atrazine 1.05% with Fertilizer | 1.05% atrazine | | |
| Syngenta | Gesaprim 90 WDG | 90% atrazine | | |
| DuPont Ag | Basis Gold | 82.44% atrazine | 1.34% nicosulfuron | 1.34% rimsulfuron |
| | | 4.34% other triazine[a] | | |
| DuPont Ag | Breakfree ATZ | 24.4% atrazine | 32.6% acetochlor | |
| DuPont Ag | Breakfree ATZ Lite | 16.3% atrazine | 43.4% acetochlor | |
| Monsanto | Bullet | 14.5% atrazine | 25.4% alachlor | |
| | | 0.8% other triazine[a] | | |
| DuPont Ag | Cinch ATZ | 33.0% atrazine | 26.1% S-metolachlor | |
| | | 0.7% other triazine[a] | | |
| DuPont Ag | Cinch ATZ Lite | 28.1% atrazine | 35.8% S-metolachlor | |
| | | 0.6% other triazine[a] | | |
| Monsanto | Degree Xtra | 14.5% atrazine | 29% acetochlor | |
| Monsanto | Field Master | 16.2% atrazine | 21.6% acetochlor | 8.2% glyphosate |
| DowAgroSciences | FulTime | 16.6% atrazine | 24.8% acetochlor | |
| BASF Ag | G-Max Lite | 29.5% atrazine | 24.1% S-dimethenamid | |
| BASF Ag | Guardsman Max | 35.3% atrazine | 18.2% S-dimethenamid | |
| Monsanto | Harness Xtra | 18.3% atrazine | 46.3% acetochlor | |
| Dow AgroSciences | Keystone | 24.4% atrazine | 32.6% acetochlor | |
| Dow AgroSciences | Keystone LA | 16.2% atrazine | 43.4% acetochlor | |
| Micro Flo | Laddok S-12 | 25% atrazine | 27% sodium bentazon | |
| Monsanto | Lariat Flowable | 15.5% atrazine | 27.2% alachlor | <0.8% other triazine[a] |
| Bayer CropScience | Liberty ATZ | 31.75% atrazine | 10% glufosinate-ammonium | 1.67% other triazine[a] |
| BASF Ag | Marksman | 22.23% atrazine | 13.2% dicamba(K salt) | |
| MANA-Makhteshim Agan | Parallel Plus | 30.0% atrazine | 28.9% metolachlor | |
| MANA-Makhteshim Agan | Double Team | 19.1% atrazine | 38.2% acetochlor | |
| UAP-Loveland | Rifle Plus | 22.23% atrazine | 13.4% dicamba(K salt) | |
| Drexel | Simazat 4L | 21.03% atrazine | 21.4% simazine | 0.39% other triazine[a] |
| Drexel | Simazat 90DF | 44.18% atrazine | 45% simazine | |
| Drexel | Auguzine | 4% atrazine | 0.08% related triazine[a] | |
| DuPont Ag | Steadfast ATZ | 85.3% atrazine | 2.7% nicosulfuron | 1.3% rimsulfuron |
| Drexel | Trizmet II | 33.1% atrazine | 26.1% metolachlor | 0.6% other triazine[a] |

[a]MSDS says related product; this is assumed to be another triazine product.

**Table 2. Inert Ingredients in Labeled Atrazine Products. Only products with atrazine as the only active ingredient are shown. Data were derived from www.cdms.net, www.greenbook.net, and MeisterPro's Crop Protection Handbook 2007.**

| Manufacturer | Product Name | Active Ingredients (%) | | Adjuvants in Product (%) | |
|---|---|---|---|---|---|
| | | Atrazine | Other triazines[a] | Hazardous to Aquatic Organisms | Non-Hazardous or Uncertain |
| Syngenta | Aatrex 4L | 42.6% | | ≤6% ethylene glycol | |
| Syngenta | Aatrex Nine-O | 88.2% | | | unidentified dispersant & surfactant |
| TenKoz | Atrazine 4F | 40.8% | | 5% ethylene glycol | |
| TenKoz | Atrazine 90DF | 88.2% | | | unidentified dispersant & surfactant |
| UAP-Loveland | Atrazine 4L | 42.2% | 0.8% | 5% ethylene glycol | 52.0 |
| UAP-Loveland | Atrazine 90 WDG | 85.5% | 4.5% | | 10.0 |
| Drexel | Atra-5 | 52.5% | 0.98% | | 46.5 |
| Helena | Atrazine 4L | 48.0% | N/A | | 58.0 |
| MANA-Makhteshim Agan | Atrazine 4L | 42.9% | 0.7% | | 56.4 |
| MANA-Makhteshim Agan | Atrazine 90DF | 88.5% | | | unidentified |
| Helena | Atrazine 90WSP | 85.5% | 5.5% | | 10.0 |
| Drexel | Atrazine 90DF | 88.4% | 1.5% | | 10.0 |
| Agriliance | Atrazine 90DF | 86.5% | 3.5% | | 10% trade secret ingredient[b] |
| Agriliance | Agrisolutions Atrazine 4L | 40.8% | 2.2% | >6% ethylene glycol | 54%, including trade secret ingredient[b] |
| Tenkoz | Atrazine 4L | 42.6% | | ≤6% ethylene glycol | |
| Helena | Pro-Mate Atrazine 1.05% with Fertilizer | 1.05% | | | 98.95% unidentified mix, including N-P-K fertilizer |
| Syngenta | Gesaprim 90 WDG | 90% | | | |
| Drexel | Auguzine | 4% | 0.08% | | 95.9 |

[a]MSDS says related product; this is assumed to be another triazine product.
[b]Assuming unidentified adjuvants are classified as no more than slightly toxic to aquatic species; under current Federal law, additives classified as trade secrets, even if toxic, need not be identified (see A25A23A56http://www.btny.purdue.edu/Pubs/PPP/PPP37.html)

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