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13. ABSTRACT ***(Maximum 200 Words)***

Precision targeting is a method of determining the total distribution of any parameter of interest, and directing interventions based on that distribution. Based on geostatistics, precision targeting analyzes the locations and values of observations to discern a pattern of spatial continuity of the observations, then uses this pattern to estimate distributions between sampled locations. The total distribution is then expressed as a contour map showing isolines of equal parameter density.

Precision targeting has many advantages, but perhaps the greatest improvement it brings to the pest manager is the reduction in pesticides needed to control pests. Precision targeting's inherent pinpointing of pest infestations eliminates the need to treat the entire facility, thereby reducing the amount of pesticide used, the exposure, and expense associated with current methodologies. Precision targeting can make a key contribution to achieving DoD's mandate to reduce pesticide use by 50 per cent by 2000 while actually increasing the effectiveness of operations.

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ORACBA Newsletter

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Current Developments in the Integrated Management of Pests and Arthropod-Borne Diseases Using Spatially Based Risk Assessment Methods

by Richard J. Brenner and Dana A. Focks, Center for Medical, Agricultural and Veterinary Entomology, Imported Fire Ants and Household Insects Group, ARS, Gainesville, FL

The spatial and temporal nature of pest and arthropod-borne disease problems.

Arthropod-related disease and pest problems are usually not uniformly distributed in space or time. For example, German cockroaches in a restaurant are aggregated in habitat with suitable harborage, diminished light and optimum moisture conditions. The transmission of the dengue hemorrhagic fever virus is confined to the peridomestic environment where water storage practices permit the breeding of the mosquito vector. Also, because the population dynamics of many arthropods are intimately tied to temperature and rainfall, seasonality in weather results in pest problems being seasonal as well, clumped spatially and unevenly distributed through time. Obviously, the ability to target interventions to correspond to the spatial and temporal distributions of pests not only would reduce the direct costs of control but would reduce potential environmental and health consequences of the mitigation efforts as well.

Currently, we are cooperating with the Environmental Protection Agency (EPA) and the Departments of Defense (DoD) and Energy (DoE) with funding from the Strategic Environmental Research and Development Program (SERDP) to reduce pesticide use and risks through a process of "precision targeting" and comparative risk reduction for DoD. We anticipate the incorporation of current and the development of new and emerging technologies (including least-toxic or non-toxic substances, novel pest removal systems, and structural/environmental interventions) in the system. Strategies will be developed for militarily-important representative disease vectors and pests from three military settings: (1) Military deployments and training exercises where vector-borne diseases such as malaria, leishmaniasis, dengue, and tickborne illnesses transmitted by mosquitoes, flies, and ticks have the potential to cause direct loss in troop combat effectiveness. Vector-borne diseases are on the increase worldwide in strategic theaters of the world where U.S. forces may deploy. Historically, diseases, including vector-borne diseases, cause troop morbidity and mortality at rates two times the rate from combat losses. (2) In the DoD supply system and supply depots, where pests cause significant loss to war stocks of military rations and other materiel such as uniforms and blankets. (3) And on military installations, where a wide range of pest species cause damage to buildings and contents, these same pests and vectors adversely affect human health by transmitting pathogens, producing allergens, and contaminating foods and surfaces. We anticipate that this research will, for the first time, provide standardized procedures for achieving comparative risk reductions associated with the broad scope of disease vectors, pests, pesticides, and pesticideresistant populations in military installations and theaters of operation.

In this article, we will give an overview of precision targeting based on spatial statistics and an example of their use in a novel intervention against cockroaches on a U.S. Navy vessel. An outline of the risk assessment methods currently under development is also given.

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Overview of precision targeting based on spatial statistics.

Precision targeting is a method of determining the total distribution of any parameter of interest, and directing interventions based on that distribution. Based on geostatistics, precision targeting analyzes the ***locations*** and ***values*** of observations to discern a pattern of spatial continuity of the observations, then uses this pattern to estimate distributions between sampled locations. The total distribution is then expressed as a contour map showing isolines of equal parameter density (Fig. 1a,c; Fig. 2b).

As an environmental management tool, precision targeting is most useful when contour lines are expressed as probabilities of exceeding a given threshold. These thresholds may be number of insects per trap or plant (Fig. 1b,d; Fig. 2a.c), number of weeds per unit area, the degree of groundwater contamination, the amount of nitrogen in soil samples, water runoff rates of unprotected soil, etc. These probability contours provide a means of estimating risks, and risk-reductions associated with proposed interventions. Post-interventional re-sampling yields other contour maps that provide a "report card" of efficacy, showing areas of improvement and/or areas of deterioration (Fig. 2c).

Precision targeting may sound complicated at first, but it is not. In 2 years of studies, the concept and operation of precision targeting have been validated in studies aboard the U.S.S. Canopus at King's Bay, Georgia, Naval Station (see Figs. 1-3), and in DoD facilities at Naval Air Station, Jacksonville. The system is user-friendly and easily adaptable for use by technicians. In fact, it simplifies data collection and storage, creates a detailed, permanent record of the surveys and results, and requires less time than current survey methods.

Precision targeting has many advantages, but perhaps the greatest improvement it brings to the pest manager is the reduction in pesticides needed to control pests. Precision targeting's inherent pinpointing of pest infestations eliminates the need to treat the entire facility, thereby reducing the amount of pesticide used, the exposure, and expense associated with current methodologies. Precision targeting can make a key contribution to achieving DoD's mandate to reduce pesticide use by 50 per cent by 2000 while actually increasing the effectiveness of operations.

An outline of risk assessment methods under development.

A major research objective of our SERDP project involves the development of a process to quantify comparative risk reductions when interventions are warranted. This includes several steps: (1) Evaluate all possible interventions in the context of potential environmental pollution or direct hazards to human health; (2) integrate typical toxicology and exposure data on biocides (from EPA) with spatial patterns of land use and human activity; and (3) construct algorithms to assess the impact of each proposed intervention on the environment, adverse human health effects, and on pest/pathogen levels. Successful completion of these research components will provide, within the spatial domain of measurement (e.g., a DoD facility, a theater of deployment, or a warehousing facility), a means to construct contour maps of risk potential and risk reduction for each proposed intervention, as well as a summary of cost estimates for each intervention over the spatial areas defined by the contours. This will then serve as a decision support tool for management in determining when, where, and which interventions will be imposed. Using the same precision targeting process, contour maps will be constructed to document post-interventional efficacy. This work will provide the means to document, in a spatial context, a complete history of activity, including realized risk reductions and costs.

A significant component of this project entails a parallel path of development that will address the methods by which data are collected, accumulated, processed, displayed, and archived. This will include: (1) automating much of the precision targeting process for specific DoD applications using global positioning system (GPS), (2) transcribing data to a DoD-appropriate global information system (GIS) format to ensure a single database structure for comprehensive use at installations as well as in military deployments, and (3) incorporation of other GIS spatial data, such as land use and human activity patterns, into the same database for comparative risk assessment/reduction. We envision that the development of these standardized, globally applicable procedures will result in a high degree of accuracy that is relatively independent of the skill level of pest management technicians, thus providing extraordinary consistency in procedures over time, space, and among personnel within the DoD system and others in the civilian sector such as urban pest control and mosquito abatement operations.

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Director's Corner
by Nell Ahl

In beginning this essay, I am reminded of how quickly this year has passed: the first of November 1995, my job description was changed to Director, Office of Risk Assessment and Cost-Benefit Analysis. At that time we had no office in the physical sense, no telephone service, no mailing address, no... ORACBA existed only in the imagination of a few. My first act was to ask Ron Meekhof to join ORACBA. Ron had been a partner in the regulatory reform challenges in the early days of the 104th Congress; we had shared intense experiences in working together under difficult conditions. Ron has continued his enthusiastic and dedicated work for ORACBA and serves as our in-house economist, working to assure that major rules are based on sound cost-benefit analyses for mitigation of identified hazards. Ron developed the Risk Forum and continues to manage that very successful monthly seminar. If you have ideas or suggestions for future Forum speakers, give Ron a call; he's always looking for suggestions and ideas.

The next step was to find a secretary, a program analyst, really, who could be all things to all parts of the small ORACBA organization. We were most fortunate when Cheryl Delamater agreed to work with us.

ORACBA was initially designed to have a staff of five. Given the nature of our charge, we needed a specialist in public health and another for the environment, both of whom must have risk assessment experience. Michael McElvaine came in early January on detail from APHIS; Sue Ferenc came in late May from the private sector. The five of us work closely as a team, and the biggest challenge of all seems to be to make sure that at least one of us is in the office. Given the number of committee meetings, presentations, and other activities which we must cover, it is indeed a challenge. Michael serves as Newsletter Editor and is ORACBA's representative to many food safety committees. Sue is busily engaged in statutory review functions for two Farm Bill programs: Environmental Quality Incentives Program (EQIP) and Conservation Reserve Program (CRP). She is also working on a White Paper for the National Science and Technology Council (NSTC) on agro-ecosystems risk assessment.

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An example of precision targeting using spatial analysis.

A demonstration of the utility of precision targeting was recently conducted for DoD on a U.S. naval vessel where German cockroach populations were controlled using a novel bait technology applied according to their spatial distributions. The test vessel, the U.S.S. Canopus at Kings Bay, GA, had a history of German cockroach problems. A visual inspection revealed relatively high populations in several food preparation areas. Two of these, the bakery and the galley, were chosen as test sites. Baited sticky traps put out one morning and collected the next were used to determine the spatial distribution and population levels of roaches. A site map of each area was made, and the location of principal items (counter, refrigerator, ovens, etc.) was noted. From this sketch, X and Y coordinates were determined at numerous points to define these items and the shape of the room. The locations of the baited traps also were marked on the site maps. Trap counts along with their associated coordinates were the necessary inputs for the spatial analysis.

The next step in the process was to create maps for both sites using the spatial analysis software Surfer © (Golden Software, Inc., Golden, Co). This involved inputting the X and Y coordinates for the points that defined the room boundaries, the additional items such as the stoves and refrigerators, and the coordinates of the trap sites. These maps were created only once at the outset of the program and can be seen as the basis of Figures 1 and 2. Following map-making, Surfer was used to predict the densities of cockroaches between trap locations using geo-statistical methodology known as Kriging and to display the contours, plotting isolines of cockroach distribution (Fig. 1a). The final step was to prepare probability contour maps -- these indicated the probability of encountering foci of particular size (Fig. 1b), i.e., the probability of exceeding a threshold count of 13 roaches. This probability contour map was then used to "target" treatment interventions to only those locations where the probability of encountering pests was high (see the caption for Figure 1 for details). The following day, post-treatment trapping gave us a report on how we did (Fig. 1c and 1d) in terms of the Kriged distribution and the probability contour map. Figure 2 shows how these techniques were used to direct the second, mop-up application, and document the potential sources of reinfestation. The final map is then used as a blueprint for periodic monitor trapping. ■

Note: Figures 1 and 2 are on pages 4 and 5

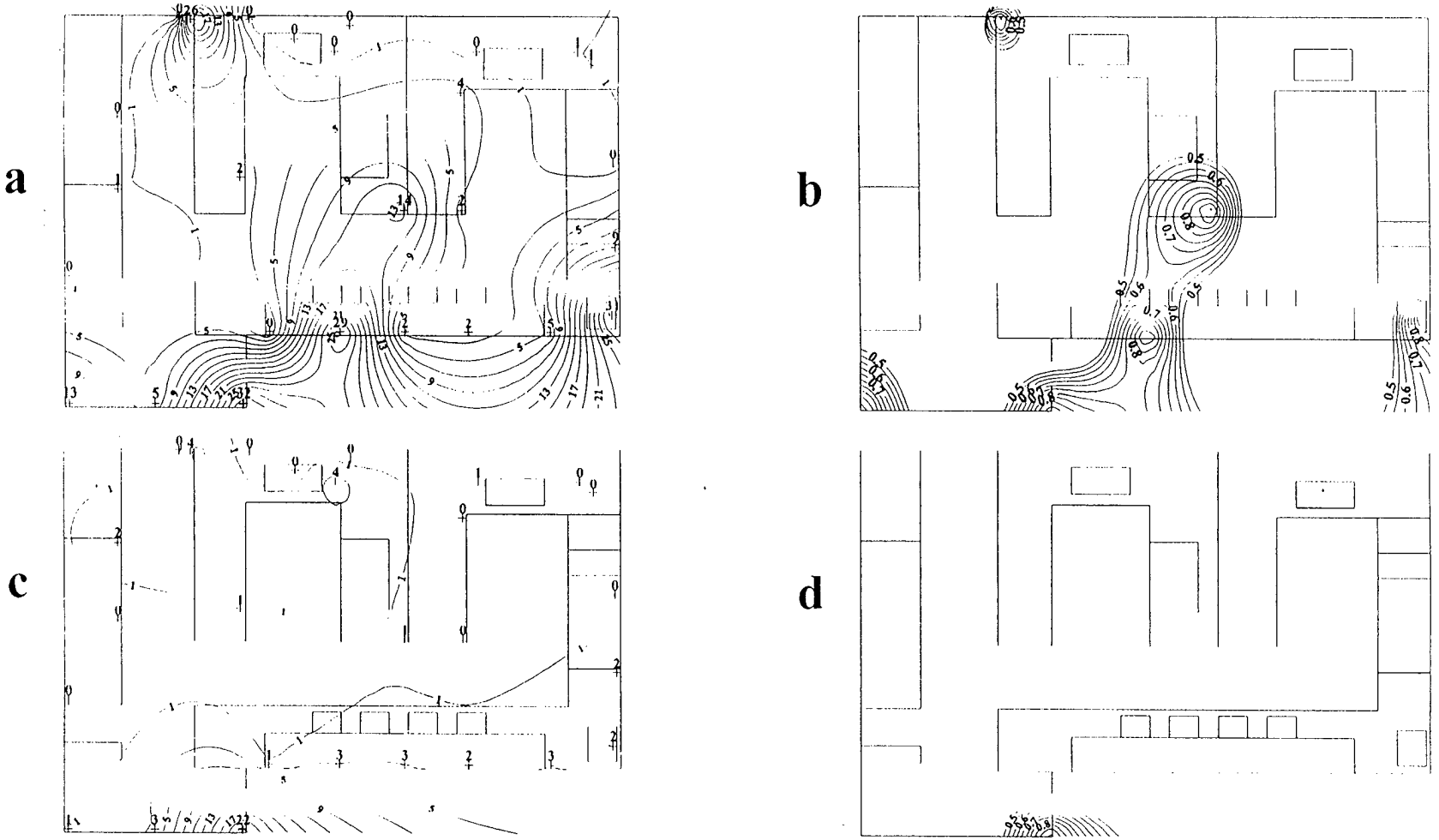

Fig. 1. German cockroach distribution and management using precision targeting in a galley on the U.S.S. Canopus. Pretreatment trap counts (27 traps; location marked with +, number above is total number of cockroaches) were used to generate a contour map of the total distribution of cockroaches (a). From this, a contour map was prepared showing areas with probabilities of 0.5 or higher of encountering foci (b). These foci cumulatively encompassed 75% of the total population, and represented a sticky trap threshold of >13 cockroaches. This was used as the precision targeting map, and bait was applied per this map. Data from 24-h post treatment were used to generate an updated distribution map (c). Based on the pretreatment threshold, only 1 area remained as a significant foci (d).

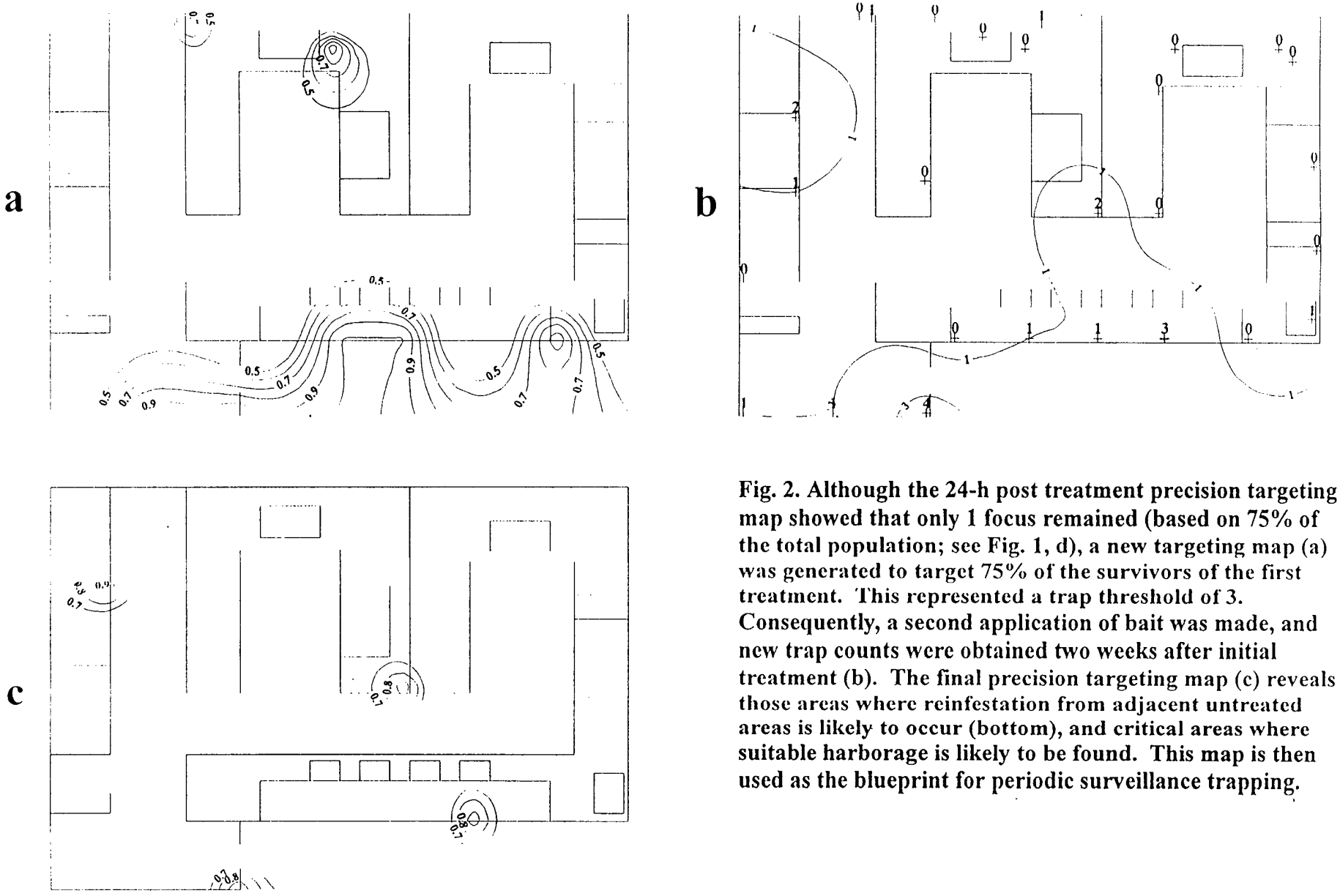

Fig. 2. Although the 24-h post treatment precision targeting map showed that only 1 focus remained (based on 75% of the total population; see Fig. 1, d), a new targeting map (a) was generated to target 75% of the survivors of the first treatment. This represented a trap threshold of 3. Consequently, a second application of bait was made, and new trap counts were obtained two weeks after initial treatment (b). The final precision targeting map (c) reveals those areas where reinfestation from adjacent untreated areas is likely to occur (bottom), and critical areas where suitable harborage is likely to be found. This map is then used as the blueprint for periodic surveillance trapping.

Report on September Risk Forum:
Dr. Allison O'Brien

The featured speaker at the September 13 Risk Forum was Dr. Allison O'Brien, Chair of the Department of Microbiology and Immunology of the Uniformed Services University of the Health Sciences (USUHS). Dr. O'Brien received her Ph.D. in Medical Microbiology at Ohio State University and continued her postgraduate training at the Walter Reed Army Institute of Research prior to joining USUHS. Her presentation was "Profile of a Foodborne Pathogen: Enterohemorrhagic *E. coli.*"

Dr. O'Brien first explained that Enterohemorrhagic *Escherichia. coli* (EHEC) is a term used for those *E. coli* that cause disease in humans; there are other shigatoxin-producing bacteria in animals that have not been found to cause disease in humans. In addition to causing intestinal infections, EHEC can also develop into Hemorrhagic Uremic Syndrome (HUS) in children and Edema Disease in adults. HUS can be fatal in children as in the highly publicized 1993 outbreak of *E. coli* O157:H7 infections caused by hamburgers from a fast-food restaurant chain.

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Though there are only five of us permanently in ORACBA, we would be remiss if we did not mention the myriad others who have made it possible for us to carry out the many duties that have come our way. Our colleagues have supported us by reviewing risk assessments and research reports when we had no in-house expertise on the topic. Others from USDA, as well as FDA and EPA, have served on a variety of panels to support the review of regulations, to help develop methods for risk assessment, and to support our training activities. Because of the cooperation of Dr. Charles Yoe (College of Notre Dame), Dr. Yacov Haimes (University of Virginia Center for Risk Management) and Drs. Anne Smith and Warner North (Decision Focus, Inc.), and many colleagues in USDA and FDA, ORACBA has been able to deliver two training sessions in its first year. A review of the first 5 issues of the Newsletter reflects this wonderful cooperative spirit we have met each place we have asked for help. We appreciate the cooperation.

Now what can be expected for Year Two? First, the Risk Forum seminar series will continue and the Newsletter will carry forward. Editor McElvaine is asking for comments and suggestions for the future (please fill out and return the survey attached at the end of this Newsletter issue). Undoubtedly we are continuing our service on interagency committees and a variety of review functions. We are continuing to support statutory review functions, with EQIP and CRP risk assessments nearly complete. We are pleased that FSIS called us early in the process to consult on risk assessments for the upcoming "egg reg" and a mammoth transportation initiative for all potentially hazardous foods. Both the egg and transportation advanced notices of proposed rule making are joint with FDA, and thus they present an added challenge.

We expect to institutionalize our training activities through the USDA Graduate School. In fact, ORACBA and FDA's Center for Food Safety and Nutrition (CFSAN) are collaborating in the development and implementation of a series of courses. To support that effort, ORACBA has hired a graduate student, Bea Covington, with training and experience in developing training materials, to work on this project. (She is completing her Ph.D. in agricultural economics at the University of Florida.) Bea is also responsible for the newly organized Resource Room for ORACBA (come check it out!). (NOTE: The National Agricultural Library materials on risk in agriculture are also available for use in the ORACBA Resource Room.) We expect to have several detailees (2-3 months each) from ARS and CSREES. We have a visiting scientist, Dr. Michael Kamrin, coming in April; Dr. Kamrin is a toxicologist, an AAAS Fellow and is world-renown for his work in risk communication. It is also possible that several other scholars will be joining us for a year beginning next summer, allowing us to expand our resources and better accomplish our mission .

There are several special things we are working on, in addition to the items in the statutory mission. One is a project, in conjunction with FDA and OMB, to examine uncertainty in cost-benefit analysis. Another is editing a monograph providing a world-wide perspective on risks from foods of animal origin. Yet another is serving on several non-government committees to examine uncertainty in risk assessment (University of Virginia) and to look at Life Cycle Risk Assessment (American Society of Mechanical Engineers). We will continue our initiative in hazard identification for USDA, the development of the Risk Resource Desk Reference, and a closer look at how to improve the regulatory analytic process. The Executive Risk Advisory Committee will undoubtedly be of service in this endeavor.

We appreciate your continuing support and cooperation. It will be a busy year! ■

Report on October Risk Forum:
Dr. Rogene Henderson

The October 11 Risk Forum featured Dr. Rogene Henderson of the U.S. Department of Energy (DoE). Dr. Henderson is a Senior Scientist with the Inhalation Toxicology Research Institute and an Advisor to Dr. Carol Henry in the Office of Science and Risk Policy in the Office of Environmental Management at DoE. (Dr. Henry, originally scheduled for this Forum, was unable to speak due to unexpected schedule conflicts.) Before coming to DoE, Dr. Henderson was a professor at the University of Arkansas School of Medicine and was a Fulbright Scholar. The title of her presentation was "Risk in Decision Making in the U.S. Department of Energy, Office of Environmental Management."

DoE has over 3,700 sites, in 34 States and territories, that are contaminated with hazardous, radioactive, and mixed wastes. Many of these sites were involved with nuclear energy research and production and radioactive waste stores and/or contamination. Until the 1980's, DoE and the agencies it replaced were almost exclusively self-regulating, in part due to national security interests. The Environmental Management Program was begun in 1989 with a primary mission to protect human health and the environment. DoE goals included addressing urgent risks and threats, maintaining a safe workplace, providing sound financial management, and building partnerships with stakeholders. Credible risk assessment and good risk management were highlighted as keys to achieving these goals.

The central question facing DoE, according to Dr. Henderson, was how to set priorities that incorporated all the identified risks and hazards and also considered all of their goals. To help with this question, DoE requested the National Academy of Sciences (NAS) to determine if a risk-based approach to DoE's environmental remediation program would be feasible and desirable. In their 1994 report, NAS acknowledged that the DoE program had merit; NAS also provided guidance for implementation of the program. Since this report, DoE has been developing, applying, evaluating, and improving its risk evaluation and management processes through several other working groups and publications.

Dr. Henderson closed with several comments about lessons learned so far, focussing on the importance of getting input from all stakeholders with acknowledgment of the different values and specific concerns of each group. However, she did confess that their approaches for public involvement have had mixed reviews. In closing, Dr. Henderson noted that results should be regarded "not as analytically pure but rather judgmentally correct and unlikely to be far wrong." ■

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Dr. O'Brien and her colleagues have identified a protein called "intima" that is essential for binding of EHEC to the intestinal mucosa, thus affecting the pathogenicity of EHEC. They are collaborating with other researchers at the National Animal Disease Center in Ames, Iowa, and the University of North Carolina at Greensboro in looking at calf models. The goal is to develop a vaccine to be administered to the calves that would prevent infection by EHEC. One promising research area is in transgenic alfalfa which could provide an easy route of administration through the diet.

For the final part of her presentation, Dr. O'Brien discussed research on different subtypes of shigatoxin. Her group has identified a supercolonizing strain of EHEC that produces a shigatoxin that has a much higher pathogenicity for humans than other shigatoxins. This research may lead to future advances in prevention and control of EHEC infections in humans. ■

ORACBA News

Regulatory Plans for Major Rules in USDA

Several USDA agencies have announced plans for major rulemaking activities. In some cases, major rules have already been proposed; in other cases they are in the announcement stage. A major rule, as defined under PL 103-354, Section 304, is deemed to be economically significant if it has an annual impact of $100 million or more on the economy. Under statutes applicable to the USDA, such rules require a risk assessment and cost-benefit analysis if their primary concern is human health, human safety, or the environment. While not all agency plans are finalized, the coming year appears to provide some significant challenges to risk assessors and regulatory analysts in USDA.

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USDA Risk Assessor In Profile:

Drs. Robert (Bob) Buchanan and Richard (Dick) Whiting

This Risk Assessor Profile is really about two researchers who have been working together in predictive microbiology since 1988, though each alone has worked in microbiology and food science far longer. Dr. Robert (Bob) Buchanan and Dr. Richard (Dick) Whiting of ARS' Eastern Regional Research Center, Wyndmoor, PA, have been engaged in food safety risk assessment research since 1993, a natural extension of their earlier modeling work. Bob, with a Ph.D. from Rutgers and Dick with a Ph.D. from Oregon State, each have impressive research records, boasting a total of over 200 publications. Much of this work concerns predictive microbiology, that is, developing and applying growth models to help understand how microbes remain on food after processing and grow to numbers that can ultimately cause illness in humans.

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The Environmental Quality Incentives Program (EQIP) was established by the 1996 Farm Bill to assist producers in making environmental and natural resource conservation improvements. Technical assistance, cost-share payments, grants, and education will be provided to producers who voluntarily enroll in the program to address environmental problems in their farming and livestock operations. The program encourages partnerships with State and local organizations in addressing these problems and directs the program to focus on conservation priority areas. Due to regulatory deadlines imposed by the 1996 Act, the proposed rule (published October 11, 1996) was not accompanied by a risk assessment and cost-benefit analysis as required. However, these analyses are underway and the risk assessment will accompany the final rule. By 1 year after final proposal, the cost-benefit for mitigation will be produced, based on actual sign-up data. The major issues addressed by the regulatory impact analysis concern the identification of conservation priority areas and implementation decision criteria which require that the program be implemented in a manner which maximizes the environmental benefits per dollar spent.

The Conservation Reserve Program (CRP) was established by the Food Security Act of 1985 to provide for environmental, production control, and farm income objectives. The CRP is a long-term land retirement program, designed to encourage farmers to put highly erodible or environmentally sensitive land into a conserving use, thereby improving soil and water resources and improving wildlife habitat. The 1996 revisions to the program will place greater emphasis on the enrollment of environmentally sensitive lands. Under the proposed rule, announced on September 23, 1996, land eligibility criteria would be modified to include all cropped wetland and other sensitive wetland areas. Financial incentives would be available to encourage farmers to enroll environmentally sensitive land in the program. Farmers re-enrolling land whose contracts have expired must do so on the basis of environmental benefits and costs. Due to regulatory deadlines, a risk assessment did not accompany the CRP proposed regulation; however, it is underway. The results of the analysis will assist program managers in USDA's Farm Service Agency in developing program policies to enroll acreage that will provide the greatest environmental benefits per dollar spent. The cost-benefit of mitigation will be completed 1 year after final rule promulgation and will be based on land sign-ups.

Improving the safety of shell eggs and egg products is a joint regulatory activity undertaken by the Food and Drug Administration (FDA) and USDA's Food Safety and Inspection Service. Currently, the proposed regulation will address four major areas where egg safety can be improved: shell egg production and handling, processed egg products, cooling and transportation of eggs, and labeling and consumer education. Joint jurisdiction for egg safety has led FDA and USDA to coordinate their risk assessment and cost-benefit analyses for options to improve the safety of shell eggs and egg products. The major concern from the risk assessment perspective is the development of a well-specified model to identify the critical points where *Salmonella enteritidis*, if present in the egg, can multiply to unsafe levels and the likelihood that human health may consequently be threatened.

ORACBA Newsletter Evaluation

This issue marks the completion of the first year of the ORACBA Newsletter. The Newsletter has grown and developed far beyond our original aspirations. Over the next 2 months, we will be reviewing our first six issues in order to plan for the coming year. We would like your help in this review. Attached at the end of the Newsletter is a short evaluation form. We ask you to spend a few minutes to share your opinions about the Newsletter. Please return the form to us by fax by December 1 so that we can use your input in our planning. You may also mail the form to us at our address found on page 1. Your help is greatly appreciated!

Risk Resources - Newsletter on the World Wide Web

The staff of ORACBA is happy to announce that the Newsletter now appears on the World Wide Web. You can find us by first going to the USDA Homepage at: http://www.usda.gov and then clicking on "About USDA," "USDA Agencies and Programs," and finally "Office of Risk Assessment and Cost-Benefit Analysis." You may also go directly to the ORACBA Homepage at: http://www.usda.gov/oce/oracba/oracba.htm. At the ORACBA Homepage you will find the latest issue of the newsletter as well as our previous issues, beginning with our first issue from January 1996. The Homepage

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One of the reasons this work is so fascinating, according to Dick, is that it ties microbiology and public health together with a readily understandable, tangible element, food. "The value of a risk assessment is the insight into processing obtained from doing the sensitivity analysis." Bob reminds us that the more precise quantitative approach to problem solving is helping researchers understand that common wisdom may not be either common or wise. As an example, he cites the time and temperature elements of thermal processing. As quantitative risk assessment has been applied, it is apparent that temperature fluctuation (even a degree) is more important than time.

Traditional food processing developed by trial and error over centuries, and both Bob and Dick are amazed by how safe these traditional methods are, citing cooking, canning, and pasteurization as examples. In the jargon of risk analysis, these are risk management techniques. Rather than place emphasis on preventing the occurrence of micro-organisms on food (micro-organisms have been known to science only a little more than 100 years) preservation and cooking were emphasized to improve flavor or keeping qualities. Fortuitously, such steps also helped assure that the unrecognized microbial hazards were minimized.

In spite of how safe our traditional approaches are, both food processes and micro-organisms evolve and change over time and when they do, they present us with new challenges. For example, 20 years ago, dry cured salami, an uncooked fermented product, was originally designed to eliminate such bacteria as *Staphylococcus aureus* and *Salmonella spp* by using a starter culture. The decreased pH and extreme dryness led to a product in which no bacterial growth could occur even though these organisms might survive. About 10 years ago, concern over *Listeria* arose, but this pathogen is also eliminated by the low pH. In the past few years, however, a type of *Escherichia coli (E. coli)* with increased tolerance to an acid environment has emerged. Coupled with that, this *E. coli* has very low infective doses, thus setting the stage for an emerging public health problem.

When asked to share insights into food safety risk assessment, Bob and Dick reminded us that much more work is needed, that there are lots of blanks in our knowledge base. Laboratory researchers and risk assessors must work together. Risk assessment is a multidisciplinary enterprise and the many components of knowledge required must be shared in partnerships between lab scientists, industry processors, consumer behavior specialists, animal and plant producers, and epidemiologists in order to provide a farm-to-table understanding of food safety. "An important future use of risk assessment will be at the food industry level to design safer processes to assure government, consumers and the public health community of the safety of food," asserts Bob. Dick reminds us that "HACCP without risk assessment has no scientific foundation."

Risk assessment does not give a black or white answer, but organizes ideas and information to help the decision maker make wise choices, those that are both effective and efficient. Classic risk assessment, a snapshot in time, is not always sufficient to help the food safety decision maker; rather the risk assessment must be dynamic, combining growth models with probabilistic ones, especially when dealing with organisms which replicate and food processes that may be altered.

Perhaps the biggest challenge of all is that micro-organisms change and evolve and thus new pathogens emerge. Can risk assessment predict emerging pathogens? "No," both agree, "but situations in which animal parts are recycled for food for other animals is a likely place to look. When environmental factors change, such as the introduction of new chemicals or processes, the futurists may find fertile ground for predicting emerging pathogens."

Drs. Buchanan and Whiting are engaged in exciting scholarship at the cutting edge of risk assessment. They have been generous participants in ORACBA Risk Forums and Food Safety Risk Assessment Workshops. We appreciate their input. ■

Risk Calendar

November 1996
The ORACBA Risk Forum will be Wednesday, November 13, from 10-11:30 in the Williamsburg Room, Whitten 104-A. (If room is pre-empted, Risk Forum will be in Room 0305, South Building.) Dr. William Wood and associates from Environmental Protection Agency (EPA) Office of Research and Development will make a presentation of the EPA Draft Guidelines for Ecological Risk Assessment. For more information, please call (202) 720-8022.

Duke University Law School and the Nicholas School of the Environment and the Research Triangle Chapter of the Society for Risk Analysis are presenting "Risk in the Republic: Comparative Risk Analysis and Public Policy" on November 15-16, 1996. This conference focuses on the science, law and ethics of evaluating and managing risks. For further information, please contact H. Christopher Frey at (919) 515-1155 or email to frey@eos.ncsu.edu.

December 1996
The annual meeting of the Society for Risk Analysis (SRA) is scheduled for December 8-11 in New Orleans, LA. This will be a joint meeting with the International Society of Exposure Analysis. For more information, contact SRA at (703) 790-1745.

The ORACBA Risk Forum will be Wednesday, December 11, from 10-11:30 in the Williamsburg Room, Whitten 104-A. Dr. John Fedkew of the Forest Service will present "Managing Multiple Uses on National Forests: A 90-year Learning Experience and an Approach to Ecosystem Management." For more information, please call (202) 720-8022.

January 1997
The ORACBA Risk Forum will be Wednesday, January 8, from 10-11:30 in Whitten 107-A. Dr. Morris Potter from the Centers for Disease Control and Prevention in Atlanta will be discuss "Current Issues in Food Safety and Public Health." For more information, please call (202) 720-8022.

February 1997
The World Association of Veterinary Microbiologists, Immunologists, and Specialists in Infectious Diseases will hold its XV International Symposium in Cyprus from February 16-21. Theme of the symposium is: Salmonellosis-Brucellosis As World Health Problems for Humans and Animals. For further information, contact K. Polydorou, Veterinary Public Health Institute, P.O. Box 284, Nicosia, Cyprus, Telephone (357-2-) 453121.

March 1997
The Risk Assessment & Policy Association will be holding a national meeting on March 6-7, 1997, in Alexandria, VA. They have solicited papers on a broad range of topics about risk assessment, risk management, and related policy issues. For more information, contact Carol Ruh at (603) 228-1541 or at URL http://www.fplc.edu/tfield/rapamtg.htm. ■

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version of the Newsletter has been reformatted with an index to provide hotkey access to all of the articles and features. If you enter our address as a bookmark on your browser, you will have all issues of the Newsletter at your fingertips.

The rest of the ORACBA Homepage remains under construction at this time. In the near future, we will be adding information to our homepage about ORACBA functions, activities, staff, and contact information. Please let us know if you have any suggestions. ■

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