

SCWDS BRIEFS

A Quarterly Newsletter from the
SOUTHEASTERN COOPERATIVE WILDLIFE DISEASE STUDY
COLLEGE OF VETERINARY MEDICINE
THE UNIVERSITY OF GEORGIA
ATHENS, GEORGIA 30602

GARY L. DOSTER, EDITOR

Phone (706) 542-1741
FAX (706) 542-5865

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SCWDS History Continued: The CapChur Gun

This is the third in a series of articles in recognition of the 50th anniversary of the beginning of SCWDS on July 1, 1957. The first article presented historical data on the organization of SCWDS, and subsequent articles are highlighting some notable events. This article concerns the development of the CapChur Gun.

Nothing had as much impact on the success of deer restoration efforts in this country as the dart gun. As soon as a useable model was perfected, it immediately gained wide acceptance and became a valuable tool in the management of many species of wildlife and domestic livestock throughout the world. Although early efforts to invent the dart gun began before the "birth" of SCWDS, Dr. Frank Hayes, later to be the first SCWDS director, was very much involved in its development and its eventual success. After SCWDS was formed, Dr. Hayes and his staff continued to make substantial contributions to improvement of the gun, darts, and drugs.

State and federal wildlife agencies began serious attempts to reestablish deer in many parts of the United States after WWII, but they had limited means of capturing deer for relocation. Some early capture methods included box traps and driving deer into nets or corrals. Both methods were labor intensive and expensive, and neither was very efficient. In addition to being expensive, the box traps were large and heavy and difficult to move around, and the deer drives took a lot of manpower for the few deer captured. There were early efforts

by others to discover suitable drugs for immobilizing deer and to develop a method of successfully administering the drugs by remote means; however, nothing really worked until Jack A. Crockford and James H. Jenkins teamed up to tackle the problem.

Crockford and Jenkins were wildlife biologists with the Georgia Game and Fish Commission (now the Wildlife Resources Division of the Georgia Department of Natural Resources). As far back as the late 1940s, when they were working together on translocating white-tailed deer in Georgia, they knew that they desperately needed a better method of catching deer and discussed the possibility of using drugs to immobilize them. Finally, in 1954 they decided to do something about it. By this time, Jenkins had earned a PhD and was on the faculty of the University of Georgia's School of Forestry (now the Daniel B. Warnell School of Forestry and Natural Resources). In his home workshop, Crockford designed and built a variety of blowguns, spearguns, and air guns before devising a successful means of delivering a drug-laden dart – an extensively altered air rifle. Many types of darts were designed and tested by Crockford and Jenkins before they came up with the best one.

Realizing that they needed someone with expert knowledge of drugs and veterinary medicine, Crockford and Jenkins brought in their friend Dr. Frank A. Hayes, a veterinarian on the faculty of the University of Georgia's School of Veterinary Medicine (now the College of Veterinary Medicine). This was a few years before SCWDS was founded, but Hayes had a life-long interest in wildlife and was anxious to join the team. With his extensive knowledge of pharmacology and physiology, Hayes played a critical role in evaluating the effects of the experimental drugs,

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first on laboratory animals and later on wild deer, and he was always ready to head to the field. They later added Dr. Sheldon D. Feurt, a pharmacist with the University of Georgia's School of Pharmacy, to the group.

The first drug tried on laboratory animals was curare. It worked well as long as they used the correct amount, based on the weight of the animal, and if they could immediately administer oxygen and provide respiratory support for the animal until the effects of the drug wore off. Guessing the correct weight of a wild animal and hauling an oxygen tank around with you in the woods when capturing deer was not practical, so they knew they needed a different drug.

The next drug tried was strychnine. This also worked well with laboratory animals, but it was critical to administer an antidote as soon as the animal was immobilized, so strychnine, too, was not practical to use under field conditions with wild deer. However, while using strychnine, the group actually captured their first deer with the dart gun on Ossabaw Island, Georgia, on August 1, 1955. Although they succeeded in capturing a few more deer using strychnine, it was too dangerous and inconvenient for sustained use in the field, and they knew they needed to try something else.

The first real success they had was with nicotine. It would immobilize an animal in a short time and did not require oxygen or an antidote to ensure recovery of the animal. After experimenting with laboratory animals, the team went back to Ossabaw Island to field test it with deer. Although there were some negative aspects of using nicotine, it did work, and they brought back seven whitetails on the first trip and eight deer on the next trip. Over the next few years Crockford continued to improve the air guns and darts, and, just as important, the choice of effective drugs was expanded. The result was the successful capture and relocation of hundreds of deer from Georgia's coastal islands other areas in Georgia.

Now that they had a dependable gun and drugs that would work, they were deluged with requests from wildlife departments all over the

country who wanted to buy the dart gun and have the Georgia team train their employees to use it. Since Crockford was designing and building the guns and darts in his home workshop, it was all he could do to supply his own needs. At this time they added Atlanta businessman and entrepreneur, Harold C. "Red" Palmer to the group. Palmer was president of de Leon Pharmaceutical Laboratories, Inc., and he provided financial and technical assistance for further development of the equipment. With Palmer's input, they soon were mass-producing precision darts and carbon dioxide-powered guns to meet the demand, and the Palmer Chemical and Equipment Company, Inc. was founded to furnish the equipment to users worldwide. The CapChur Gun has been used on every continent in the world to capture many kinds of wild animals from lions and tigers to gorillas and elephants.

Although the five principals involved have been rightly credited for the invention of the tranquilizer dart gun, untold numbers of other wildlife biologists, wildlife technicians, wildlife law enforcement officers, veterinarians, and many others played important roles in the development of this wonderful invention. Of the original five, only Jack Crockford survives. Now 84 years old, Jack (and Fio, his wife of 59 years), still live at the same address in Chamblee, Georgia, and when he's not hunting or fishing Jack still spends a lot of time in his home workshop, making collector-quality knives, engraving guns and knives, and building an occasional muzzle-loading rifle. (Prepared by Gary Doster)

SCWDS Honored

In recognition of its 50th anniversary and its many contributions to wildlife management, SCWDS recently received several honors from its peers. The awards were presented at a dinner given during the Annual Spring Directors Meeting of the Southeastern Association of Fish and Wildlife Agencies, held in Athens, Georgia, May 5, 2007. The Quality Deer Management Association (QDMA) presented SCWDS with its 2007 Agency of the Year Award. The QDMA (www.qdma.com), which was founded in 1988, is a non-profit wildlife conservation organization dedicated to ensuring a

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high-quality and sustainable future for white-tailed deer and white-tailed deer hunting. Previously, only state wildlife or agricultural agencies had received this award; however, QDMA honored SCWDS this year as “as North America’s leading experts not only on diseases, parasites and other anomalies of white-tailed deer, but of many other wildlife species as well.”

The National Wild Turkey Federation (NWTF) presented SCWDS with a beautiful sculpture of three gobblers mounted on a walnut pedestal “in recognition of and appreciation for 50 years of service to the wildlife community.” Founded in 1973, the NWTF (www.nwtf.com) is a grassroots, nonprofit organization with 584,000 members in 50 states, Canada, Mexico, and 14 other foreign countries. It supports scientific wildlife management on public, private, and corporate lands, as well as wild turkey hunting as a traditional North American sport. The NWTF has been a strong SCWDS supporter and collaborator on several wild turkey health projects over the years.

Dan Forster, Director of the Georgia Division of Wildlife Resources, presented SCWDS with a resolution passed by the Georgia House of Representatives in January 2007 that recognized and thanked SCWDS “for 50 years of dedicated service to the people of Georgia through the scientific investigation of wildlife health issues... and the invaluable role SCWDS has played in the conservation of wildlife in Georgia and across the Southeast.”

Bob Duncan, Wildlife Division Chief for the Virginia Department of Game and Inland Fisheries and also Chairman of the SCWDS Steering Committee, presented SCWDS with original artwork commissioned in observance of the 50th anniversary. The painting, which depicts 18 species of wildlife on which SCWDS conducts diagnostic or research investigations, can be seen on the SCWDS website at www.scwds.org, along with images of the QDMA and NWTF awards. The original painting now hangs in the SCWDS building while numbered and signed prints are being prepared. We are humbled and gratified by all this praise and

proudly share it with all SCWDS staff, past and present. (Prepared by John Fischer)

More Interesting HD Events from 2006

In the October 2006 issue of the SCWDS BRIEFS, we reported that we had isolated numerous and diverse serotypes of bluetongue viruses (BTV) and epizootic hemorrhagic disease viruses (EHDV) from white-tailed deer during 2006. Isolations of BTV were made from Kansas (BTV-17), Kentucky (BTV-17), and Missouri (BTV-10, BTV-11, BTV-17). EHDV-1 was isolated from deer in Mississippi and Missouri, and EHDV-2 was isolated from deer from Colorado, Georgia, Illinois, Kansas, Louisiana, Mississippi, Missouri, and Texas. Two events occurred that were unprecedented: the isolation of five BTV/EHDV serotypes from white-tailed deer in a single season in a single state (Missouri); and the isolation of EHDV-2 from a white-tailed deer from Texas in March (all previous HD isolates have been made from July to December). This was a very interesting year, but the story does not end here.

On September 28, 2006, we received tissues from a captive white-tailed deer from Iroquois County, Illinois, and a wild deer from Vermillion County, Indiana. The isolated viruses tested positive for EHDV by PCR, but we could not identify the serotype (EHDV-1 or EHDV-2) using standard virus neutralization techniques. This was followed by four additional isolations of this “unidentifiable” EHDV from captive deer: one from Henry County, Indiana, and three more from Iroquois County, Illinois. These isolates were sent to USDA’s National Veterinary Services Laboratories (NVSL) for identification; testing confirmed that these viruses are EHDV, but not EDHV-1 or EHDV-2, the subtypes normally found in the United States. The isolates have been forwarded by NVSL to the European Union BTV/AHS Reference Laboratory at the Institute for Animal Health, Pirbright, United Kingdom, for serotype identification. Results are pending.

If this were not enough, on October 18, 2006, we isolated a virus from a wild white-tailed deer from Yalobusha County, Mississippi, that tested

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positive to BTV by PCR, but the virus could not be identified to serotype using antisera for indigenous BTV serotypes (BTV-2, -10, -11, -13, and -17). Initially, we suspected BTV-1, which is an exotic BTV that we isolated from a white-tailed from Louisiana in 2004. To our surprise, this isolate was identified as BTV-3 by NVSL.

It appears that in 2006 we either documented two instances of orbivirus introduction into the United States or detected viruses that had been present but were “under the radar.” Because these introductions may occur through both natural and unnatural (human assisted) paths, it is difficult to understand the implications. BTV-3, like the BTV-1 isolated in 2004, is a subtype that occurs in the Caribbean and in Central America, and its presence in the Gulf States may represent nothing more than a natural incursion. The EHDV isolates from Illinois and Indiana, however, are more confusing. It is possible that this may be an introduction of an exotic virus associated with some type of human activity. It is known, for example, that cattle and deer that are infected with EHDV can have prolonged periods of viremia without clinical signs of disease, and, under this situation, it may be possible to transfer these viruses in translocated animals (domestic and wild). Movement of infected vectors also is a possibility. Solving such a mystery is complicated by the lack of current knowledge on the global distribution of EHDV serotypes (there currently are 10 serotypes recognized), as well as a scarcity of reference isolates for many of the serotypes. Regardless of the source, it will be interesting to determine if either of these viruses persist or expand their range in the United States.

These findings document the value of including wildlife in animal disease surveillance systems and the need to clearly identify the causes of wildlife mortality through diagnostic testing. These events also demonstrate the global need for expanded knowledge of the diversity and distribution of these orbiviruses in order to better understand such events. Furthermore, introduction of orbiviruses has not been restricted to the United States. During the past year, BTV-8 has been documented in parts of

Europe that traditionally have not been affected by bluetongue, and, in Israel, EHDV-7 was associated with bluetongue-like disease in cattle. If unexplained white-tailed deer mortality is observed in your area this year, please contact us for diagnostic support. (Prepared by David Stallknecht and Donna Johnson, USDA-APHIS-VS-NVSL)

Fever Ticks

A survey conducted by USDA-APHIS for fever ticks on nilgai antelope (*Boselaphus tragocamelus*) in the Lower Rio Grande Valley National Wildlife Refuge in south Texas has brought national media attention to USDA's fever tick eradication program. The effort, which involved the shooting of 37 nilgai from a helicopter, was conducted after fever ticks were found on a hunter-killed nilgai in the area. Nilgai are native to India and were first released on the King Ranch in South Texas in about 1930. Several additional releases were made in Kenedy County up until 1941. The nilgai adapted well, and an estimated 15,000 nilgai now inhabit the area from Baffin Bay southward to near Harlingen. These nilgai move between Texas and Mexico and may be bringing fever ticks from Mexico into Texas.

Fever ticks, both the cattle fever tick (*Rhipicephalus annulatus*, formerly *Boophilus annulatus*) and the southern cattle tick (*Rhipicephalus microplus*, formerly *Boophilus microplus*), originally were introduced into the Western Hemisphere by Spanish colonists. These ticks are the vectors of babesiosis, also known as “Texas fever” and “cattle fever,” and prior to the eradication program that began in 1906, these ticks were the most significant external parasites of cattle in the United States. Direct and indirect economic losses caused by fever ticks were estimated to be \$130.5 million in 1906, equivalent to over \$3 billion in 1999.

At the beginning of the USDA fever tick eradication program in 1906, the quarantine zone included all areas below a line that passed through Virginia, North Carolina, Tennessee, Missouri, Oklahoma, Texas, and California and included 700,177 square miles. Officially, the

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eradication was concluded in 1943, although additional efforts continued in Florida until 1961. Eradication was accomplished via quarantines, systematic dipping of cattle in acaricides, and vacating pastures. Since 1943, USDA-APHIS has maintained a permanent quarantine zone between Texas and Mexico. Fever ticks are present in Mexico, and outbreaks have continued to occur in the quarantine zone and occasionally north of the quarantine zone. However, in the last few years the outbreaks have increased dramatically. Challenges to the eradication program include acaricide resistance in fever tick populations in Mexico, the potential for further development of acaricide resistance, limited funding and resources, illegal movement of cattle, and an increased presence of alternate wildlife hosts for the ticks, specifically white-tailed deer and exotic ungulates.

White-tailed deer and exotic ungulates are acceptable hosts for fever ticks and are more abundant now in south Texas than they were during the original fever tick eradication. Furthermore, they are increasingly implicated in fever tick outbreaks and in situations where the traditionally effective pasture vacation technique has not been successful. But while the potential for maintenance and dissemination of fever ticks has been acknowledged, the actual role and importance of wildlife in the ecology of these ticks are not well understood, and controlling ticks on these animals presents a substantial challenge. Technologies such as the "4-Poster," an acaricide applicator developed by USDA's Agriculture Research Service to deliver acaricide doses to white-tailed deer, have proven effective in field tests. However, successful application of this and other technologies will depend on quantitative information as to the role of white-tailed deer and exotic ungulates in supporting the tick populations and on development of strategies to implement this and other integrated strategies on a broad scale in South Texas. Surveys such as those of the nilgai are part of an increased effort to address the ongoing impacts of infestation of wildlife by fever ticks on the cattle fever tick eradication program. (Prepared by Joe Corn)

Ehrlichia in White-tailed Deer

White-tailed deer are known to serve as hosts for numerous tick-borne bacteria and rickettsiae, including *Ehrlichia* spp., *Anaplasma* spp., and *Borrelia* spp. The importance of deer to the maintenance of these organisms differs, depending on the species of tick vector. Organisms vectored by the lone star tick (*Amblyomma americanum*), which includes *E. chaffeensis*, *E. ewingii*, and *B. lonestari*, either utilize or are suspected to utilize deer as reservoirs (deer serve as a source of infection to larval or nymphal stages). In contrast, organisms vectored by *Ixodes scapularis*, including *A. phagocytophilum* and *B. burgdorferi*, primarily utilize rodents as reservoirs, and deer are dead-end hosts that are infected when adult ticks feed.

An *Ehrlichia* species closely related to *Ehrlichia ruminantium* (previously called *Cowdria ruminantium*) recently was detected in a lone star tick from Panola Mountain State Park, Rockdale County, Georgia, and is referred to as PM *Ehrlichia* sp. Subsequently, a domestic goat was experimentally infested with lone star ticks collected from Georgia by investigators at the Centers for Disease Control and Prevention, and the PM *Ehrlichia* sp. was detected in blood samples from the goat. The infected goat exhibited fever and mild clinical pathologic abnormalities consistent with ehrlichiosis.

Ehrlichia ruminantium, the causative agent of heartwater (cowdriosis) in ruminants, is widely distributed in sub-Saharan Africa and is established on some islands in the Caribbean. Numerous species of *Amblyomma* ticks can transmit *E. ruminantium*, but *A. variegatum* and *A. hebraeum* are the two primary vectors in Africa. There is great concern that if *E. ruminantium* were introduced into the United States the organism could become readily established in wildlife reservoirs and native ticks. White-tailed deer are experimentally susceptible to infection with *E. ruminantium*, and the Gulf Coast tick, *A. maculatum*, is an experimentally competent vector. In addition, *E. ruminantium* recently has been recognized as a zoonotic disease in South Africa, and the PM *Ehrlichia* sp. recently was

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detected in a human patient from Atlanta, Georgia, with a history of lone star tick bites.

To investigate the possibility that white-tailed deer are potential hosts of the PM *Ehrlichia* sp., we screened samples of whole blood collected from 87 wild white-tailed deer from 20 locations, using a species-specific nested polymerase chain reaction (PCR) assay. Of the tested deer, one deer each from Kentucky, North Carolina, and Virginia were positive for the PM *Ehrlichia* sp.

In addition, two laboratory-raised white-tailed deer fawns were infested with wild-caught adult lone star ticks from Missouri to determine the ability of wild ticks to transmit the PM *Ehrlichia* sp. to deer. The wild-caught ticks transmitted the bacterium to one of the two deer fawns. Colony-reared nymphal lone star ticks acquired the organism from that deer, maintained it as they molted to adults, and transmitted the PM *Ehrlichia* sp. to two naïve fawns. These findings indicate that white-tailed deer are naturally and experimentally susceptible to infection with PM *Ehrlichia* sp. and are able to serve as a source of infection to lone star ticks.

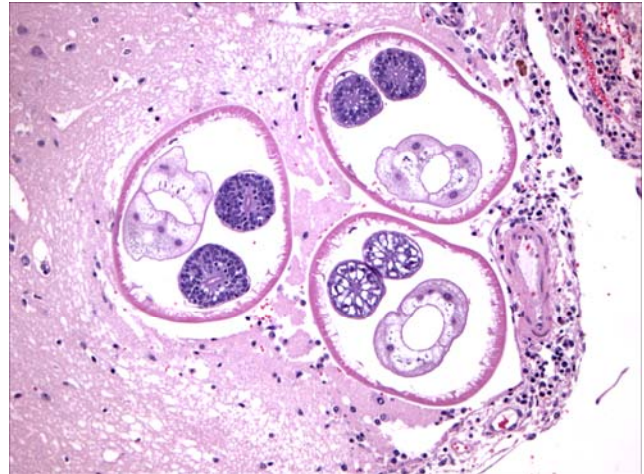
Prior infection with the PM *Ehrlichia* sp., which is serologically cross-reactive with *E. ruminantium* in a goat model, might not protect deer from infection, but may protect them against clinical disease with exotic *E. ruminantium* strains. Further research is needed to determine if cross-protection is afforded against heterologous species of *Ehrlichia* following infection with the PM *Ehrlichia* sp. (Prepared by Michael Yabsley)

Meningeal Worms in Sika Deer

On February 14, 2007, landowners on the Eastern Shore of Maryland noticed an adult female Sika deer walking in circles in their yard. Personnel of the Maryland Department of Natural Resources (MDNR) were contacted and the deer was euthanized due to its apparent neurologic disease. A postmortem examination was performed at the Salisbury Laboratory of the Maryland Department of Agriculture.

Samples subsequently were forwarded to SCWDS for additional investigation.

No gross lesions were obvious in the deer, but microscopically the brain had severe inflammation. This inflammation thickened the tissues covering the brain and also extended deep into the parenchyma, where it often surrounded blood vessels. Three cross-sections of nematodes were present in one of the sections examined.



A complete identification cannot be made by histopathology alone, but the worms seen are consistent with the deer meningeal worm, *Parelaphostrongylus tenuis*.

The normal hosts for the meningeal worm are white-tailed deer, which rarely develop clinical disease when infested by this parasite. However, other species, such as moose, mule deer, elk, and llamas may develop neurologic disease when meningeal worms invade brain and spinal cord tissues in an aberrant migration pattern. Normally, deer acquire larval meningeal worms when they eat the intermediate host, a terrestrial snail or slug, attached to vegetation. The larvae travel to the spinal cord where they take about 30 days to develop to the next stage. The subadults then emerge from the spinal cord and travel beneath the dura mater, the tough connective tissue loosely covering the spinal cord, until they reach the brain. The adults normally reside on the surface of the brain and cause little host response in the white-tailed deer. In other species, however, the nematodes migrate

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excessively and for longer periods as larvae, or invade brain tissue as adults. The tissue damage and inflammation that result can cause fatal neurologic disease.

Though elk and Sika deer belong to the same genus, the disease apparently has not been reported in Sika deer. Surveys conducted on wild deer by SCWDS on the Delmarva Peninsula in 1981 revealed meningeal worms in 4 of 10 whitetails but in none of the 10 Sika deer examined. In that study, Sika deer appeared to be in better nutritional condition than white-tailed deer on the same range. They also had fewer ectoparasites, fewer internal parasites, and were less commonly positive for the infectious diseases assayed by serology. The significance of the meningeal worm to Sika deer populations is uncertain. Sika deer have persisted in the area for a long time, and in the earlier studies conducted by SCWDS they did not harbor meningeal worms. Anecdotally, there have been reports of Sika deer in the area that seemed blind or exhibited other neurologic signs. These deer rarely have been available for necropsy. If additional Sika deer are observed with neurologic signs, we hope to have the opportunity to examine them to assess the prevalence of disease due to the meningeal worm in this population. (Prepared by Kevin Keel)

The Devils' Disease

It is uncommon for diseases alone to lead directly to wildlife population extinctions in the absence of other threats; however, a disease first identified in 1996 is seriously threatening Tasmanian devil (*Sarcophilus harrisii*) populations. This infamous mammal makes its home on the small island of Tasmania, which is about the size of West Virginia, located off the southeastern coast of Australia. Primarily opportunistic scavengers, Tasmanian devils are the world's largest surviving carnivorous marsupial and are well known for their fierce vocalizations and "jaw-wrestling" over carrion.

A devastating disease known as devil facial tumor disease (DFTD) currently is sweeping

through the island's devil population. Since 1996, dramatic population declines have been observed in all but the western portion of Tasmania. The total devil population has declined by 50% in 10 years, with some local populations declining by as much as 90%.

Devil facial tumor disease is characterized by tumors that occur primarily on the lips, oral mucosa, or face. The tumors are typically large, firm masses with a flat, ulcerated surface; the tumor cells are aggressive, malignant and frequently metastasize to other organs. The disease is ultimately fatal. More than 95% of DFTD cases have been diagnosed in animals between 2 and 4 years of age, and affected devils die within 6 months. This has resulted in a population of primarily young animals, in which females only live long enough to engage in one breeding event; normally, females breed every year for 5 to 6 years.

Initially, the disease was thought to be caused by a virus, but virus isolation attempts were uniformly unsuccessful. In February of 2006 in the journal *Nature* (Vol. 439, No. 7076, p. 549), researchers Anne-Maree Pearse and Kate Swift published the "allograft theory" of transmission, whereby a transplantable cancer cell line is passed directly between animals through bite wounds. Tasmanian devil DNA has 14 paired chromosomes, but this research showed that the devil tumor cells have only 13, several of which are visibly abnormal. Most importantly, these anomalies were identical in all facial tumors from 11 individuals with different stages of tumor development. This allograft theory - that a transmissible rogue cell line emerged from a single devil and is now rapidly and fatally spreading through the population by direct contact while fighting and breeding - has gained the support of much of the scientific community. However, research continues in order to more fully reveal the progression and epidemiology of the disease.

Other than organ transplants, direct transmission of cancer cells between individuals has been documented in only two other types of tumors: a cellular transmissible tumor that was reported in a colony of Syrian hamsters in 1964, and the more

extensively studied canine transmissible venereal tumor (TVT). The cell line that causes canine TVT appears to have originated with the domestic dog's wolf ancestors. The dog's immune system can overcome TVT, and the tumors regress with time. Devils with DFTD, however, show no sign of an immune response to the tumor cells. Perhaps through natural selection the Tasmanian devil will eventually develop an immune response to the tumors.

Tasmanian researchers are not willing to take a wait-and-see approach as the situation grows more serious. Collaborative efforts between biologists, pathologists, and state and federal officials are underway to better understand the disease and its effects on the devil population. Researchers with the recently organized Devil Facial Tumor Disease Program are establishing methods for managing the impact of the disease on the wild population and have initiated a captive breeding program with devils taken from western Tasmania, where there has been no record of the disease. (Prepared by Jesse Fallon, Virginian-Maryland Regional College of Veterinary Medicine, Class of 2008)

Recent SCWDS Publications Available

Below are some recent publications authored or co-authored by SCWDS staff. Many of these publications can be accessed online from the web pages of the various journals. If you do not have access to this service and would like to have a copy of any of these papers, fill out the request form and return it to us: Southeastern Cooperative Wildlife Study, College of Veterinary Medicine, University of Georgia, Athens, GA 30602.

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