Brown Treesnake Technical Working Group Meeting

Agenda & Abstracts

16, 17 & 18 April 2008

Hawaii Prince Hotel
Honolulu, Hawaii

Brown Treesnake Technical Working Group Meeting

Hawaii Prince Hotel, Honolulu, April 16-18, 2008

Wednesday, April 16, 2008

9:00 AM Introduction

Session Moderator & Introduction – Earl Campbell, USFWS, BTS Technical Working Group Coordinator

Welcome and opening remarks
Review agenda, logistics, announcements, housekeeping
Introduction of participants

Session 1 - Recent Research and Management Developments

An evaluation of the potential economic impacts of the introduction of the brown treesnake on tourism in Hawaii
Stephanie A. Shwiff, Karen Gebhardt and Katy N. Kirkpatrick
USDA-APHIS-WS, National Wildlife Research Center

Uncertain populations and the value of information
Sean D'Evelyn[1], Kim Burnett[2], Nori Tarui[1], and Jim Roumasset[1]
[1]University of Hawai'i at Manoa
[2]University of Puget Sound

~ 10:30 Break

Canine team detection of free-ranging radio-telemetered brown treesnakes
Julie Savidge[1], Robert Reed[2], James Stanford[3], Ginger Haddock[3], Rebecca Stafford[3]
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University
[2] U.S. Geological Survey, Fort Collins Science Center
[3] U.S. Geological Survey, Brown Treesnake Project, Guam

An operational assessment of bait station design and toxicant use and their demographic effects on the brown treesnake (*Boiga irregularis*)
Craig Clark[1], Daniel Vice[1], and Peter J. Savarie[2]
[1]USDA-APHIS, Wildlife Services, Guam
[2]USDA- APHIS-WS, National Wildlife Research Center

Spotting cryptic critters in the dark: Headlamps meet the closed population
Björn Lardner[1], Gordon H. Rodda[2], Julie A. Savidge[1], Robert N. Reed[2], Amy A. Yackel Adams[2].
[1]Department of Fish, Wildlife and Conservation Biology, Colorado State University
[2]U.S. Geological Survey, Fort Collins Science Center

Paper flags for aerial Delivery of baits to brown treesnakes
Peter J. Savarie[1], Craig S. Clark[2], and Tom Mathies[1]
[1]USDA-APHIS-WS, National Wildlife Research Center
[2] USDA-APHIS-Wildlife Services, Guam

12:00 - 1:00 Lunch

Session 2 – Status and Future Directions for Vertebrate Species Recovery in the Marianas

Moderator: Tino Aguon, Guam Department of Agriculture, Division of Aquatic Wildlife Resources

1:00 –

Birding on Guam: the possibilities are endless!
Diane Vice, Guam Department of Agriculture, Division of Aquatic & Wildlife Resources

Conservation banking preliminary case study: Re-establishing the Saipan Upland Mitigation Bank
Holly Herod, US Fish and Wildlife Service, Honolulu, HI

Trends in bird populations on Saipan
Richard J. Camp, USGS, Hawaii Cooperative Studies Unit

Guam rail recovery on Guam: Ko'ko' for Cocos
Diane Vice, Guam Department of Agriculture, Division of Aquatic & Wildlife Resources

~ 2:30 Break

Marianas species recovery panel discussion
Moderator: Holly Freifeld, US Fish and Wildlife Service, Honolulu, HI

3:30 – 4:00 Adjourn

7:30 – 9:30 PM Optional field trip: Reptile searching

Thursday, April 17

Recent Research and Management Developments, Continued

Moderator: Tom Mathies, USDA-APHIS-WS, National Wildlife Research Center

8:00 –

Observations associated with reproduction in captured brown treesnakes
Petko Petkov, Guam Department of Agriculture, Division of Aquatic & Wildlife Resources

Field evaluation of baits for brown treesnakes
Peter J. Savarie, Kenneth L. Tope, and Kathleen A. Fagerstone
USDA-APHIS-WS, National Wildlife Research Center

Prey scents and guide ropes as a method to enhance brown treesnake (*Boiga irregularis*) trap capture success
Lisa C. Mason[1], Julie A. Savidge[1], Gordon H. Rodda[2]
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University
[2] U.S. Geological Survey, Fort Collins Science Center

Accessibility of Different Types of Brown Treesnake Bait Stations in Different Placement Situations by Four Non-target Species
Tom Mathies[1], Brenna A. Levine[1,2], Esther Daniells[1,2], Julie A. Savidge[2], Craig S. Clark[3], and Kathleen A. Fagerstone[1]
[1] USDA-APHIS-WS, National Wildlife Research Center
[2]Department of Fish, Wildlife, and Conservation Biology, Colorado State University
[3]USDA-APHIS, Wildlife Services, Guam

Movements of brown treesnakes in a food-rich environment
Gordon H. Rodda[1], Kathryn Dean-Bradley, Julie A. Savidge[2], Michelle T. Christy[2], and Claudine L. Tyrrell[1]
[1] U.S. Geological Survey, Fort Collins Science Center
[2] Department of Fish, Wildlife and Conservation Biology, Colorado State University

~9:45 Break

Food preferences and food acceptance in juvenile brown treesnakes (*Boiga irregularis*)
Björn Lardner[1], Julie A. Savidge[1], Gordon H. Rodda[2], Robert N. Reed[2]
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University
[2] U.S. Geological Survey, Fort Collins Science Center

Funnel trap traits, and how (not) to improve capture rates of small brown treesnakes
Björn Lardner[1], Julie A. Savidge[1], Gordon H. Rodda[2], Robert N. Reed[2], Amy A. Yackel Adams[2].
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University,
[2] U.S. Geological Survey, Fort Collins Science Center

Cabras Island snake eradication project
Craig Clark, USDA-APHIS-Wildlife Services, Guam

"How low can you go?" – Discussion: What does "severe snake suppression" mean?
Gordon H. Rodda, U.S. Geological Survey, Fort Collins Science Center
Will Pitt and Pete Savarie, USDA-APHIS-WS, National Wildlife Research Center

12:00 – 1:00 Lunch

Session 3 – Regional Invasive Species Issues

Moderator: Nate Hawley – CNMI DFW/USFWS Brown Treesnake Program

1:00 -

Early Detection/Rapid Response planning in Hawai'i
Mindy Wilkinson, Hawaii DLNR, DOFAW

Veiled chameleon control efforts on Maui
Brooke Mahnken, Maui Invasive Species Committee

Overview of the Micronesia Regional Invasive Species Council (RISC)
Phil Andreozzi – National Invasive Species Council
Nate Hawley – CNMI DFW/USFWS Brown Treesnake Program

Brown treesnake prevention strategies on the receiving end of pathways to CONUS
Dr. Scott Henke[1], Samantha Wisniewski[1], Bob Pitman[2]
[1]Texas A&M University-Kingsville
[2]USFWS, Region 2, Albuquerque, NM

~ 2:30 Break

3:00 – 5:00 Breakout Meeting: Navy/JGPO Budgeting Issues (*Attendance Optional*)

Friday, April 18

Session 4 - Invasive Species Issues Associated with Military Growth in Guam and the CNMI

Moderator: Craig Clark, USDA-APHIS-Wildlife Services, Guam

8:00 AM -

Report to Congress
Peter Egan, Armed Forces Pest Management Board

Mariana Islands Range Complex, **Draft Environmental Impact Statement**
Ed Lynch, Kaya Corp.

JGPO biosecurity issues: Construction, training, and port operations
Lisa Fiedler, NAVFACPAC

Biosecurity procedures in Marine training
MSgt Troy Barlow, US Marines

Air Force Update
TBD – PACAF

~ 9:45 Break

Session 5 - Quarantine Issues – Increasing Inspection Capacity and Regulatory Authorities

Budgetary breakdown of USDA Wildlife Services control efforts at COMNAVMAR
Mike Pitzler, USDA-APHIS, Wildlife Services, Honolulu

K-9 and cargo inspection update
Marc Hall, USDA-APHIS, Wildlife Services, Guam

Potential effects of military expansion on Guam port operations
Herman Paulino, Guam Port Authority

Projects related to cargo biosecurity at Guam International Airport
Juan Reyes, Guam International Airport Authority

FAA planned Regional Airport quarantine facility projects
Ron Simpson, FAA, Honolulu

12:00 - 1:00 Lunch

1:00 PM –

Moderator: Mindy Wilkinson, Hawaii DLNR, DOFAW

Hawaii's biosecurity program: Quarantine in transition
Domingo Cravalho, Hawaii Department of Agriculture, Plant Quarantine Branch

CNMI quarantine regulations
Nate Hawley, CNMI DFW/USFWS Brown Treesnake Program

Customs and Border Protection's role in inspection
Jim Kosciuk, CBP, Honolulu

Successful large-scale quarantine programs
Michael Simon, USDA-APHIS, Plant Pest Quarantine

~ 2:30 Break

Discussion of quarantine and regulatory needs
Mindy Wilkinson, Hawaii DLNR, DOFAW

3:30 – 4:00 Wrap-up and Adjourn –Earl Campbell, USFWS, BTS Technical Working Group Coordinator

Abstracts (*Alphabetical by lead author)*

Overview of the Micronesia Regional Invasive Species Council (RISC)
Phil Andreozzi – National Invasive Species Council
Nate Hawley – CNMI DFW/USFWS Brown Treesnake Program

The Micronesia Regional Invasive Species Council (RISC) was created in 2005 by the Chief Executives of the Commonwealth of the Northern Mariana Islands, the Territory of Guam, the Republic of Palau, and Yap State in the Federated States of Micronesia, to meet the need for coordination and cooperation to meet the threat of invasive species in the Micronesian Region. The mission of RISC is to reduce the likelihood of introduction of invasive alien species to islands across the region and to control or, when feasible, rid our islands of existing invasions through coordination of efforts throughout Micronesia. Since its inception, RISC has generated various public education materials (calendars, regional invasive species guides, and a website) that target the Micronesian Region. RISC has also developed a five year strategic plan that is focused on improving public awareness, cooperation and communication; providing recommendations on policy and management to Chief Executives; developing human and financial resources to achieve RISC goals; and to expand the RISC membership to all jurisdictions in Micronesia associated to the United States of America.

Trends in bird populations on Saipan
Richard J. Camp, USGS, Hawaii Cooperative Studies Unit

The avifauna of the Mariana Islands, an archipelago in the west Pacific, faces the dual threats of rapid economic development and the spread of a super-predator, the Brown Tree Snake (Boiga irregularis). In this paper, we examine the status and trends of the land bird fauna of Saipan Is. based on three island-wide surveys conducted in 1982, 1997, and 2007. During this period, the human population on Saipan increased more than four-fold and much of the island has been developed. The surveys employed standard point-transect methods. Remarkably, we found that in 2007 nearly all species of land birds—11 native species and 3 introduced species—to be common or abundant, with population densities ranging from 11 birds/km2 for Yellow Bittern (Ixobrychus sinensis) to 4,713 birds/km2 for the Bridled White-eye (Zosterops saypani). The exception was the Micronesian Megapode (Megapodius laperouse), a historically rare species that was not found on the 2007 survey, although its populations are faring better on more remote islands. A Z-test comparison of species densities between the two years 1982 and 2007 showed that six species, mainly fruit and seed-eaters, had increased and three species of insectivorous birds had decreased—the Rufous Fantail (Rhipidura rufifrons), Nightingale Reed-Warbler (Acrocephalus luscinia), and Golden White-eye (Cleptornis marchei). Of these three, the Nightingale Reed-Warbler is listed by the U.S. Fish and Wildlife Service as an endangered species. The 2007 survey yielded a density of 22 reed-warblers per km2.

Cabras Island snake eradication project
Craig Clark, USDA-APHIS-Wildlife Services, Guam

An operational test project using toxicants to eradicate brown treesnakes was activated on Cabras Island, Guam, in September 2006. The island, approximately 150 acres in size and situated off the west coast of Guam, serves as the primary commercial port for the island. Cabras Island can be viewed as a microcosm of Guam and has benefits of a manageable landscape, ease of access (established cooperators), and limited opportunity for incursion by BTS post-primary control. This presentation will discuss progress and findings to date in this project.

An operational assessment of bait station design and toxicant use and their demographic effects on the brown treesnake (*Boiga irregularis*)

Craig S. Clark[1], Daniel S. Vice[1], Peter J. Savarie[2]
[1] USDA-APHIS-Wildlife Services, 233 Pangelinan Way, Barrigada, GU 96913
[2]USDA- APHIS-WS, National Wildlife Research Center, 4101 LaPorte Ave., Fort Collins, CO 80521

This study targeted the brown treesnake, *Boiga irregularis*, (BTS) an introduced pest species to the island of Guam. This study examines the effect of bait station design and relative bait take by both targeted animals (BTS) and non target animals. There were three bait station designs, constructed of polyvinyl chloride (PVC) pipe in various diameters and configurations: 1) 2 cm diameter x 30 cm in length, hung horizontally; 2) 8 cm diameter x 30 cm length hung almost vertically; 3) 5 cm diameter x 30 cm in length with a 8 cm to 5 cm reducer attached to the upper end, and hung almost vertically. Baits provided were dead neonate mice (DNM) and dead adult mice (DAM). Sixty bait stations were deployed, with each bait station design represented by ten DNM and ten DAM each. The baits were deployed along forest plot edges on COMNAVMARIANAS property. Forty percent (N=24) of the bait stations had acetaminophen-laden DNM and DAM, which had a small radio transmitter surgically implanted in the body cavity, and then placed in bait stations in a random array. Snakes that ingested the transmitter-baited mouse were then radio-tracked and the radio and snake retrieved. Morphological data were recorded for all snakes collected. The objective of this study was to quantify the size classes of brown treesnakes that ingested the two size classes of dead bait mice. The final results will aid in the design of a practical, large-scale control program using bait stations, together with traps, as part of an operational integrated pest management technique to reduce brown treesnake populations on Guam.

Hawaii's biosecurity program: Quarantine in transition
Domingo Cravalho, Hawaii Department of Agriculture, Plant Quarantine Branch

Hawaii's quarantine program has been in existence for over 120 years with the monitoring of articles that are agricultural in nature that enter all air and sea ports throughout the State of Hawaii. With the added increase of transportation shipments to the Aloha State added pressures have been placed upon the Plant Quarantine Branch to prevent the unwanted introduction of invasive species that affect Hawaii's agricultural and horticultural industries, animal and public health, natural resources and environment. To meet these new demands the Plant Quarantine Branch has transitioned into a comprehensive biosecurity program that will further reduce these risks. The program's success will depend upon the following key elements: 1) Pre-entry compliance agreements and reporting requirements; 2) Port-of entry inspection facilities and treatment mitigation efforts; 3) post-entry monitoring and rapid response capabilities; and 4) Market substitution and increased in-state production of agricultural commodities. Each element is vital and an integral part in the success of the program that ultimately affects the future of Hawaii.

Uncertain populations and the value of information
Sean D'Evelyn[1], Kim Burnett[2], Nori Tarui[1], and Jim Roumasset[1]
[1]University of Hawai'i at Manoa
[2]University of Puget Sound

The question this paper seeks to answer is how managers can determine optimal control efforts for an invasive species when the population is unknown. Given an uncertain population size, a resource manager's control efforts provide two potential benefits: (1) a direct benefit of possibly reducing the population of invasive species, and (2) an indirect benefit of information acquisition (due to learning about the population size, which reduces uncertainty). We provide a methodology which takes into account both of these benefits, and show how optimal management decisions are altered in the presence of the indirect benefit of learning. We then apply this methodology to the case of controlling the brown treesnake (*Boiga irregularis*) in Saipan. Preliminary results indicate that snake management integrated with the learning technology can save an average of $65 million compared to snake management without learning.

Report to Congress
Peter Egan, Armed Forces Pest Management Board, Walter Reed Army Medical Center, Washington, DC

The fiscal year 2008 National Defense Authorization Act requires the Secretary of Defense to submit a report to Congress on three actions on Guam. First, what is the Defense Department (DoD) doing to prevent the spread of BTS to snake free areas? Secondly, what is DoD doing to plan for the proposed military buildup on Guam to reduce the risk of spread of the BTS? Third, what has DoD done, in the Installation Natural Resources Management Plan to initiate a pilot plan to reduce invasive species impacts to native species? This will be a brief progress report on actions taken to date.

JGPO Biosecurity Issues: Construction, Cargo, and Training
Ed Lynch, Kaya Corp.
Lisa Fiedler, Joint Guam Program Office, Guam
MSgt Troy Barlow, US Marines, Guam

Associated with the relocation of Marines from Okinawa to Guam is a $10 billion construction program and Marine training in the CNMI. To be successful, this relocation will need to be conducted in a manner that prevents the introduction of additional invasive species into Guam and the CNMI, while at the same time preventing the export of invasive species, such as the brown tree snake, from Guam to other locations. This presentation will discuss Tactical Training Theater Assessment and Planning, the Mariana Islands Range Complex Management Plan and the current status of the associated Environmental Impact Statement. An overview of current construction and training biocontrols will be provided and recommendations discussed for improving biocontrols for construction, cargo operations, and training.

K-9 and cargo inspection update
Marc A. Hall, USDA-APHIS, Wildlife Services, 233 PangelinanWay, Barrigada, Guam 96913

Wildlife Services-HI/GU brown treesnake (BTS) interdiction program faces some significant challenges over the next few years. The Department of Defense (DoD) is in the process of expanding its operations and capabilities on Guam. Such developments promise to increase the off-island movements of DoD and civilian aircraft, cargo, and personnel throughout the Pacific region. These increased movements will also mean an increased opportunity for movement of the BTS throughout the region. Current interdiction efforts include trapping and canine inspections and future DoD plans will dictate an expansion of these operational tools.

The current canine interdiction program is staffed by 19 employees and 19 detector dogs who conduct inspections at all ports of exit while operating from two kennel facilities. It will be necessary to expand canine operations to meet future DoD operational activities. How this will be achieved will depend on the development of some key areas: 1) Infrastructure, 2) Operations and training, 3) Data collection and management, and 4) Communication. There are external and internal elements that will influence the development of these four areas and while canine interdiction will only be able to have a reactionary response to some future events, i.e. DoD operations, it can and must take a proactive stance on the development of the four key areas. Cooperative and agency demands are increasing at various levels, e.g. reporting requirements, and the canine program must successfully meet those challenges. By focusing on the four key areas the canine interdiction program should grow into a more professional and robust program to better serve the future needs of all involved in managing the BTS problem.

Brown tree snake prevention strategies on the receiving end of pathways to CONUS

Dr. Scott Henke[1], Samantha Wisniewski[1], and Bob Pitman[2]
[1]Texas A&M University-Kingsville
[2]USFWS, Aquatic Invasive Species Coordinator, Region 2, Albuquerque, NM

The North American Brown Tree Snake Control Team (NABTSCT) is a collaborative effort between federal and state agencies, universities and private organizations to prevent the brown tree snake from becoming established in the Continental United States (CONUS). NABTSCT was formed in the late 1990s as a component of the Gulf & South Atlantic Regional Panel of the Aquatic Nuisance Species Task Force. NABTSCT is implementing strategies derived from a working Brown Tree Snake Conference held in Houston, TX, June 2000. Long-term prevention will be achieved by working collaboratively with stakeholders and managers to develop and implement risk reducing strategies in known BTS pathways to North America. In adaptive management style the Team will adjust actions to meet changes in pathways and their associated risks.

The most at risk locations for brown tree snake establishment are the states surrounding the Gulf of Mexico but climate change could increase this zone and the overall risk for establishment in North America. Fish & Wildlife Service Port Inspectors have twice detected correctly identified brown tree snakes in pet trade shipments, although it is unclear why this species would be desired as a pet. Inspectors have reported that misidentified snakes are common and it is impossible for them to verify the identity of all the snakes coming through in the pet trade pathway. In the early 90s BTS were documented in household goods received from Guam and unpacked in the Corpus Christi, TX, area. These joint presentations by the Fish & Wildlife Service and Texas A&M University-Kingsville will describe present pathway challenges and the collaborative strategies being used to reduce risks and provide response capacity for suspicious sightings from pathways ending in the CONUS.

Re-Establishment of the Saipan Upland Mitigation Bank

Holly Herod[1] and Laura Williams[2]
[1] U.S. Fish and Wildlife Service, Honolulu, Hawaii
[2] Division of Fish and Wildlife, Saipan

The Saipan Upland Mitigation Bank will be managed to provide perpetual conservation and management for endangered nightingale reed-warbler (*Acrocephalus luscinia*) and other native species within the bank boundaries. Subsequently, the Saipan Upland Mitigation Bank will be used as a conservation option for eligible projects that will result in unavoidable impacts to the nightingale reed-warbler. This presentation will use the re-establishment of the Saipan Upland Mitigation Bank as a case study to demonstrate the principles of conservation banking.

U.S. Customs and Border Protection's role in cargo inspection
James Kosciuk, U.S. Customs and Border Protection, Honolulu, HI

U.S. Customs and Border Protection (CBP) is responsible for ensuring that air and sea cargo, as well as aircraft and vessels entering the United States meet specific regulatory requirements. The Area Port of Honolulu is a diverse port of entry that also inspects at military bases and the Honolulu International Mail Branch. CBP's work involves close coordination with other federal agencies, state interests, and industry.

Spotting cryptic critters in the dark: Headlamps meet the closed population
Björn Lardner[1], Gordon H. Rodda[2], Julie A. Savidge[1], Robert N. Reed[2], Amy A. Yackel Adams[2].
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University, Fort Collins, Colorado 80523.
[2] U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Avenue, Fort Collins, Colorado 80526.

Visually searching for brown treesnakes at night is an important tool in snake control, especially in high prey density environments. We have previously shown that snake searchers are more successful if using floodlight lamps than spotlight lamps, and more successful when using more powerful lamps. Starting in October 2006, we had our staff search for snakes and geckos in the so-called 'Closed Population' – a 5-ha snake enclosure – using two different lamp types on alternate nights. One lamp was the strong spotlight we have used in the past, while the other lamp was a strong floodlight headlamp. During a total of 1335 standardized 220-m transect walks conducted by seven persons, 544 brown treesnakes and 2082 geckos were spotted. Of these, 1271 geckos were sighted during the 640 transects searched with floodlights while 811 geckos were seen during 696 transects searched with spotlight lamps; thus, 71% more geckos were spotted per unit effort with floodlight than with spotlight lamps. This figure is weighted with the (quite variable) search efforts spent by the different people participating in the field work, but all searchers seemed to gain a substantial boost in gecko sightings when using the floodlight lamp. For snakes the story is a bit more complicated. Overall, 24% more snakes were found per unit effort when the floodlight lamp was used, but the benefit of the floodlight lamp was not seen in all searchers. Also, some searchers contributed too small a search effort to allow the lamp effect on their search result to be thoroughly assessed. We hypothesize that the benefit of a floodlight lamp is greatest when the target of the search is a small and cryptic animal that does not stand out clearly from the surrounding habitat matrix.

Food preferences and food acceptance in juvenile brown treesnakes (*Boiga irregularis*)

Björn Lardner[1], Julie A. Savidge[1], Gordon H. Rodda[2], Robert N. Reed[2]
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University, Fort Collins, Colorado 80523.
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On the Pacific island of Guam, control of the invasive brown treesnake (*Boiga irregularis*) relies largely on methods using mice as bait. While stomach content analyses have shown that juvenile snakes feed primarily on lizards and their eggs, little is known about prey preference. We conducted an experiment to investigate the preferences for, and also the acceptance rate of, euthanized geckos, skinks, and neonatal mice, in juvenile snakes ranging from 290 mm to ca 700 mm snout-vent length (at which size they start appearing in mouse-baited traps). Snakes of the entire size range showed a preference for geckos over skinks and neonatal mice; a gecko was the first prey chosen in 87% of 224 initial trials (56 snakes subjected to four trials each; 33% would be expected from a random choice). This preference was most pronounced in the smallest snakes tested. While many of the snakes accepted neonatal mice and/or skinks, some snakes across the entire size range were reluctant to feed on anything but geckos – especially when not starved. Our data indicate that between 15 and 40% of a small snake population exhibiting a demographic pattern similar to our test snakes may be refractory to capture with rodent bait. The design of the experiment also allowed us to test whether repeated experience of a certain prey type makes a snake increase its preference for that particular prey; data on which will be presented at the meeting. Our results suggest that control methods relying solely on rodent bait may be inefficient for targeting snakes <700 mm SVL and that individual heterogeneity may cause a significant part of this juvenile cohort to be completely refractory to capture with rodent bait – even if the bait is dead, thus not posing any threat to the snake, and small enough to be readily swallowed.

Funnel trap traits, and how (not) to improve capture rates of small brown treesnakes

Björn Lardner[1], Julie A. Savidge[1], Gordon H. Rodda[2], Robert N. Reed[2], Amy A. Yackel Adams[2].
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University, Fort Collins, Colorado 80523.
[2] U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Avenue, Fort Collins, Colorado 80526.

Much of the brown treesnake interdiction around Guam's airports, seaport, and cargo facilities rely on funnel traps that use live, adult mice as a lure. Unfortunately, these traps are almost totally ineffective for snakes smaller than 700 mm SVL. Using 64 snakes <700 mm SVL in 16 laboratory trials each, we conducted a study that asked several questions regarding how particular trap design features may affect the chances that a small snake can, and will, enter a trap. Snakes were housed in experimental units consisting of a cage compartment and a 'trap' compartment, separated by a wall incorporating a funnel ending in a flap. Three key variables were tested: flap design,

orientation of entry path (vertical *vs*. horizontal funnel), and how much 'foothold' was offered by a structure leading up and into the funnel. Almost every snake that was active during a trial eventually entered the trap compartment. While even the smallest snakes could readily push and get past the conventional flaps mounted in the end of the funnel, the snouts of small snakes tended to get "stuck" in the wire mesh when pushing the flap. Trap entry after fewer push attempts was achieved with a novel flap type. Our prediction that snakes may enter more readily if the funnel is directed upwards (instead of sideways) was not supported; nor did snakes enter more easily if supplied with ample 'foothold' in the form of a branched stick (as opposed to a metal wire similar to those used to hang traps). It seemed as if most trap compartment entries were caused by cage exploration rather than stalking prey, since presence or absence of a gecko lure had no clear effect on the trap entry process. We discuss trap improvements that could help target also the smallest snakes.

Prey scents and guide ropes as a method to enhance brown treesnake (*Boiga irregularis*) trap capture success

Lisa C. Mason[1], Julie A. Savidge[1], Gordon H. Rodda[2]
[1] Department of Fish, Wildlife and Conservation Biology, Colorado State University, Fort Collins, Colorado 80523.
[2] U.S. Geological Survey, Fort Collins Science Center, 2150 Centre Avenue, Fort Collins, Colorado 80526.

The brown treesnake is known to employ both visual and olfactory cues when searching for prey. At present, these cues emanate only from the trap proper, a small source. We hypothesized that trap success could be enhanced by providing substrate-born olfactory cues leading to the trap. In a laboratory setting, we exposed 24 snakes (12 small, <700 SVL; 12 large, >900 SVL) to seven different scent cues in a modified Y-maze. We used scents from live mice, geckos, and skinks; carrion mice, geckos, and skinks; and we also had a no-scent control. Large snakes spent significantly more time in arms of the Y-maze scented with live geckos and carrion geckos compared to control arms without scent, whereas small snakes spent significantly more time in arms scented with carrion mice and carrion geckos compared to controls ($P \leq 0.05$). We then conducted a field study in a 5-ha snake enclosure on Guam that examined effectiveness of standard traps baited with live mice and augmented with scented guide ropes as attractants. A pilot study using ropes with various scents suggested ropes scented with live mice might have the greatest utility. We established a trapping grid of 144 traps with live mice scented ropes, unscented ropes, and no ropes. Preliminary results suggest more captures for traps equipped with both live mice scented ropes and unscented ropes when compared to traps without guide ropes. No difference was found in number of captures between traps with unscented ropes and traps with live mice scented ropes, suggesting the rope alone may act as a guide to a trap. We discuss reasons for the lack of congruence between the lab and field results and suggest potential future research.

Accessibility of Different Types of Brown Treesnake Bait Stations in Different Placement Situations by Four Non-target Species

Tom Mathies[1], Brenna A. Levine[1,2], Esther Daniells[1,2], Julie A. Savidge[2], Craig S. Clark[3], and Kathleen A. Fagerstone[1]

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Use of toxic baits in bait tubes is an emerging technology for operational control of the brown treesnake. One concern is that non-target species are removing baits. The objective of this laboratory study was to evaluate the accessibility of four bait tube designs in three different placement situations by coconut crabs, Norway rats, black rats, and Polynesian rats. Two experiments preceded the main experiment: Experiment 1: determine if each species takes dead neonatal mouse (DNM) when readily available, and Experiment 2: identify a preferred bait type for each species. The third and main experiment (in progress) uses these preferred baits to motivate animals to access bait tubes. Three tube designs are being evaluated: 2"x12", 0º (control), 4"x12", 45º, upper end capped, and 2"-3"x12", 65º, upper end capped. Each tube type is evaluated in three simulated natural placement settings: "cyclone fence", "vegetation", and "rebar tripod". Animal activity is filmed nightly with cameras attached to video recorders. In Experiment 1, all species took DNM (both fresh and "aged" 24 h). In Experiment 2, all rat species were presented with a side-by-side choice of DNM, peanut butter-oat ball, cheese, and regular chow. Crabs received DNM, coconut, and their regular omnivore chow. Based on bait masses consumed, two bait types were selected for each species for use in Experiment 3. DNM and peanut butter mixture were selected for Norway and black rats, DNM and cheese for Polynesian rats, and DNM and omnivore chow for crabs. In Experiment 3, there have been 24, 21, 19, and 32 tube evaluation nights for Norway, Black, Polynesian, and crabs, respectfully. On five evaluation nights, five rats (some of each species) accessed bait in control tubes. Only one individual Norway accessed both types of angled tubes. No crabs have accessed tubes. Information on attempts to access tubes will be presented.

Guam port operations and potential effects of military expansion

Herman Paulino, Guam Port Authority

This presentation will provide an overview of the Port, Port Master Plan and proposed improvements, quarantine and inspection facilities footprint, and projected cargo volumes. These subjects will be discussed in relation to prevention of invasive species.

Observations associated with reproduction in captured brown treesnakes
Petko Petkov, Guam Department of Agriculture, Division of Aquatic & Wildlife Resources.

Reproduction in brown treesnakes (*Boiga irregularis*, BTS) may involve profound modifications to behaviors such as feeding and change of habitat use, and physiological modifications such as body fat storage. Historic data from BTS trap captures in the Munitions Storage Area on Andersen Air Force Base (AAFB), Guam has yielded a 50:50 male to female ratio (DAWR unpublished data). Recent BTS trap data collected in two cliff areas in the Tarague Basin area on AAFB has resulted in over 80% female captures, extremely high levels of fat content in females and males, seven gravid females with low fat content, three females in poor condition with no obvious signs of parasites or disease and two females with snake remains in stomach. Similar efforts in a beach strand area have not resulted in similar results. Lizard activity observations in cliff and beach strand (control) areas indicate prey base may be relatively low in the cliff area. Based on these preliminary observations a number of questions have arisen. They include: 1) Are female BTS attempting a sexual migration to cliff areas for laying eggs?; 2) Is the sexual migration a seasonal occurrence?; 3) Are female BTS more trappable in this location during specific times of the year?; and, 4) Are females dying following egg laying in relatively low prey density areas? Details of trap capture observations will be presented and discussed.

Movements of brown treesnakes in a food-rich environment
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How might a brown treesnake (BTS, *Boiga irregularis*) arriving on Saipan behave? The obvious experiment is ecologically hazardous. Examining data on the movements of BTS on Guam when Guam was food rich (i.e., prior to most prey extinctions) may provide insight. Using a mix of previously-published and new data from the introduced BTS population on Guam we provide evidence that: 1) BTS accessed a food bonanza when colonizing Guam, and then depleted it; 2) during the irruption, high-dispersing BTS benefited the most by accessing undepleted or less-depleted food areas; and 3) after the irruption, high-dispersing BTS probably wasted effort through superfluous movement, and BTS activity areas on Guam decreased in size in the 1990s, possibly in response to selection pressure for reducing superfluous movement. Nonetheless, 4) confined BTS had better fitness measures in 2004-2006 than snakes free to disperse, suggesting that selection pressure to reduce movements was ongoing. Evidence of the initial food bonanza derives from prey abundance estimates prior to and after the irruption. Prey abundance estimates were obtained from direct counts before and after peak snake numbers, post-irruption censuses of plots with snakes present and after snakes were experimentally removed, as well as from Guam prey biomasses compared with those recorded on adjacent snake-free islands. Evidence that high-dispersing snakes accessed

undepleted food is based on the geographic pattern of snake captures and bird count declines. High dispersal of snakes during the irruption is evident in the geographically-synchronous and temporally-abrupt island-wide decline in snake body condition following the irruption peak. These data suggest that post-irruption BTS on Guam are behaving in a way that is at least partially adapted to pre-prey depletion conditions. If such snakes were to reach Saipan, they would encounter prey rich conditions, and might not be selected to greatly change their movement patterns, though mildly augmented activity area size is plausible over time.

Paper flags for aerial delivery of baits to brown treesnakes

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The goal of this project is to develop a system for aerial delivery of baits to brown treesnakes *(Boiga irregularis)* in inaccessible forested areas. Dead neonatal mice (DNM) attached to the cardboard on commercial biodegradable paper flags (cardboard attached to one end of a 3.1 m paper streamer; i.e., flag-baits) were deployed either by mechanical dispenser or hand from a helicopter in August 2007 on two 4-ha test sites. One site was in a mowed open field and the other was in forest. The purpose for using the open field was to observe the aerodynamic and physical characteristics of the flag-baits without the interference of trees. There were a total of 8 drops (1 each by dispenser and hand over the open field, and 3 each by dispenser and hand over the forest), with 144 DNM flag-baits deployed per drop. For each of the 6 drops in the forest, 28 of the 144 flag-baits had a radio transmitter attached to the DNM for tracking purposes. Canopy landing of the radioed DNM was 85% (61 of 72) by dispenser and 79% (66 of 84) by hand. From the total of 168 radioed DNM deployed by dispenser and hand, 18 radioed DNM baits remained in the field over the first night (the remainder were recovered the same day as deployed). Five of the 18 radioed DNM (28%) were consumed by 4 snakes (2 radioed DNM were consumed by 1 snake), and 1 of 18 (6%) was taken by a marine toad *(Bufo marinus).* Overall performance of the aerial delivery system was successful. Modifications needed to improve the aerial delivery system include: 1) a paper streamer that is more resistant to water [the current paper streamer tore apart and the DNM dropped to the ground when it rained]; and 2) the use of a paper flag with cardboard attached to each end of the paper streamer. This double-ended cardboard paper streamer forms a loop in the air and should increase entanglement in the canopy.

Field evaluation of baits for brown treesnakes

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The goal of these studies is to develop a bait to replace dead neonatal mice (DNM) that are used as the matrix for the oral toxicant, acetaminophen, for brown treesnakes *(Boiga irregularis).* Field evaluations of bait consumption (bait-take) were conducted on Guam in April (dry season) and August (wet season) 2007. Test baits were placed in bait stations (5.1 cm diameter x 30.5 cm long polyvinyl chloride tubes) with a bolt secured halfway across each end to mitigate bait access by non-target animals. Bait stations were positioned horizontally about 1.5 m high in vegetation at 20 m intervals along the forest perimeter adjacent to roads and trails. Bait types were randomly assigned to bait stations. In April five baits were tested: (1) unadulterated DNM (uDNM), (2) dehydrated DNM (dDNM); (3) freeze-dried DNM (fdDNM), (4) unadulterated beef (ubeef), and (5) beef treated with the decomposition products of uDNM that had "aged" under field conditions for 48 h. The 4-day cumulative bait-take (n=30 per treatment) were: uDNM – 93%; dDNM – 63%; fdDNM – 73%; ubeef –7%; and treated beef – 67%. In August three baits were tested: uDNM, ubeef, and beef treated with decomposition products from DNM "aged" for 0, 24, 48, 72, and 96h under field conditions. The 3-day cumulative bait-takes (n=40 per treatment) were: uDNM – 85%; ubeef – 30%; and ranged from 43% to 93% for beef treated with "aged" DNM. Bait consumption for the beef treated with 48h "aged" DNM was 93%. Results from these two studies show that decomposition odors of dead mice can be used to substantially increase brown treesnake bait consumption of beef. Future studies will be directed towards evaluation of synthetic bait matrices treated with decomposition products of "aged" DNM.

Canine team detection of free-ranging radio-telemetered Brown Treesnakes

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We are investigating canine teams (dogs and their handlers) as a potential tool for finding Brown Treesnakes (BTS), especially incipient populations on islands other than Guam. Canine teams have demonstrated proficiency at finding captive snakes in hidden tubes. Teams also find free-ranging BTS in various habitats, but detection rates for the latter are unknown. Dog handlers usually rely on visual searchers to locate BTS once a dog has signaled snake presence. At times, dogs signal but the visual search team cannot locate the snake; this complicates attempts to quantify detection rates. Our research aims to estimate detection rate of free-ranging BTS by canine teams as a function of snake attributes, characteristics of snake refugia, and environmental conditions. In each trial, canine teams search a defined 40m x 40m forested area with a snake that has consumed a dead mouse containing a radio-transmitter. A tracker knows the snake's location, but dog

handlers and data recorders do not. We record data on dog alerts and on-scent behavior during the trial. This study will provide initial estimates of canine team efficacy when searching for free-ranging BTS in complex habitats and information on optimizing visual search strategy after a dog signals snake presence (defining size of area to search, identifying preferred refugia, etc.). Trials were initiated in December 2007 and are ongoing. We discuss experimental design, challenges and initial results.

An evaluation of the potential economic impacts of the introduction of the brown treesnake on tourism in Hawaii

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In 2004, a study estimated the economic impacts likely to occur to the Hawaiian Islands by the translocation of the brown treesnake (*Boiga irregularis*) from Guam. The approach was to collect and compile data about the snakes' impacts from Guam and extrapolate the impacts to Hawaii. There were three categories of economic impact due to brown treesnake examined; medical treatments, electrical outages and tourism losses. Potential medical and electrical impacts to Hawaii were extrapolated using data gathered on Guam. Impacts from the brown treesnake to the tourism sector of the economy had never before been estimated and therefore a hypothetical range of decreased tourist numbers (1% - 10%) was projected using an input-output model. In order to more accurately define the range of potential tourist impacts from the brown treesnake a survey was conducted in Oahu during January 2008. This survey elicited responses from the major tourists groups (i.e. U.S. West, U.S. East, and Japan) on how they would alter there behavior in response to the presence of the brown treesnake. Survey results indicated that initial estimates of the 2004 study were conservative. This presentation will describe the major findings of the survey and discuss the implications of the brown treesnake to the Hawaiian economy.

Successful large-scale quarantine programs

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APHIS- Plant Protection and Quarantine (PPQ) develops and oversees extensive offshore programs to mitigate risk of U.S. introduction of animal and plant pest and diseases. Several examples of these programs are the military preclearance program in the U.S. European Command and U.S. Central Commands. This is a collaborative program between the Department of Defense (DoD) and APHIS-PPQ where PPQ works as a team member to provide training and accreditation of military Customs Border Clearance Agents (CBCA). This extensive program provides the dual purpose of regulatory compliance and to expedite arrival of military cargo, vehicles, and passengers. In addition, PPQ has a joint program with foreign governments to authorize predeparture vessel inspections for Asian gypsy moth in seaports of Russia and Japan. In addition to these countries, gypsy moth survey trapping is conducted in partnership for AGM in

Korea and China. These are just two examples of large-scale programs that APHIS-PPQ coordinates and works closely with other government entities for mutual benefit.

Birding on Guam: the possibilities are endless!
Diane Vice, Guam Department of Agriculture, Division of Aquatic & Wildlife Resources

Following the introduction and spread of the brown treesnake (*Boiga irregularis*) on Guam, most of Guam's native avifauna is either extirpated or extinct. Recent efforts to protect and reestablish Guam's native forest birds have produced interesting results. This talk will focus on the current and future plans, as well as results of conservation agencies' efforts to renew Guam's native avifauna.

Guam rail recovery on Guam: Ko'ko' for Cocos
Diane Vice, Guam Department of Agriculture, Division of Aquatic & Wildlife Resources

The Guam rail *(Gallirallus owstonii*), known as ko'ko' in Chamorro, is a federally listed, flightless bird endemic to Guam. The goal, of the Ko'ko' for Cocos Project, is to establish a breeding population of ko'ko' on Cocos Island. Habitat preparations on the 83-acre island, prior to the release of 16 captive-bred rails, include the eradication of rodents, enhancement of native forest and the reduction of monitor lizards. In order to prevent incursions to Cocos Island of snakes, rats and other unwanted pest species, biosecurity procedures have been developed that include inspections by boat owners of vessels and cargo destined for Cocos Island. Compliance with biosecurity procedures will be promoted by the implementation of a Rare Pride Campaign focused on the ko'ko' bird. This talk will provide an update on the past year's activities associated with the project.