YALE UNIVERSITY
School of Forestry
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11 October 2014

Ms. Laura Simon
Wildlife Ecologist
Humane Society of United States

Greeley Lab
370 Prospect Street
New Haven, CT 06511
oswald.schmitz@yale.edu

Dear Ms. Simon:

Please find attached a report in response to your request to review whether the recommendations in the *Deer Management Report* for Jekyll Island are supported by scientific evidence.

In particular, you asked that I evaluate the methodology and findings of the Jekyll Island *Deer Management Report* (and accompanying *2013 Camera Trap Study –Updated Assessment*) in terms of whether or not a solid scientific basis has been established for claims that:
· Deer are having a significant ecological impact on the maritime forest
· Deer numbers need to be reduced to avoid the possibility of a severe ecological impact
and whether the procedures described in the documents adhere to established scientific protocols for assessing both deer density and deer impacts on forest regeneration/ biodiversity;

My conclusion is that there **is not a solid scientific basis for making the claims** that there are significant signs of heavy browsing by deer in the forest, and about the possibly of severe, if not irreversible damages if deer numbers are not reduced. In reaching this conclusion, I do not dispute that the kinds of scientific methods used are appropriate for assessing deer impacts. My conclusions, rather, are based on my determination that the ways the methodologies have been implemented to (i) measure deer browsing impact, (ii) estimate the Jekyll Island herd size, (iii) asses the health of the herd and (iv) monitor vegetation impacts, do not reach the level of rigorous, objective wildlife science needed to make scientific-based recommendations for management.

In reaching my conclusions I have consulted the following documents:
1) Draft Summary of Jekyll Island White-tailed Deer Management Recommendations. July 2014—hereafter called the "Draft Summary". (Provided by HSUS)
2) 2013 Camera Trap Survey-Updated Assessment-August 2014 (Provided by HSUS)
3) Jekyll Island Master Plan (Accessed from http://www.jekyllisland.com/wordpress/wp-content/uploads/2014/02/JekyllIslandMasterPlanFinal.pdf on October 5, 2014).

The reasons for my conclusion are presented in detail in the Appended report. In that report, I elaborate the basis for my concerns about the way the methodology has been executed and hence explain the basis for my concerns about the reliability of the scientific data that were collected.

I am also furnishing you with an abbreviated CV, which provides evidence of my scientific credentials in wildlife science and conservation to evaluate the materials as they relate to deer management.

Sincerely,

Oswald J. Schmitz
Oastler Professor of Population & Community Ecolog

Assessment of Scientific Methods and Data in Support of the Jekyll Island Deer Management Recommendations

Oswald Schmitz, Professor of Population and Community Ecology, Yale University School of Forestry and Environmental Studies.

The stated mission of the Jekyll Island Conservation Plan (JICP), as presented on Page 1 of the Draft Summary, is to "Preserve, maintain, manage, and restore Jekyll Island's natural communities and species diversity while providing nature-based educational and recreational opportunities to the general public". It further notes that (my emphasis in **bold**):

(i) white-tailed deer "can 'adversely affect **long-term conservation goals** by preferentially foraging on propagules and saplings of desirable native plant species.'"

(ii) Hence a **deer management goal** is to " 'sustain a healthy population that is not fed by humans and thereby poses less risk in spreading disease and damaging the fragile ecosystem'."

At a very fundamental level, the issue here is that these deer management and long-term conservation goals are too imprecise to provide the kind of benchmarks or targets for management success that are needed to guide any scientific assessment.

For example, it is unclear what constitutes a "natural community"? Deer have been part of Eastern USA "natural communities" for millennia. How do deer then fit into a definition of natural community? Also, what is the nature of species diversity that is being managed? Is it simply the number of species (called alpha diversity or species richness)? If so, what is the target number of species? Is it equal representation of all species (called evenness)? Is it a variety of species in a variety of habitat types (called landscape or beta diversity)? Is it the diversity of different species with different functional roles in providing services for human welfare (called functional diversity)?

In light of this, it is unclear what "long-term conservation goals" means, making it difficult to determine whether or not deer will even be in conflict with these goals. There seems to be an implicit assumption in goal statement (i) that it relates somehow to the species composition of forests. The issue, however, is that deer are by nature preferential feeders and this preferential foraging is independent of their population densities. Thus, lowering deer populations will not necessarily lead to reductions in preferential foraging on propagules and saplings: it especially will not if the plants are highly nutritious.

Likewise, goal statement (ii) never specifies what the diseases of concern are, or who is at risk of contracting the diseases. Is it humans? Is it other wildlife or plant species? It also provides no indication what the current risk levels are or whether or not deer abundance instrumentally influences the disease risk level. It is also unclear what is meant by "not fed by humans". Does this mean not engaging in a large scale supplemental feeding programs that artificially hold populations at high levels? Does it mean no individual feeding by the public to enhance wildlife observation opportunities? Finally, it never specifies why the ecosystem is considered to be fragile. What makes the ecosystem fragile to begin with?

Below I systematically evaluate the scientific procedures presented in the Draft Summary and the Camera Trapping report and the resulting data.

Draft Summary Appendix A

Report by Mr. Will Ricks, Dated October 2011
Browse Survey

The report (page 13 of the Draft Summary) states that a browse survey was completed on 5, 100 yard transects. The report indicates that the survey was done at a beach site, a field site, a golf course site, at a marsh site and a forest site. The land use maps provided in the Jekyll Island Master Plan suggest that there are 7 land use types: the 5 transects are spread across 5 of the 7 land use types; which is good in the sense that it tries to be representative of different habitat types. But, there is no indication of the transect width, and hence the area that was surveyed. As an example calculation, a browse transect typically would be about 1 yard in width. Thus, each transect would at least be 900 square feet in area (or 0.2 acres). Using data on acreage of land use from the Jekyll Island Master Plan (Map page 27), the sampling covers a tiny fraction of the area of the habitats: 0.05% of the Beach (Dune) area; 0.05% of the golf course (Fairway) area; and 0.001% of the field, forest and marsh (Natural/forest/marsh) area. A browse survey that would reliably inform management should cover at least 5-10% of an area.

The browse survey only reports impact in terms of number of bites (usage). It does not relate that impact to the number of items that are available. It is long known in the wildlife literature (e.g. Johnson 1980; Thomas and Taylor 1990) that usage alone is not reliable measure of foraging impact because it is equivocal. High usage could simply be a consequence of high availability of forage (proportional usage, hence a potentially weak impact) or a consequence of high usage of low availability forage (disproportionate usage, hence strong impact but only on selected plants). Moreover, a one-time survey does not adequately assess the production capacity of the forage and hence its ability to regrow after browsing. Heavy browsing could occur, but it may not be damaging if the forage plants have the capacity to regenerate, as alluded to in the Russell et al. (2001) paper cited in the Draft Summary.

Spotlight Survey

The report (page 14 of the Draft Summary) states that a spotlight survey was conducted over a four night period. It does not state what time of year the survey was done (presumably it was done in October, like the 2012 and 2013 surveys: Draft Summary page 21). It does not specify the size of the area that was sampled or which of the 7 land use types were included. It then states "a formula was later used to determine the population parameters." The formula has not been provided, so its validity cannot be evaluated. It seems that the estimate of deer population size was simply extrapolated evenly across the Island (meaning the population estimate is based on the assumption that deer are equally likely to occur in all 7 land uses). The reliability of this extrapolation is highly questionable without knowing whether deer are in fact spread evenly across the landscape or if they congregate within a subset of the available land use types. For example, it is stated that 73% of the deer were counted along the golf course. But, deer may be attracted to such open Fairway (golf course) areas and be highly visible there, especially during warm nights, because of the ample, highly nutritious fertilized grass that can be grazed. This would give a biased estimate of deer numbers if it were extrapolated to the entire island.

In the section **Spotlight Survey Results** (page 14), the recommendation is made that the deer population should be reduced to somewhere between 20-30 deer per square mile. It is not explained how that particular number was reached (although in a later section of the report it is stated that this is a recommendation by the Georgia Department of Natural resources [page 19]). But, the Russell et al. (2001) paper, cited in the Draft Summary, indicates that deer are not likely to be damaging to vegetation until they exceed about 35-40 deer per square mile (14-15 deer per square kilometer). So, <u>it remains unclear what the scientific basis for the recommended density of 20-30 deer is.</u>

Report by John R. Fischer, Dated March 5, 2013
Deer herd health report

The report states that the health status of the deer herd was based on 6 deer. Assuming that the estimated size of the deer herd is 712 (based on spotlight survey results from the 2011 report), then this sample represents a tiny fraction (0.8%) of the herd.

The report does not state where the deer were collected. Was it from a single site or from several sites? Were live deer dispatched specifically for the health assessment, or were they opportunistically collected (e.g. road kills)?

The conclusion from the assessment was that deer were in a poor nutritional state. Given their health status, were these deer more likely than healthy deer to be captured when sampling? If the survey is representative of the broader population, then the health indicators would suggest that the herd will decline on its own due to disease burden and poor nutrition.

But, given the information provided, <u>one cannot rule out the possibility that this is a highly biased sample and thus an unreliable health assessment of the entire herd</u>.

In addition, Table 2 and Table 3 of the health assessment (not included in the Draft Summary report; but included in a copy of the full letter provided to me by the Humane Society of the United States), indicates that all of the animals tested negative for any potential diseases that could cause health risks to humans and other wildlife or livestock species. This suggests that one of the management goals in (ii) above is met, because it indicates that the herd at its current size may not pose health risks. But, again, given my concern about a biased sampling, a more representative sample of the herd is required to draw reliable conclusions.

Jekyll Island Authority—March 2013 and October 2013 Report
Jekyll Island Deer Population and Health Assessment Summary

The report states that the 2012 population assessment was conducted using the same spotlight survey methodology as that used in 2011. I therefore have the same concerns about the survey reliability as for the 2011 report. My concerns about potential biased sampling are reinforced by the statement (paragraph 2 page 18) that the survey was conducted "primarily in the Urban/Developed land use category as described in the Jekyll Island Conservation Plan." Because of the potential for these kinds of areas to attract deer, the extrapolation of deer density from this estimate to all other habitats across the Island is unreliable. The spotlight survey needs to be conducted in the different land use types across the Island to provide a less biased estimate of population size.

In addition, the report states that the estimated deer population size in 2011 was 711 and in 2012 it was 911 (a population rate of increase of 24%). This is a high rate of increase for a wildlife population. This would indicate that the herd is quite healthy, which is inconsistent with the Deer Herd Health report. It would also contradict the claim in the report by Mr. Will Ricks, Dated October 2011 that (page 13, under **Habitat**) "..many of the available forage species have very low digestibility and palatability….making it tough for does to make it through lactation."

November 2013-Jekyll Island deer population update and recommendation

Table 1 on page 21 of the report states that the deer population size declined from 911 to 769 between 2012 and 2013. The claim is made that this difference is not significant. Yet the inference based on comparison of 2011 and 2012 data is that the herd did increase. There is an inconsistent interpretation of what the numbers mean: either the range in numbers of ~700-900 is not different or it is. One cannot interpret it one way (growing from 711 to 911) and another way (not declining from 911 to 769).

2013 Vegetation Monitoring

The report (page 21) states that three long-term vegetation monitoring transects were established in maritime oak forest. However, the report does not state where transects were established within the forest. That is, were they near the forest edge, deep within the interior, or dispersed throughout? Location makes a big difference in impact measurement (see the Russell et al., 2001 paper cited in the Summary report). The report also does not state what fraction of the total forest area is being sampled. It also does not state why the particular variables (plant species, plant abundance, diversity) are being measured relative to management goals. It does not specify what the target numbers of plant species, plant abundances, and diversity should be if deer are not having a significant impact. Hence, there is no benchmark to evaluate whether or not any management of the deer herd will be successful or achieve management goals.

Finally, the survey method makes no provision to assess what would happen to the forest in the absence of deer. The two major review papers cited in the Draft Summary (Russell et al. 2001; Cote et al. 2004) make it quite clear that enclosure studies are critical to make solid claims about whether or not deer are the important controlling force in the plant community (i.e. whether deer are exerting significant top-down control). It is well known that in some places, ecosystems could be controlled more by "bottom-up" factors (i.e., low soil quality due to poor levels of soil nutrients, low soil moisture, high or low soil pH. etc.) than by top-down factors. Given the statement in the report by Mr. Will Ricks, Dated October 2011 (page 13, under **Habitat**) that "soil quality is low", the possibility cannot be ruled out that the recruitment rate of forest saplings is controlled more by poor soil conditions than by deer. The only way to tell is to add a deer exclusion component to the long-term monitoring. Hence the claim (page 21 last paragraph) "The data is still being analyzed, but preliminary results indicate heavy browse pressure on seedlings and saplings…..could decrease the competitiveness of heavily browse native trees " is exceedingly premature, especially given that no scientific evidence (preliminary data) is presented to support the claim.

Finally the survey is not designed to provide any kind of evidence to show that if the size of the deer herd was reduced that it will lead to outcomes that meet any sort of management goals or targets. In fact, there are studies (reviewed in Barrett and Schmitz 2013) that suggest that microclimate conditions of habitats (called settling stimulus) may be more important than density as determinants of deer impact on vegetation. Deer may seek out thermally favorable locations and impact browse in those locations because they stay there for prolonged periods. The impact arises regardless of whether a few or many deer are present there. Thus, habitat management to change microclimates, not deer population reduction, would be needed to alter browsing impact (see Barrett and Schmitz 2013).

2013 Camera Trap Survey-Update Assessment-August 2014

Camera trapping is a very useful way to discover what species of animals are present within a habitat by setting up baits near cameras and recording what animals use the baits. It can be used to determine the home range size range of individuals within an area if the traps are set up in a proper grid. But one cannot bait the camera sites for home range analysis because this will lead to biases in the movement of animals and thus lead to biased estimates of habitat usage.

Camera traps can also be used to estimate population size of animal species, but it must be done using "mark-recapture" procedures that require that animals freely move throughout the "trapping grid" (i.e., animals do not have biased movement due to baits). Mark-recapture techniques are well known and long used techniques in wildlife ecology and management. In the mark phase, one identifies the distinguishing features (marks) of different population individuals. One then "recaptures" them on the cameras in the grid as they move through the habitat. One then uses standard mark-recapture statistical analyses to estimate populations size. The statistical analysis packages to conduct these sorts of estimations—which are the gold standard in wildlife science and management—are readily available to the wildlife management community (http://www.mbr-pwrc.usgs.gov/software.html). Using them appropriately, however, requires that the sampling method be designed to collect the appropriate data.

The description of the camera trapping methodology is inadequate to determine the reliability of the study. While it provides a grid map for 18 sites of 222 acres each, it does not specify the exact grid locations where the cameras were placed (i.e., Were they set out haphazardly? Were they set out along known game trails? Were they set up in a regular grid—as would be required for a proper study?) The description also does not provide details about how many cameras were deployed. It also does not explain whether the study was set up to conform to the design needs, specified by mark-recapture statistical analyses, for a proper population size assessment. It is widely known that biases in animal detection should be avoided altogether. The camera trapping study used on Jekyll Island introduces a bias by baiting (even acknowledged by the JIA staff). It has also been recommended that mark-recapture studies using camera trapping last for at least

200 days, and preferably longer, to obtain reliable population size estimates (Rovero and Marshall 2009). The study, which only lasted the month of January 2013 (first sentence of the report), was too short to meet requirements for a reliable study. Finally, the data were not analyzed using proper mark-recapture statistical techniques that meet the current standard in wildlife science and management for estimating population size http://www.mbr-pwrc.usgs.gov/software.html).

Acknowledging the bias due to baiting camera sites (only attracted bucks which presumably guarded the baits from does and fawns; second paragraph of the report), the JIA staff implemented a correction factor to estimate population size. Specifically, they used buck:doe:fawn ratios to extrapolate from buck numbers to the full population size. The ratios were obtained from the spotlight surveys. But, there are several problems with this. First, there is a potential bias in the spotlight survey because of the location where it was done has habitat features that could attract deer and cause them to aggregate, especially into mother-daughter fawn groups (see **Spotlight Survey** above). It is therefore inappropriate to extrapolate these ratios to the entire island. Second, it does not appear that the camera traps were placed in the same locations where the spotlight surveys were conducted. Had this been done, there would be strong corroborative data that could help complete a proper assessment of population size and obtain an estimate of potential bias due to different detection likelihood between spotlight and camera surveys. Finally, the camera trapping study (done in January) was in a different season than the spotlight survey (done in October). The data used in one season cannot be reliably applied to another without providing evidence that deer do not change their use of habitats on the islands among seasons.

On precautionary management

The Draft Summary (page 9) quotes from two papers (Cote et al. 2004; Russell et al. 2001) to argue for "precautionary" management, i.e., cull the populations before they can cause damage. However, this argument, and the quotes that are used in support of the argument, has no scientific basis: it is a value-based argument. Neither of the two papers provides any scientific evidence that such management will prevent future "damage". It is rather motivated by somewhat alarmist claims that ecosystem heavily damaged by deer lead to long recovery periods, if they recover at all. However, the two papers provide no evidence of studies that have even tested whether or not ecosystems do or do not recover from heavy damage by deer, or that strategic management can enhance the recovery. A recent meta-analysis study that has evaluated ecosystem recovery reported in over 230 independent studies from a wide range of damages (Jones and Schmitz 2009) shows that ecosystems are remarkably resilient and can recover very rapidly (within a decade to decades) from heavy damages. Thus they are not as fragile as often presumed.

Conclusion

The methods evaluated here are certainly appropriate to determine whether or not deer could have an adverse impact on Jekyll Island. The problem is that they were implemented without meeting the standard of scientific rigor needed to draw reliable scientific conclusions. Specifically, I find that:

- Measures of deer browsing impact need to be related to browse availability. They also need to cover a greater amount of the area in each of the 7 different land use types on the Island to provide unbiased estimates of impact.
- Counts of the Jekyll Island herd size must be done over a larger area. The counts should include a broader coverage of the 7 land uses on the entire island. Counting procedures also must avoid introducing artifacts that enhance detectability of animals (i.e, baiting camera trap sites; conducting spotlight surveys just in land uses like golf fairways and urban fringes where deer may regularly congregate).
- The assessment of Jekyll island deer herd health needs to include more animals. Assessments should ensure that deer are sampled from all 7 land uses.
- Vegetation monitoring to determine whether or not deer impede forest regeneration needs to include deer exclosures to properly rule out other explanations for any potential regeneration failure.

Finally, there is no scientific evidence presented in the Draft Summary, and I am not aware of any in the wildlife science literature, to support the idea that precautionary deer culling is needed to prevent future deer damage.

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Curriculum Vitae
Oswald Joseph Schmitz
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DEGREES

1985-1989 Ph.D. in resource Ecology, University of Michigan, School of Natural Resources *(Dissertation title: Environmental variability and optimal foraging by a generalist herbivore: the white-tailed deer)*
1983-1984 M,Sc. in Wildlife Ecology, University of Guelph, Department of Zoology
1978-1982 B.Sc. in Wildlife Ecology, University of Guelph, Department of Zoology

PROFESSIONAL POSITIONS

2011-present Director, Yale Institute for Biospheric Studies
2004-2009 Associate Dean for Academic Affairs, Yale School of Forestry and Environmental Studies
2000-present Professor, Yale School of Forestry and Environmental Studies
1996-2000 Associate Professor with term, Yale School of Forestry and Environmental Studies
1992-1996 Assistant Professor with term, Yale School of Forestry and Environmental Studies
1990-1992 N.S.E.R.C. (Canada) Postdoctoral Fellow, Department of Zoology, University of British Columbia

HONORS

2014 Class of 2014 Teaching Award for Professor Most Exemplifying Aldo Leopold's Land Ethic, Yale School of Forestry and Environmental Studies
2006 Named the Oastler Professor of Population and Community Ecology, Yale School of Forestry and Environmental Studies
2006 Elected Fellow of the AAAS (American Association for the Advancement of Science) for distinguished fundamental contributions towards understanding the emergence and maintenance of ecosystem structure and functioning and for relating ecosystem patterns to individual behaviors.

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PROFESSIONAL AFFILIATIONS

Ecological Society of America; American Association for the Advancement of Science; Society of American Naturalists.

PROFESSIONAL SERVICE TO CONSERVATION AND POLICY

2014-present Member, Science Advisory Council, Ocean Conservancy, Washington, DC.
2012-2013 Science Advisor, Open Space Institute's Northeast Resilient Landscapes Initiative, NY
2005-2009 Advisory Board Member, Center for Conservation Solutions, American Forest Foundation, Washington, DC.
2004 Member, US Environmental Protection Agency (EPA) Scientific Advisory Board ad hoc panel reviewing the EPA Report on the USA Environment.
1994 – 2000 Scientific Advisory Board, Mistik Forest Management Ltd., Saskatchewan, Canada

SELECTED PUBLICATIONS (out of 135 total)

Books

1. Schmitz, O.J. 2007. Ecology and Ecosystem Conservation. Island Press—Foundations of Contemporary Environmental Studies Series.

Journal Articles

2. Schmitz, O.J., J.J. Lawler, P. Beier, C. Groves, G. Knight, D.A. Boyce Jr, J. Bulluck, K.M. Johnston, M.L. Klein, K. Muller, D.J. Pierce, W.R. Singleton, J.R. Strittholt, D.M. Theobald, S.C. Trombulak, and A.E. Trainor. 2015. Conserving biodiversity: practical guidance about climate change adaptation approaches in support of land-use planning. *Natural Areas Journal in press*.
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