### T. A. Brichieri-Colombi, J. M. McPherson, D. J. Sheppard, J. J. Mason and A. Moehrenschlager. Standardizing the evaluation of community-based conservation success. *Ecological Applications*

### Data used to calculate the 10-year and 20-year performance and quality scores for the evaluation of the Wechiau Community Hippo Sanctuary using SPECCS

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### File list (files found within DataS1.zip)

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Development\_Surveys\_2016.xlsx

Staff Questionnaires.xlsx

StudentSurveys.xlsx

Adult Attitudes Survey\_2016.xlsx

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**Background**

Community-based conservation, which strives to simultaneously improve nature conservation and alleviate poverty, must provide biological and socio-economic benefits that are linked through effective resilience mechanisms. To date, few community-based conservation initiatives have published comprehensive assessments that track performance in these elements of success. With 45% of the world’s protected areas in co-management with local communities, standardized measures to effectively evaluate the dual goals of community-based conservation are needed. To address this need, we developed SPECCS, a user-friendly Standardized Protocol for Evaluating Community Conservation Success that incorporates an appraisal of data quality to responsibly assess progress over time or to compare effectiveness among different initiatives ([www.calgaryzoo.com/why-we-matter/our-approach](http://www.calgaryzoo.com/why-we-matter/our-approach)). In **Brichieri-Colombi et al.** Standardizing the evaluation of community-based conservation success, *Ecological Applications,* we illustrate SPECCS’s use by evaluating the Wechiau Community Hippo Sanctuary (WCHS) of northern Ghana 10 and 20 years after its inception. Presented here are additional (raw) data used to evaluate the WCHS. For additional data and more information, please see our published works.

The Wechiau Community Hippo Sanctuary (WCHS) lies in north-eastern Ghana along 36 km of the Black Volta River, bordering Burkina Faso to the West. Founded in 1998 by the Paramount Chief of Wechiau and his sub-chiefs in lieu of a proposed government-run hippopotamus reserve, this 212 km2 community protected area (CPA) comprises 17 communities.

The sanctuary encompasses two zones: a 1-2 km wide core zone along the Black Volta River free of human habitation with bylaws to ensure minimal human impacts on hippos and their habitat, and an adjacent 5-10 km wide development zone that includes human settlements and farmland. Fourteen households originally located in the core zone were resettled to the development zone in 2002. Four ethnic groups differing in language, religion and traditional lifestyle inhabit the development zone: Wala, Birifor, Hausa and Dagaabe. The Wala, as original settlers of the land, hold all traditional authority and land rights (Sheppard et al. 2010).

Early phase socio-economic developments in WCHS included targeted infrastructure improvements (wells, sanitation, solar lights, additional schools) and an eco-tourism venture centred on hippo safaris (Sheppard et al. 2010). An organic shea nut harvesting cooperative was formed in 2008 as a second income source, with shea nuts hand-processed locally into butter since 2015 in a new community-owned factory.

# SPECCS was first applied to data spanning 1999-2009 as published in Sheppard et al. (2010) on: trends in hippopotamus numbers, bird diversity, infrastructure development, scholarships, the sanctuary’s legal status, employment, finances, environmental awareness and attitudes among school children and disadvantaged residents. We also collected comparable data 2010 – 2017 to assess performance 20 years after inception, expanding some analyses to include comparative data from outside the WCHS and adding novel datasets on environmental awareness and attitudes among adults, staff and members of the organic shea cooperative.

**File Description**

Bird Surveys.xlsx

A highly-trained community member - one of Ghana’s preeminent bird guides - conducted bird surveys along 4 permanent transects inside and 3 permanent transects outside the sanctuary during both the wet and dry season each year 2007-2017 (except 2009). Each transect was 2 km long with eight 250 m segments. During survey sessions, the bird guide walked all 7 transects within 3-4 weeks, starting each between 5:00-5:45am, and spending 30 minutes per segment to record all birds seen (with binoculars) or heard. Transect and segment-specific detection rates were calculated by conducting repeat surveys on each transect on consecutive days and dividing the number of species detected on both days by the total number of species recorded along the transect or segment in the two-day period. We generated species accumulation curves in R using the package ‘vegan’ (Oksanen et al. 2017),adding sites in random order over 100 permutations.We used GLMs with a Poisson error structure to investigate the relationship between species richness and season (wet vs. dry), place (inside vs. outside the sanctuary), year, and all pairwise interactions, applying an information theoretic framework and model averaging (Burnham and Anderson 2002) to test all possible combinations of the parameters. We used generalized linear mixed-effects models (GLMMs) with transect nested in year as random effect and a Poisson or binomial error structure, respectively, to examine the relationship between species richness or detectability and habitat type. Bird Surveys.xlsx has 2 tabs:

1. BirdRichnessBySection – for each transect/date/section we count the number of species observed (‘n\_spec’)
2. Bird Detectability – for each transect/season/year we count the proportion of birds that were observed on both days of a two-day survey (i.e. # of birds observed on both days / # of birds observed in total over the two days).

Development\_Surveys\_2016.xlsx

We obtained data on infrastructure developments between 1998 and 2016 by questioning community members, leaders and elders in May 2016 in all 17 settlements inside the WCHS and 100 settlements elsewhere in the Wechiau Paramountcy. Interviews were conducted in either Wale or Birifor and recorded the number and approximate completion date of new banks, post offices, police stations, government offices, medical facilities, schools, school meal programs, places of worship, restaurants, bars, tourist accommodations, fuel stations, roads, telecommunication towers, internet access points, electricity access, solar power, hand-dug wells, drilled wells, dams, piped water, wastewater canals, public toilets, fishery facilities, shea butter factories, and commercial shea nut markets. We then compared the rate of infrastructure development inside and outside the sanctuary for small (< 1000 people) and large (> 1000 people) settlements, with population estimates obtained from the Wa-West District Health Administration. Infrastructure data used in Sheppard et al. (2010) considered a smaller list of infrastructure developments obtained late in 2007 from the Paramountcy’s four administrative area councils. Development\_Suverys\_2016.xlsx shows developments by type and community size per period (undated developments were divided between the 3 periods) inside WCHS, outside WCHS and in the WCHS buffer zone for small and large communities.

Staff Questionnaires.xlsx

Seven long-term staff or management board members of the WCHS completed questionnaires in May 2016. The questionnaires asked respondents to identify opportunities and challenges posed by the sanctuary at the community, family and individual level, and to describe the approach to and success with addressing challenges. Furthermore, respondents were asked to express their opinions about the sanctuary and its management, and their hopes and fears for the future. Data from interviews and questionnaire were analysed using QSR International's NVivo 10 Software (QSR International Pty Ltd. 2015). Staff Questionnaires.xlsx are each participant’s response to questions (Members 1-7). To preserve anonymity, any identifying information has been removed.

StudentSurveys.xlsx

Student surveys were undertaken with a representative sample of primary and middle school students from inside WCHS in 2004 (200 students, 7 schools), 2007 (159 students, 6 schools), 2011 (290 students, 14 schools) and 2016 (194 students, 20 schools). In 2016, we additionally surveyed 199 students from 18 schools outside WCHS. Students were selected randomly but stratified based on school size and gender ratios. Questions tested their ability to describe plants and vertebrate animal classes (basic ecology), photosynthesis and animal behaviours (ecological linkages), nature’s benefits to humans, conservation concepts and the WCHS’s purpose and benefits. Each student was interviewed in their preferred language. Answers were recorded verbatim, then categorized to assign a percentage score for individual questions, sections and the entire questionnaire. Results from inside the sanctuary were analysed for temporal trends while also accounting for student age, gender, grade, and tourism exposure (binary). For 2016 surveys, we additionally compared results from schools inside and outside the WCHS while accounting for age and gender. We used GLMs with a binomial error structure to analyse all possible combinations of the covariates as additive effects, and calculated model-averaged parameter estimates in R (R Core Team 2016) using the MuMIn package (Barton 2016). StudentSurveys.xlsx are each participant’s scores in the educational survey. To preserve anonymity, any identifying information has been removed. We used the EducationScores\_before2010 tab to calculate results from surveys conducted in 2004 and 2007; we used the EducationScores\_04-16inside to calculate results for school surveys inside the WCHS; and we used the EducationScores\_2016allschools for the 2016 analysis.

Adult Attitudes Survey\_2016.xlsx

We conducted standardized interviews with adults conducted in May and June 2016 in all 17 communities inside the WCHS and 17 randomly chosen communities outside. Respondents included each community’s leader where possible, but were otherwise picked randomly in proportion to the community’s population size, with 153 residents inside and 200 outside interviewed in their language of choice – English, Birifor or Wale. Questions concerned uses and stewardship of the environment, environmental change, and understanding of and opinions about conservation. Data from interviews and questionnaire were analysed using QSR International's NVivo 10 Software (QSR International Pty Ltd. 2015). Adult Attidudes Survey\_2016.xlsx are the response from participants inside, outside and in the buffer zone of the WCHS. To preserve anonymity, any identifying information has been removed.

Disadvantaged Citizens Survey.xlsx

These are residents of the nine communities bordering the sanctuary’s core zone, who prior to the sanctuary’s establishment lived inside the core zone or depended on its natural resources. In 2007, 46 participants were interviewed and asked about their knowledge of the sanctuary, associated benefits, what they believed would happen if the project failed, and any additional opinions or concerns. In 2016, the same participants were interviewed again and additionally asked what sacrifices they made for the sanctuary. Where original respondents had passed away (6 cases), relatives of the deceased were interviewed. The Disadvantaged Citizens Survey.xlsx are the responses from all participants. To preserve anonymity, any identifying information has been removed.

Shea Coop Interviews.xlsx

We interviewed 235 women (141 Birifor and 94 Wala women) across 11 settlements within WCHS involved in the organic shea butter venture. Of these women, 59 worked in the factory, the remainder harvested shea nuts. Interviews were conducted in the women’s language of choice (Birifor or Wale) by two trained local women in May and June 2016, addressing questions about harvesting practices before and since establishment of the WCHS shea cooperative, shea-derived income and its uses, and the women’s understanding of linkages between the cooperative and nature conservation. The Shea Coop Inerviews.xlsx are the responses from all participants. To preserve anonymity, any identifying information has been removed

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