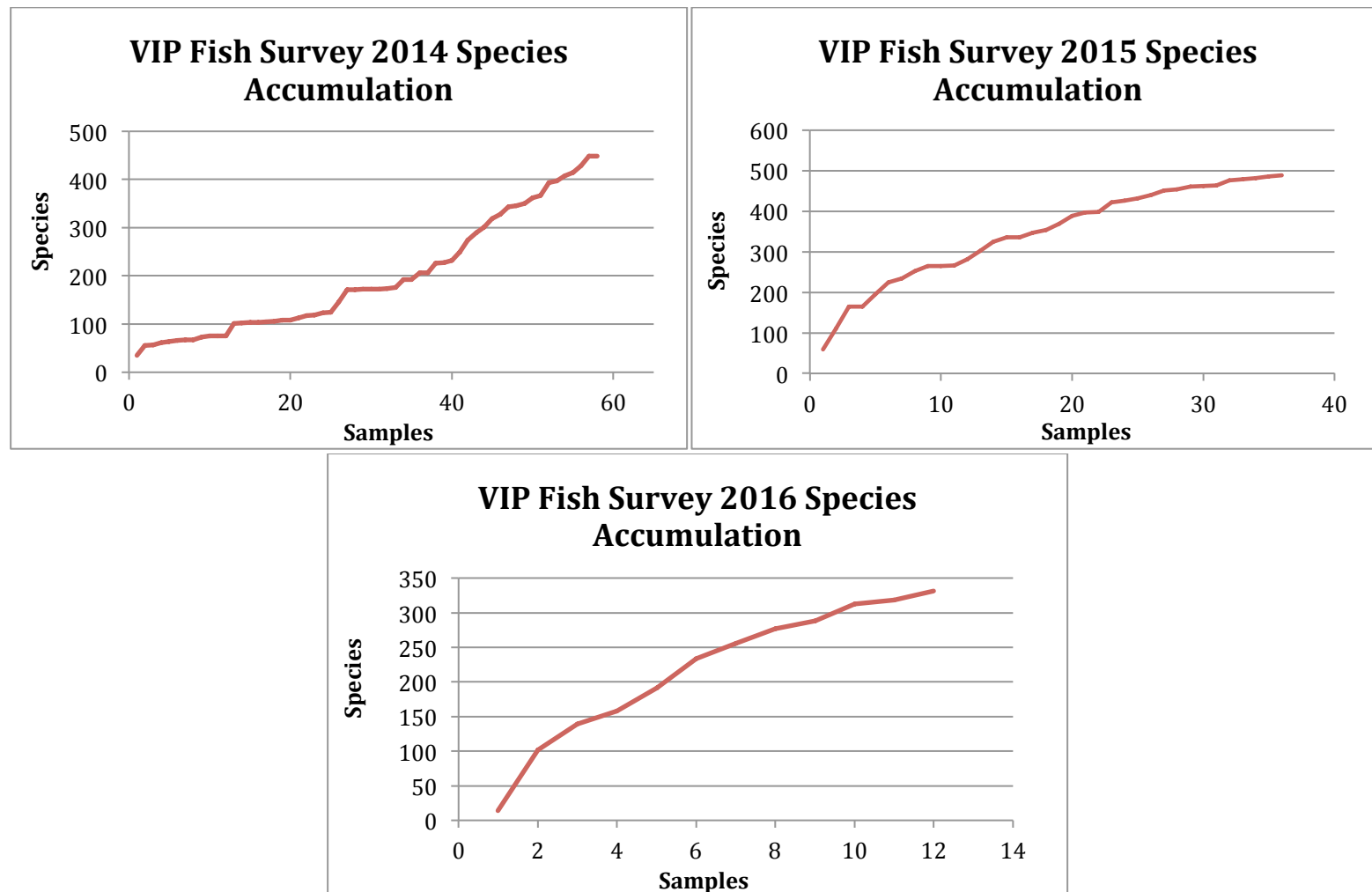


Verde Island Passage (VIP) Fish Survey 2014-2017
EstimateS Species Accumulation and Rarefaction Results
December 2017
E.E. Biesack & B.L. Stockwell (Old Dominion University)

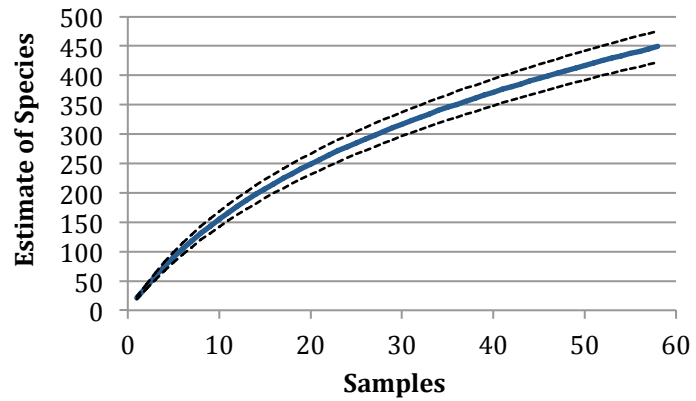
Sample-based species accumulation and rarefaction curves, not extrapolated, using classic formula for Chao1 and Chao2 bias correction and sampling without replacement for VIP rotenone stations 2014-2016. 2016 VIP surveys exclude the outgroup from the Visayas.

Yearly Species Accumulation Curves

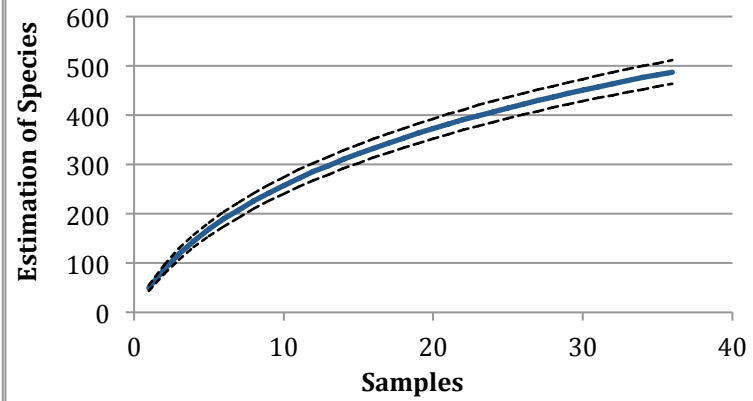


Yearly Interpolated Rarefaction Curves

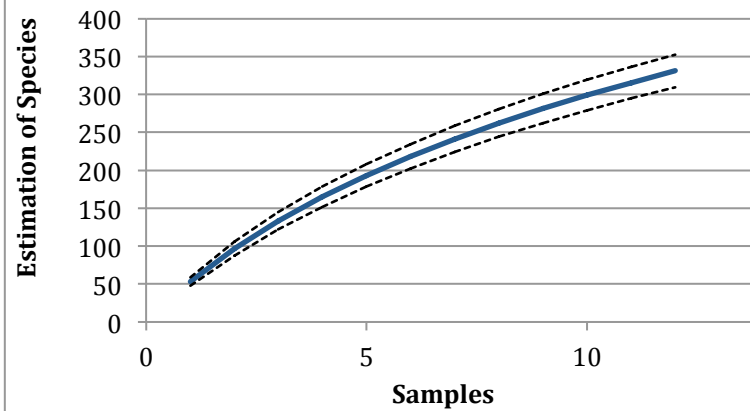
**VIP Fish Survey 2014 Rarefaction
with 95% Confidence Intervals**



**VIP Fish Survey 2015 Rarefaction
with 95% Confidence Intervals**

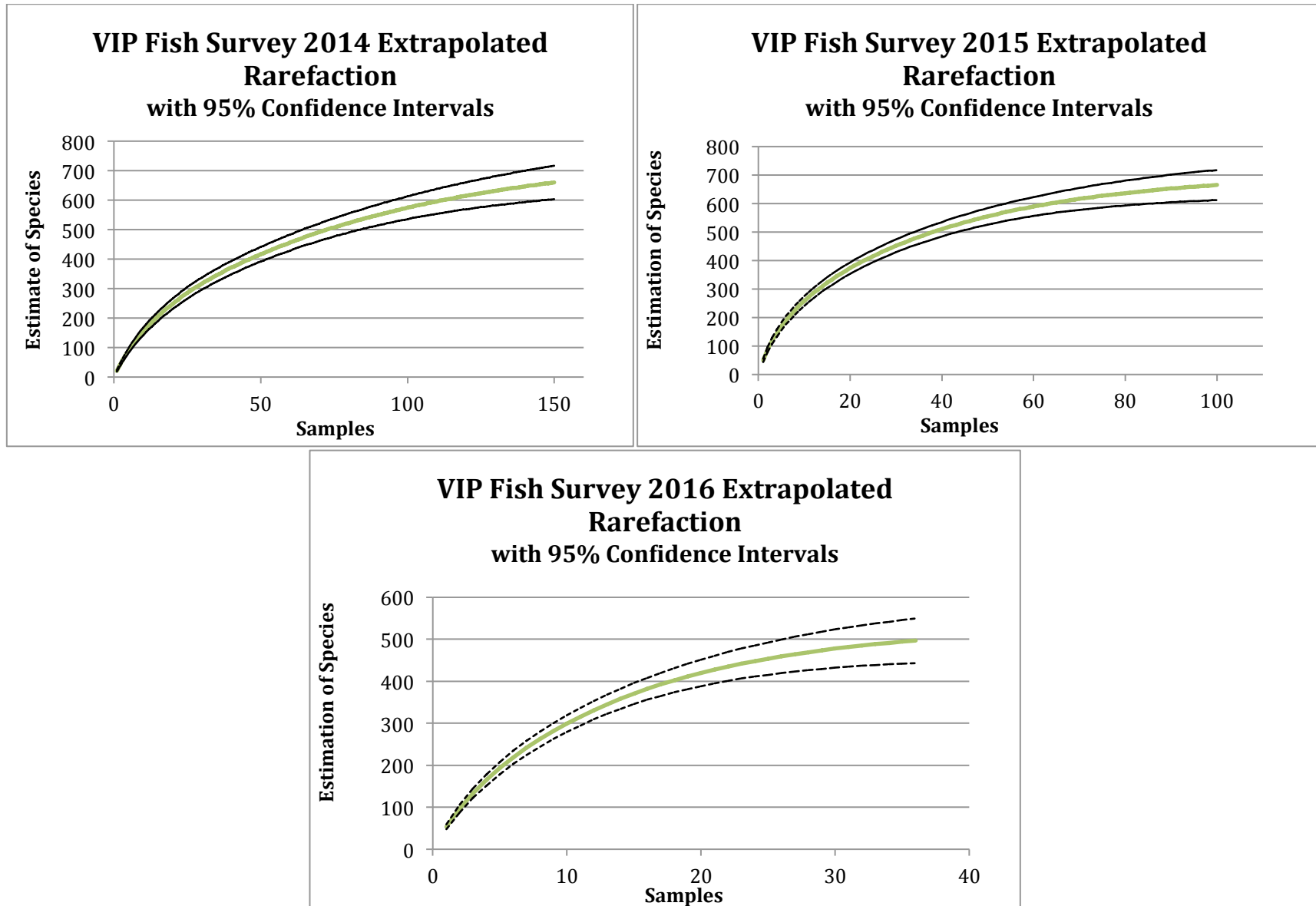


**VIP Fish Survey 2016 Rarefaction
with 95% Confidence Intervals**



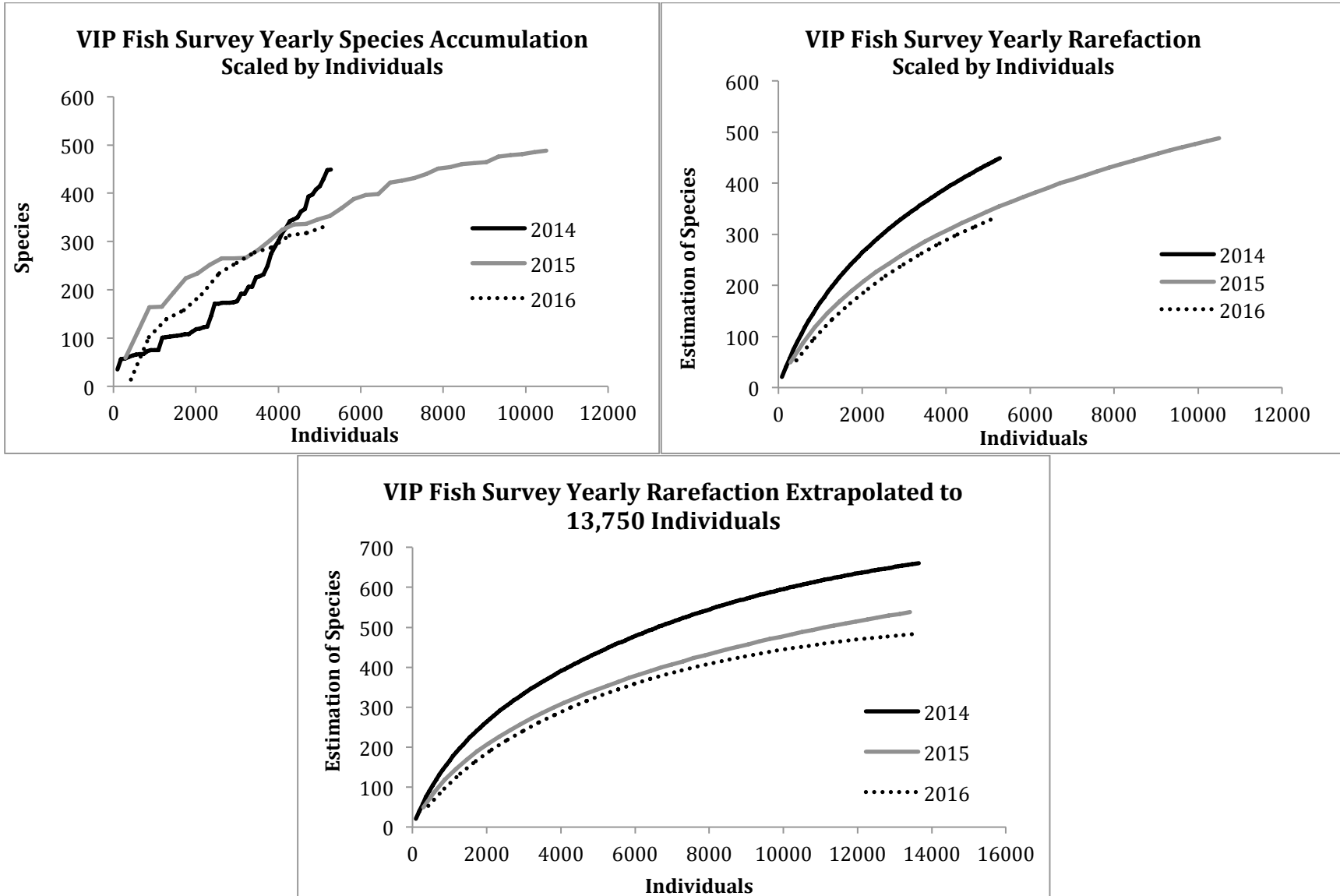
Yearly Extrapolated Rarefaction Curves

Extrapolated rarefaction curves can be used to estimate species richness (asymptote) extending beyond the number of sites actually sampled. If a non extrapolated rarefaction curve reaches its asymptote, there is no need for an extrapolated curve. Curves have been extrapolated to ~3 times the number of samples actually taken. Curves for rotenone stations exclude the Visayas outgroup from the 2016 data:



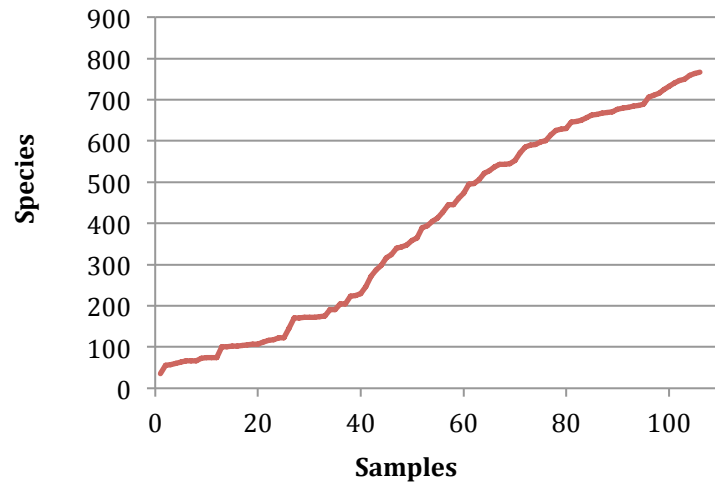
Year-by-Year Comparisons Scaled by Individuals

Species accumulation and rarefaction curves can only be compared directly if they have reached a clear asymptote (Colwell & Gotelli 2001), so the three rotenone years are compared directly below scaled by individuals rather than samples, to account for differences in abundance and sampling effort per site. Differences may also be attributable to collection from different sites in different years. The Visayas outgroup is excluded from the 2016 data.

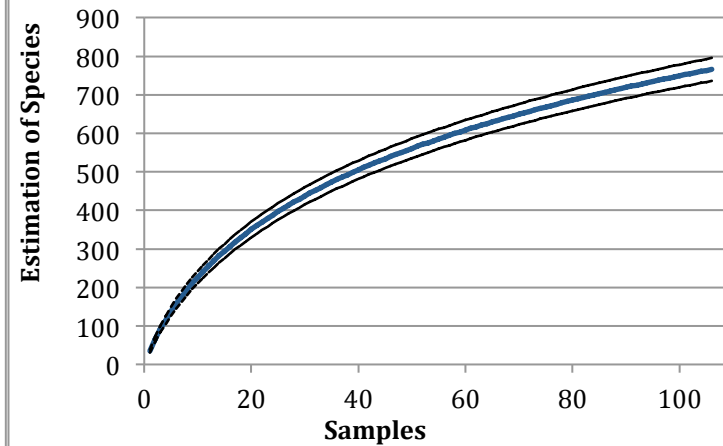


All Three Rotenone Sampling Years Curves

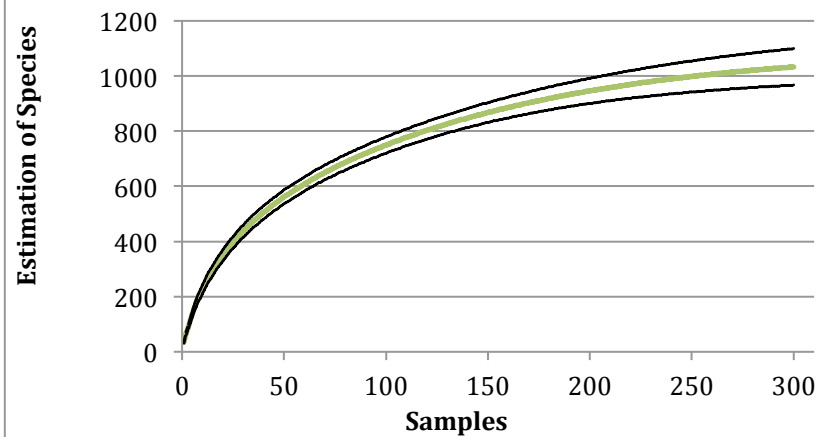
VIP Fish Survey All Years Species Accumulation



**VIP Fish Survey All Years Rarefaction
with 95% Confidence Intervals**

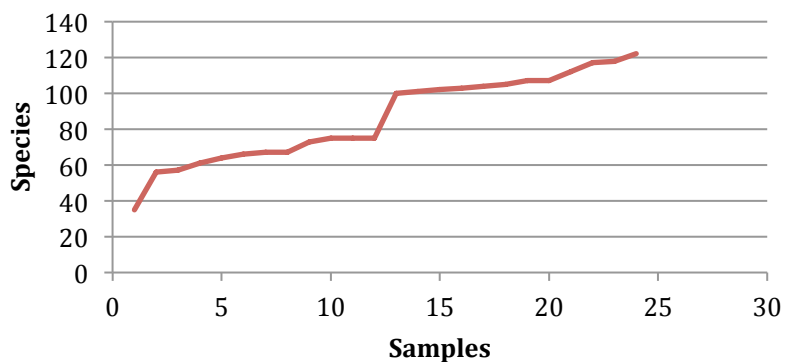


**VIP Fish Survey All Years Extrapolated
Rarefaction
with 95% Confidence Intervals**

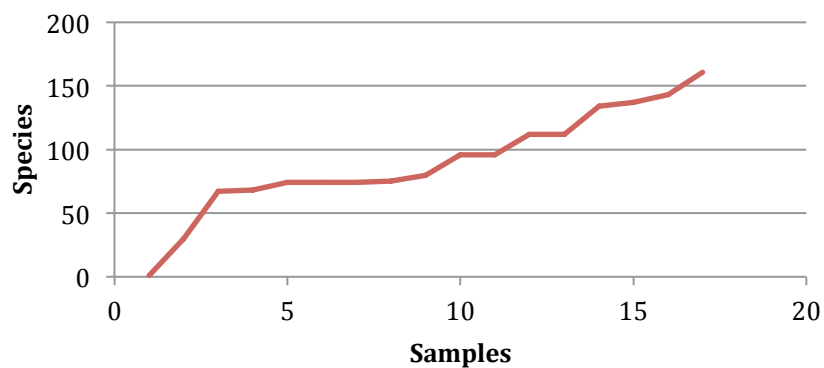


Site-by-Site Species Accumulation Curves for Rotenone Sites 2014-16

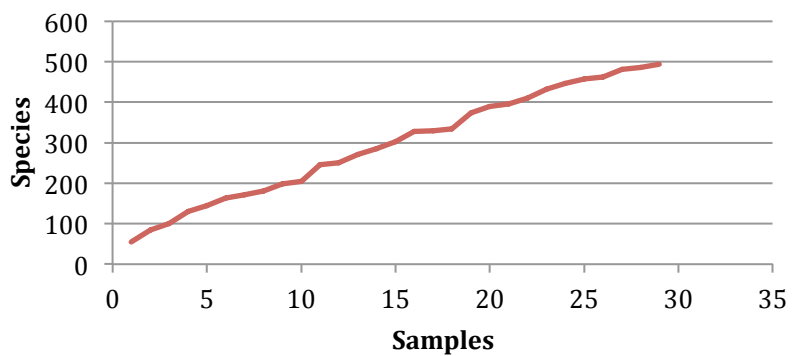
VIP Fish Survey Calatagan Species Accumulation



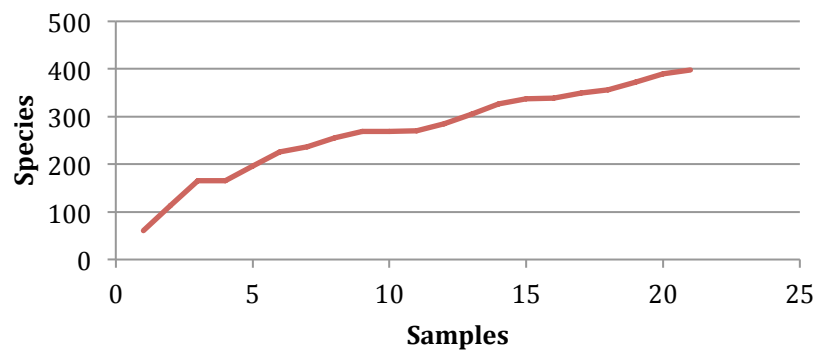
VIP Fish Survey Lubang Species Accumulation



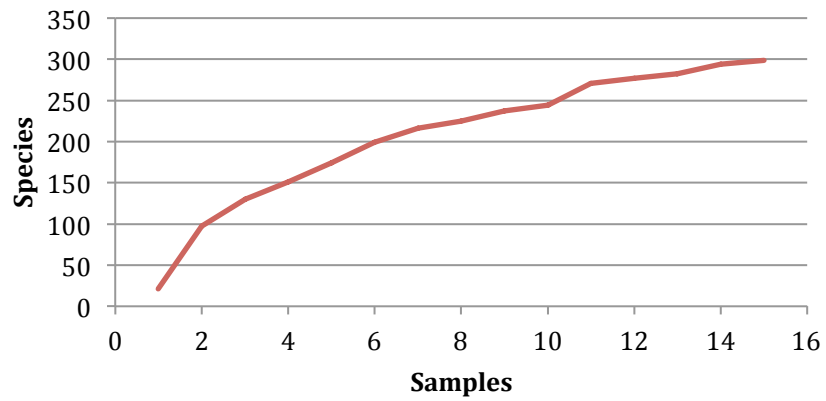
VIP Fish Survey Mabini Species Accumulation



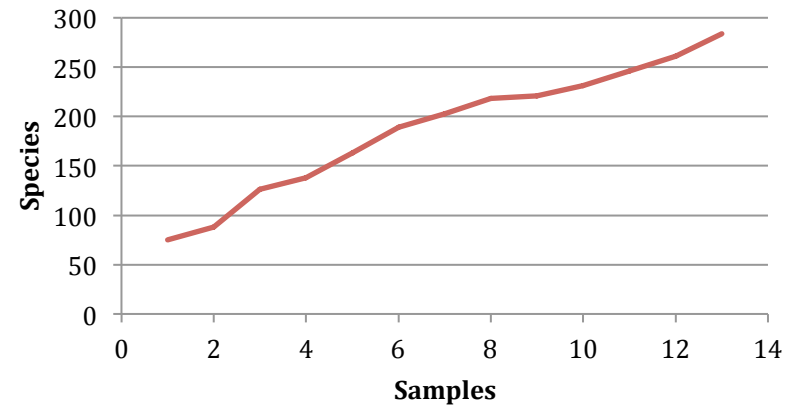
VIP Fish Survey Puerto Galera Species Accumulation



VIP Fish Survey Verde Island Species Accumulation

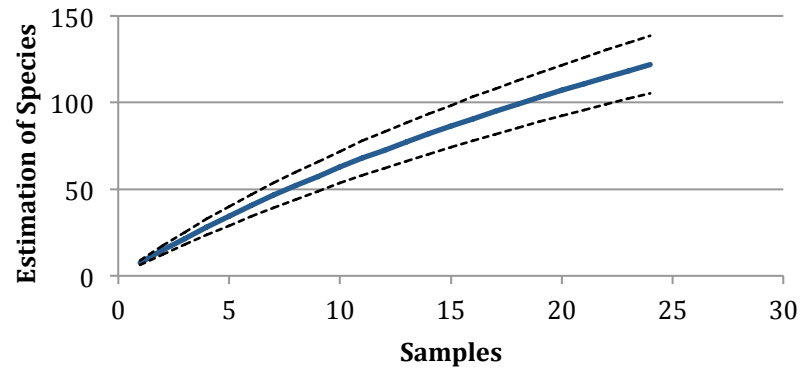


VIP Fish Survey Visayas Outgroup Species Accumulation

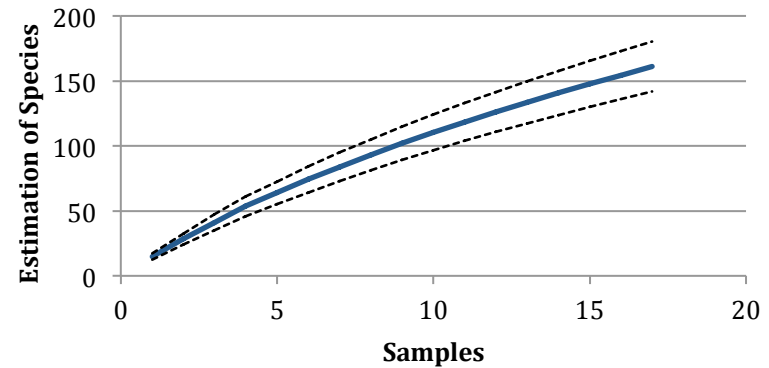


Site-by-Site Interpolated Rarefaction Curves for Rotenone Sites 2014-16

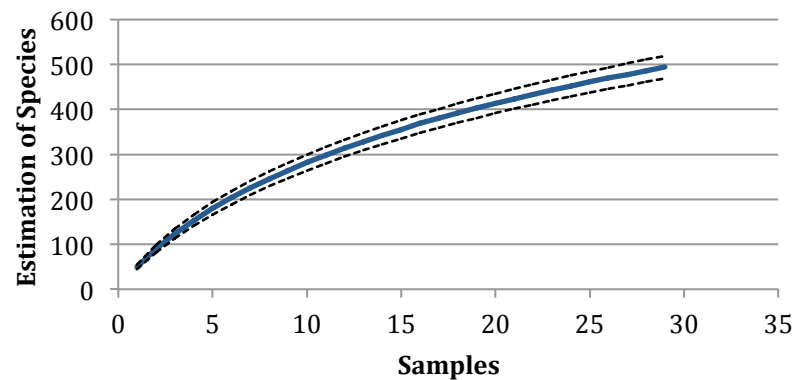
**VIP Fish Survey Calatagan Rarefaction
with 95% Confidence Intervals**



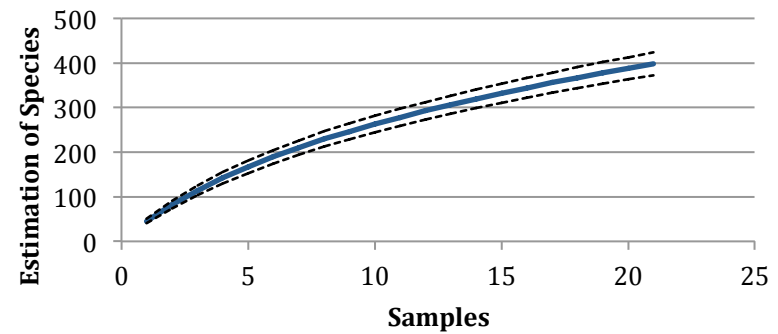
**VIP Fish Survey Lubang Rarefaction
with 95% Confidence Intervals**



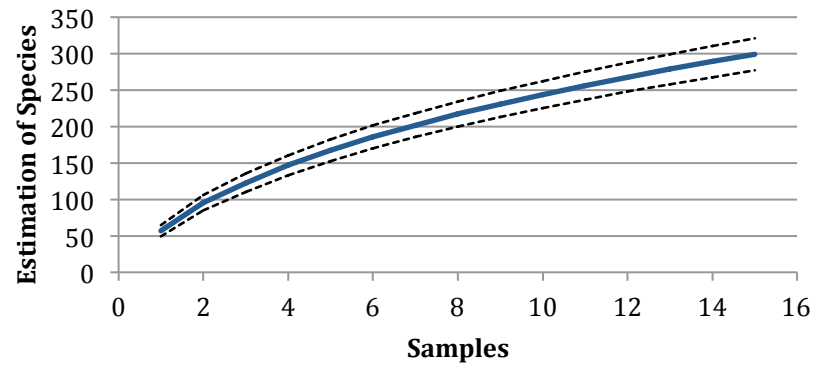
**VIP Fish Survey Mabini Rarefaction
with 95% Confidence Intervals**



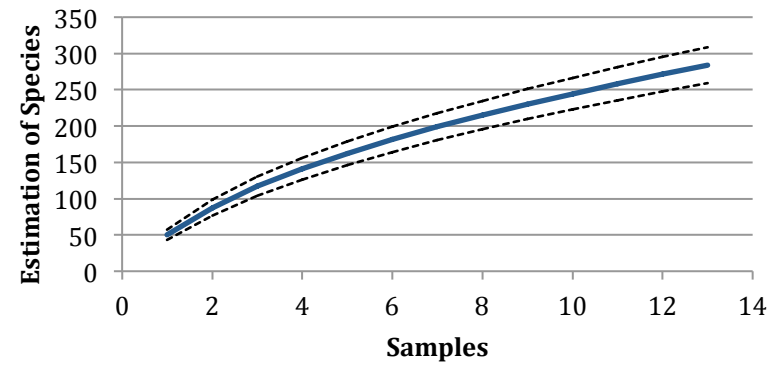
**VIP Fish Survey Puerto Galera
Rarefaction
with 95% Confidence Intervals**



**VIP Fish Survey Verde Island
Rarefaction
with 95% Confidence Intervals**

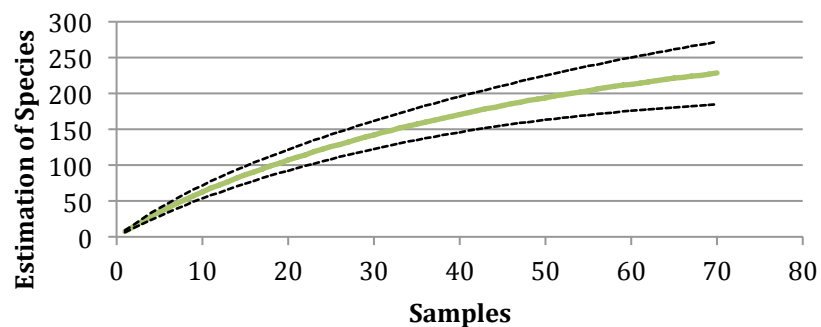


**VIP Fish Survey Visayas Outgroup
Rarefaction
with 95% Confidence Intervals**

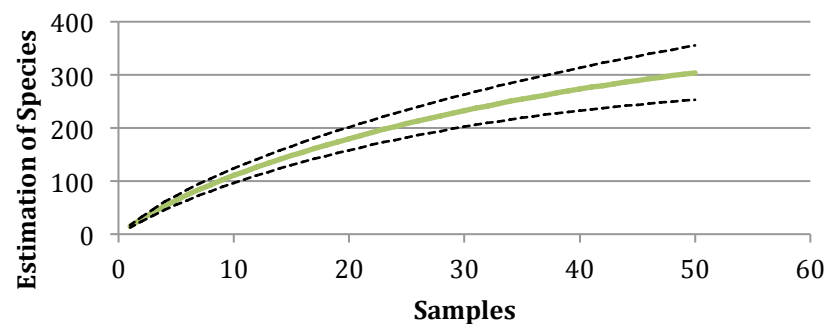


Site-by-Site Extrapolated Rarefaction Curves for Rotenone Sites 2014-16

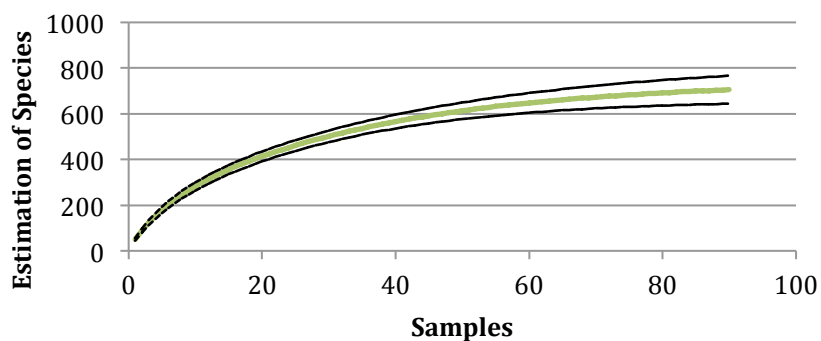
**VIP Fish Survey Calatagan Extrapolated
Rarefaction
with 95% Confidence Intervals**



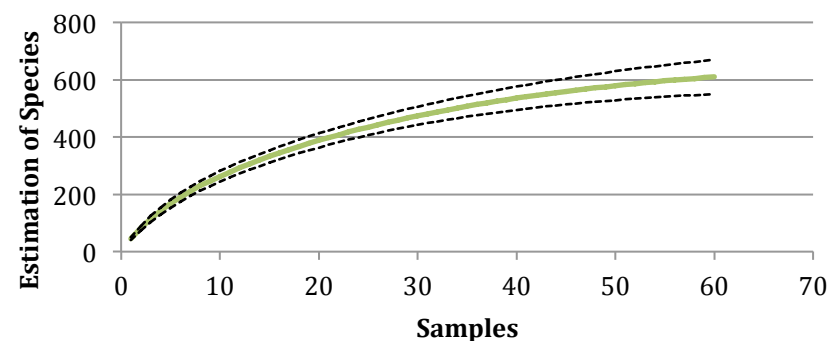
**VIP Fish Survey Lubang Extrapolated
Rarefaction
with 95% Confidence Intervals**



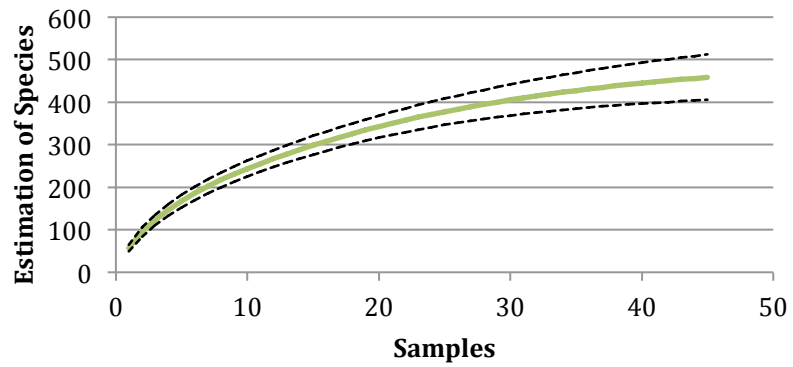
**VIP Fish Survey Mabini Extrapolated
Rarefaction
with 95% Confidence Intervals**



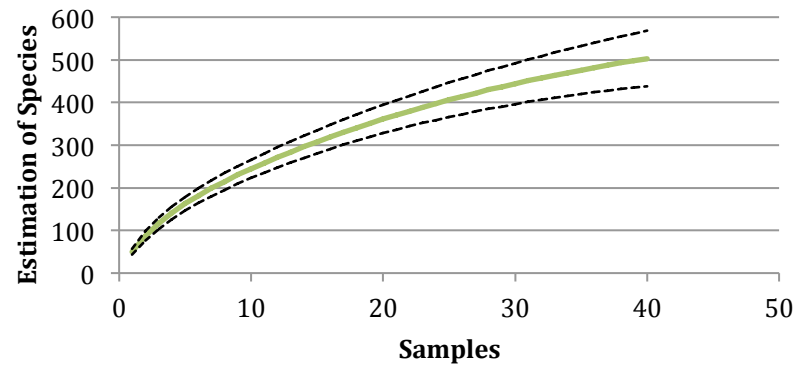
**VIP Fish Survey Puerto Galera
Extrapolated Rarefaction
with 95% Confidence Intervals**



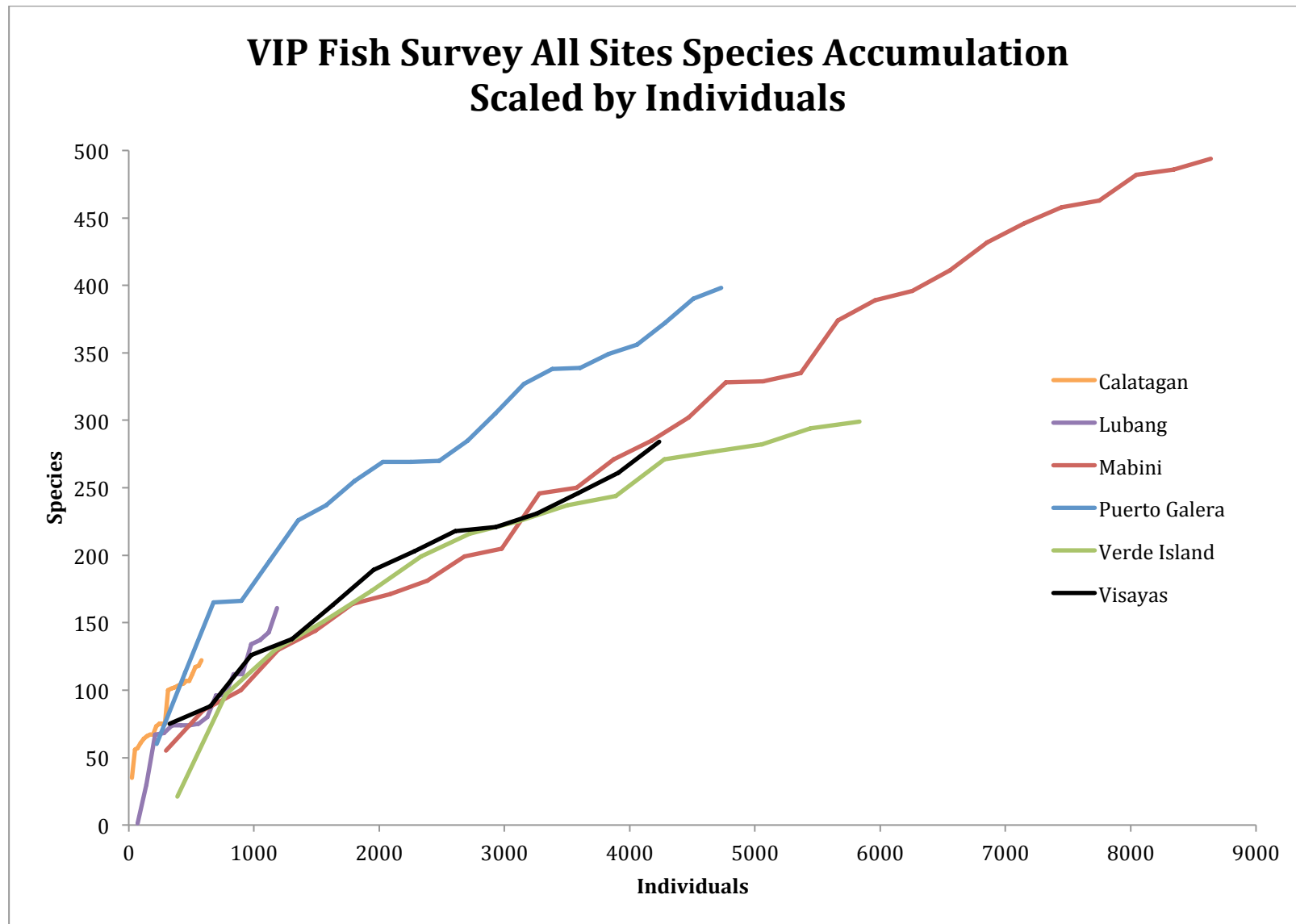
**VIP Fish Survey Verde Island
Extrapolated Rarefaction
with 95% Confidence Intervals**



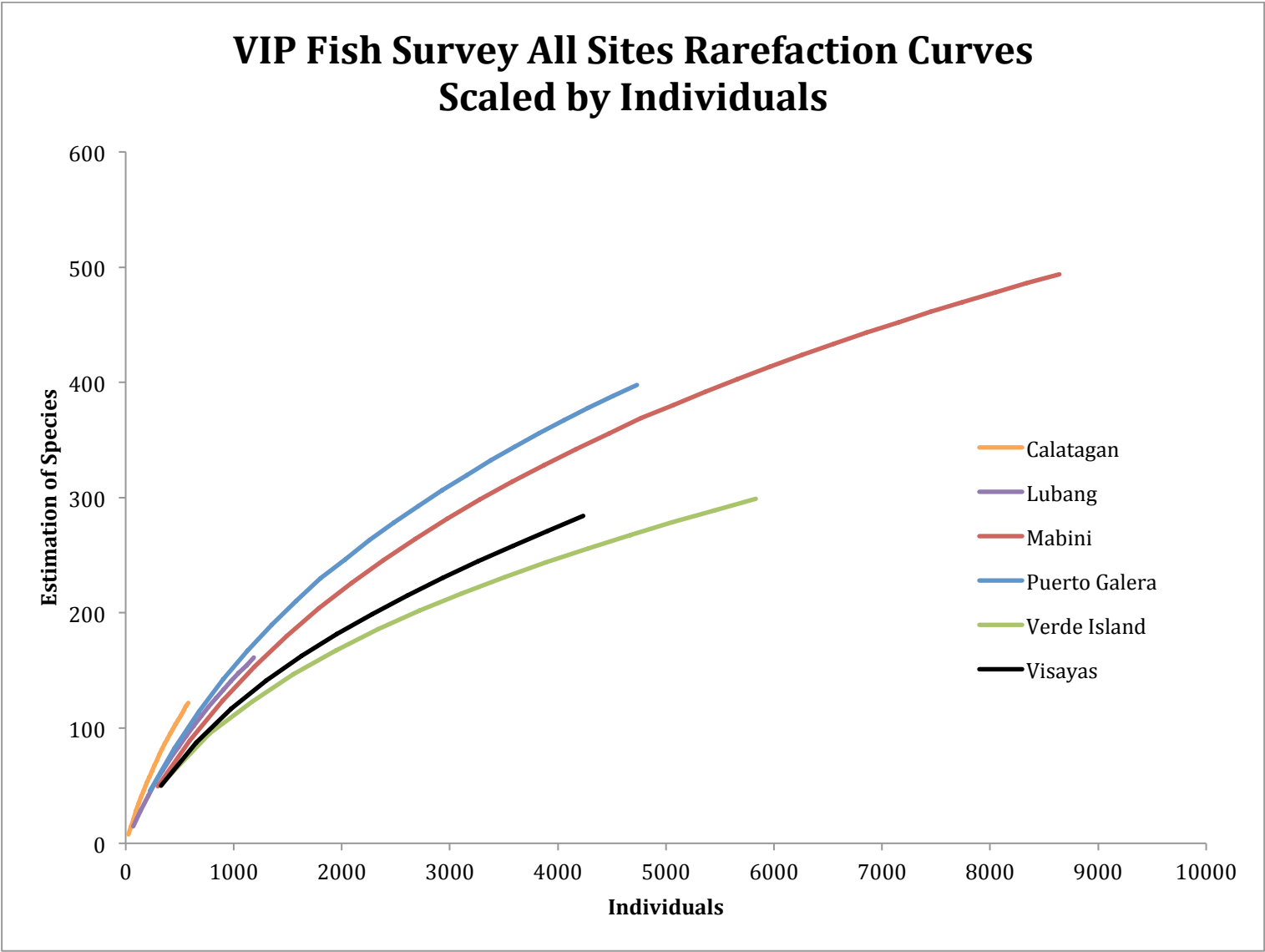
**VIP Fish Survey Visayas Outgroup
Extrapolated Rarefaction
with 95% Confidence Intervals**



All Rotenone Sites Species Accumulation Curves Scaled by Individuals for All Three Years

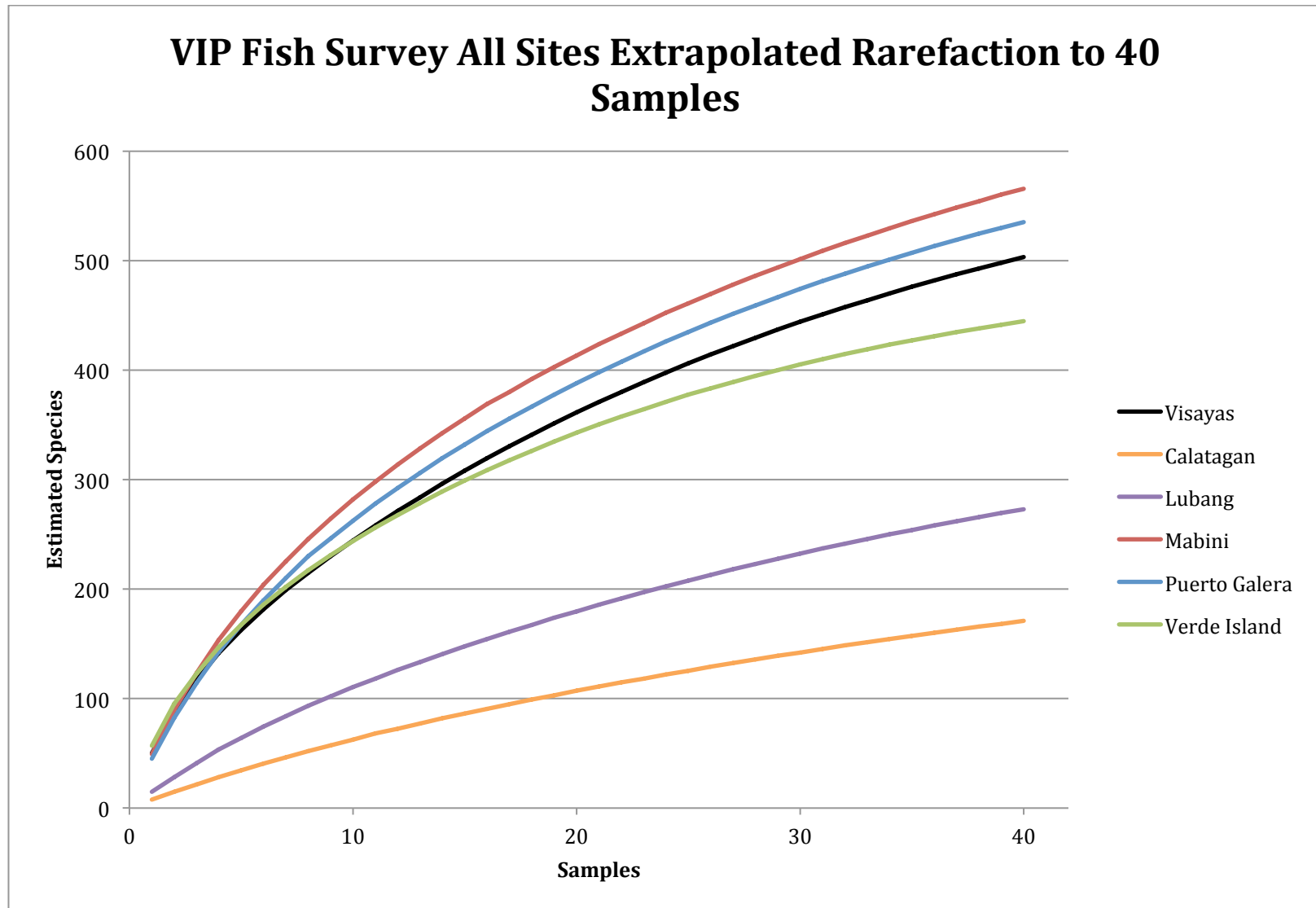


All Rotenone Sites Interpolated Rarefaction Curves Scaled by Individuals for All Three Years

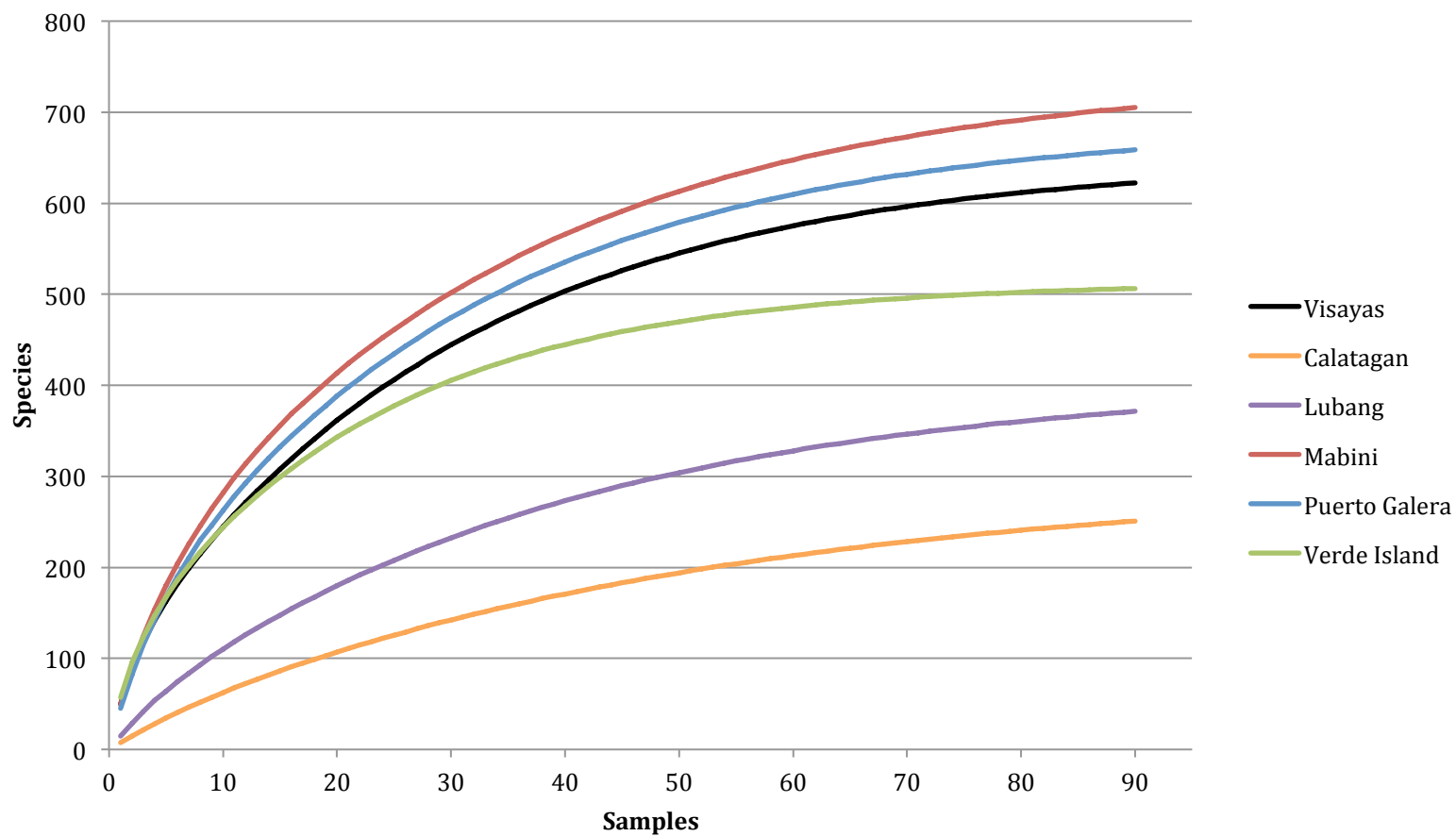


All Rotenone Sites Extrapolated Rarefaction Curves for All Three Years

Including the Visayas outgroup as a separate dataset

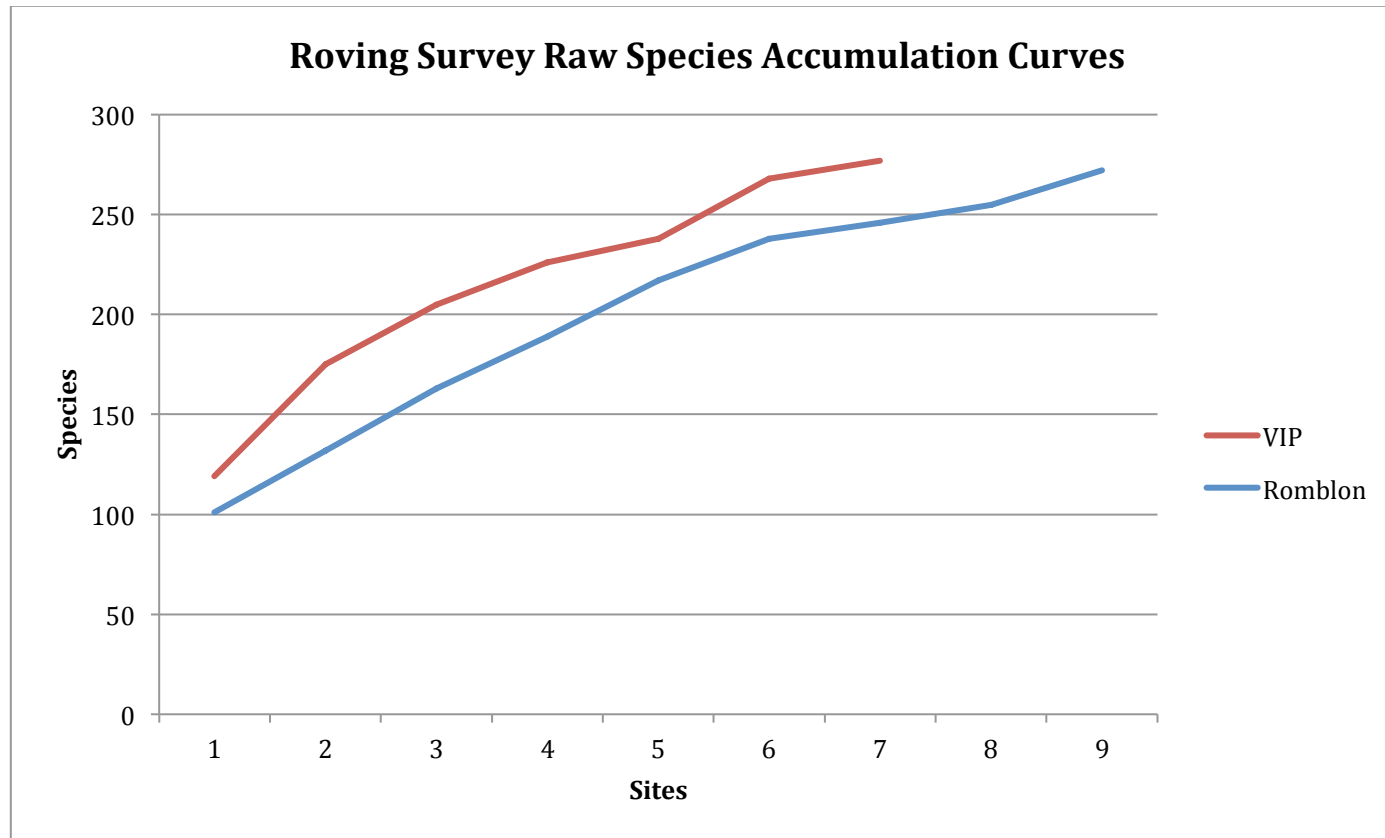


VIP Fish Survey All Sites Extrapolated Rarefaction to 90 Samples

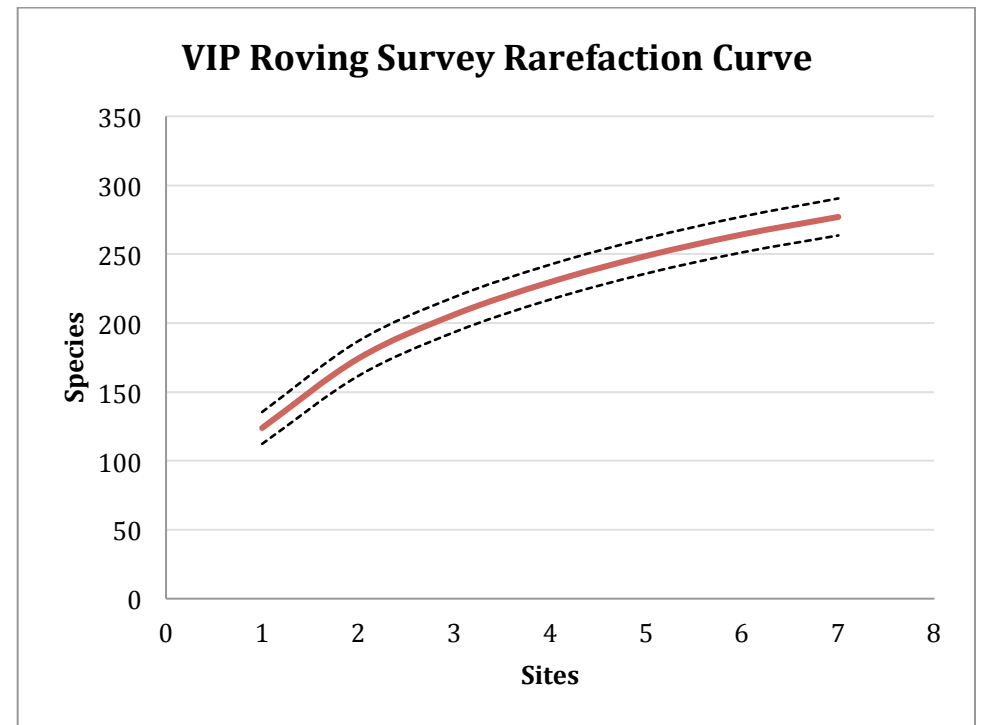
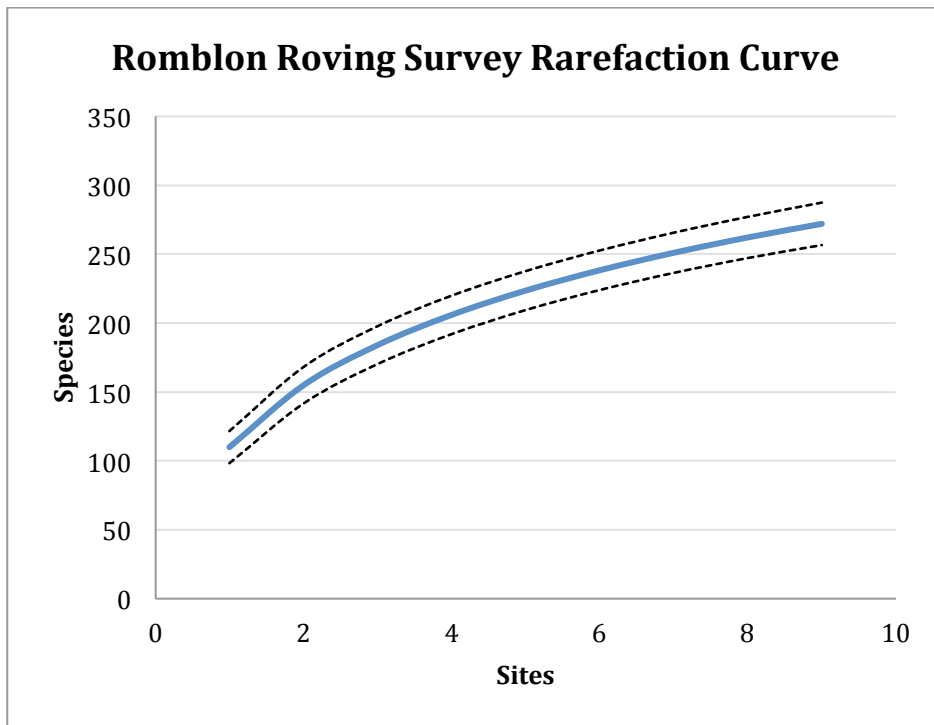


2017 Roving Survey Site (Romblon) Sample-Based Species Accumulation Curve

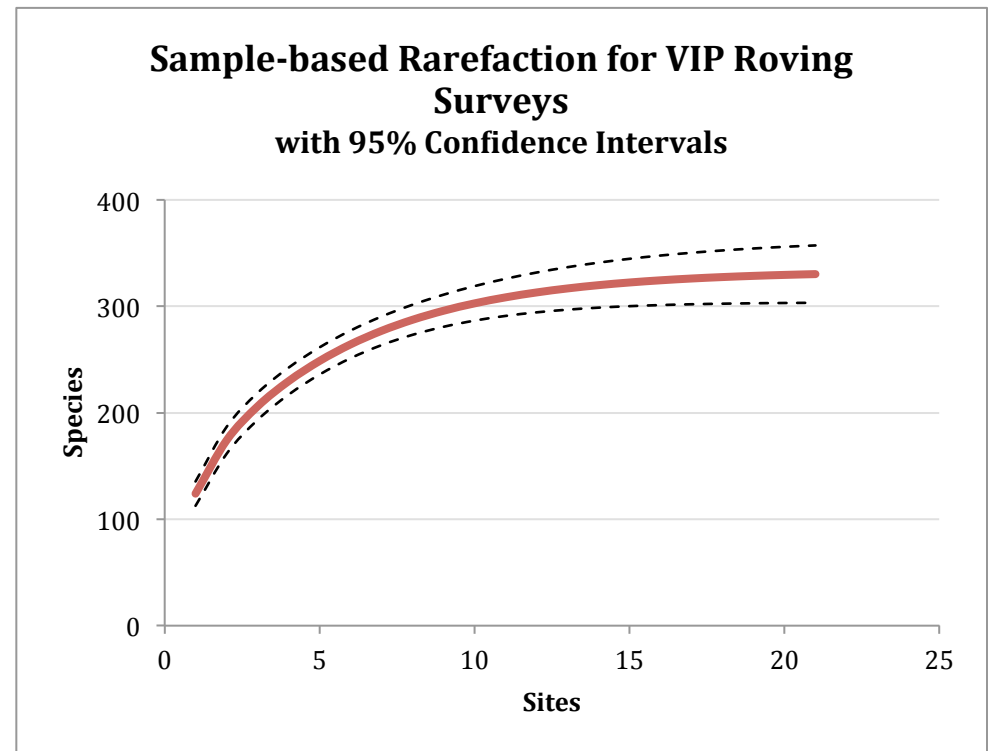
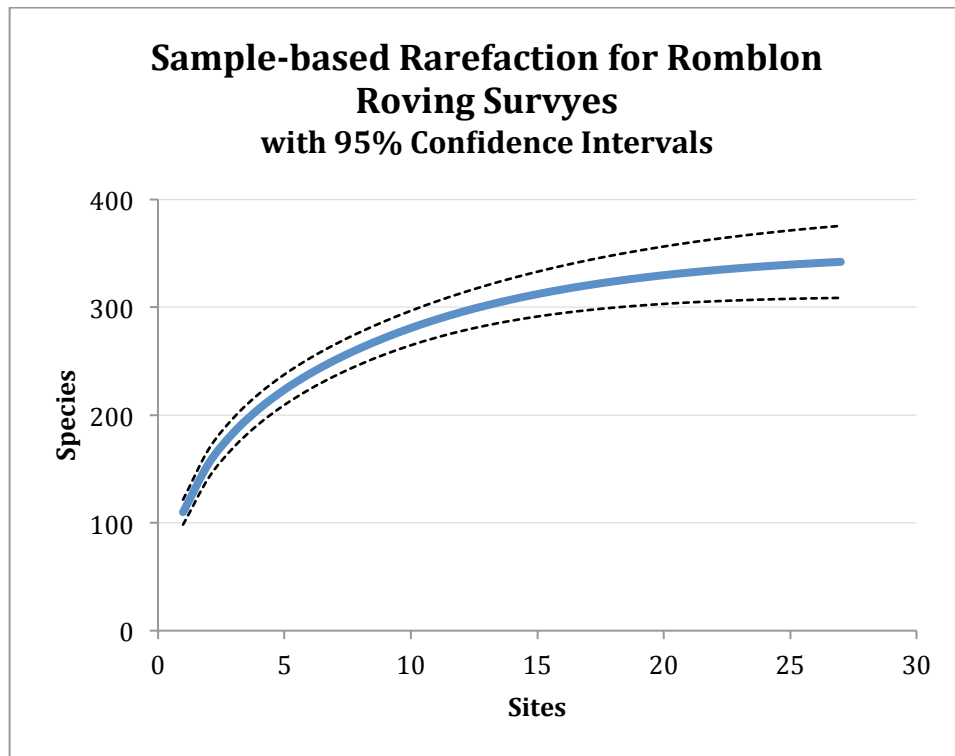
The 2017 data was taken from an underwater roving survey using transects, due to a ban on rotenone at the collection sites. Observations were recorded for present species as “one”, “few”, or “many”. Thus, individual-based analyses are not possible, as exact numbers of observations were not recorded. These data are not comparable to rotenone stations because the differences in methodology bias species composition (rotenone biased toward smaller, more cryptic species and roving surveys biased toward larger, more visible species). However, previous roving survey data collected in 2005 and 2007 from the Verde Island Passage (VIP) is used to compare.



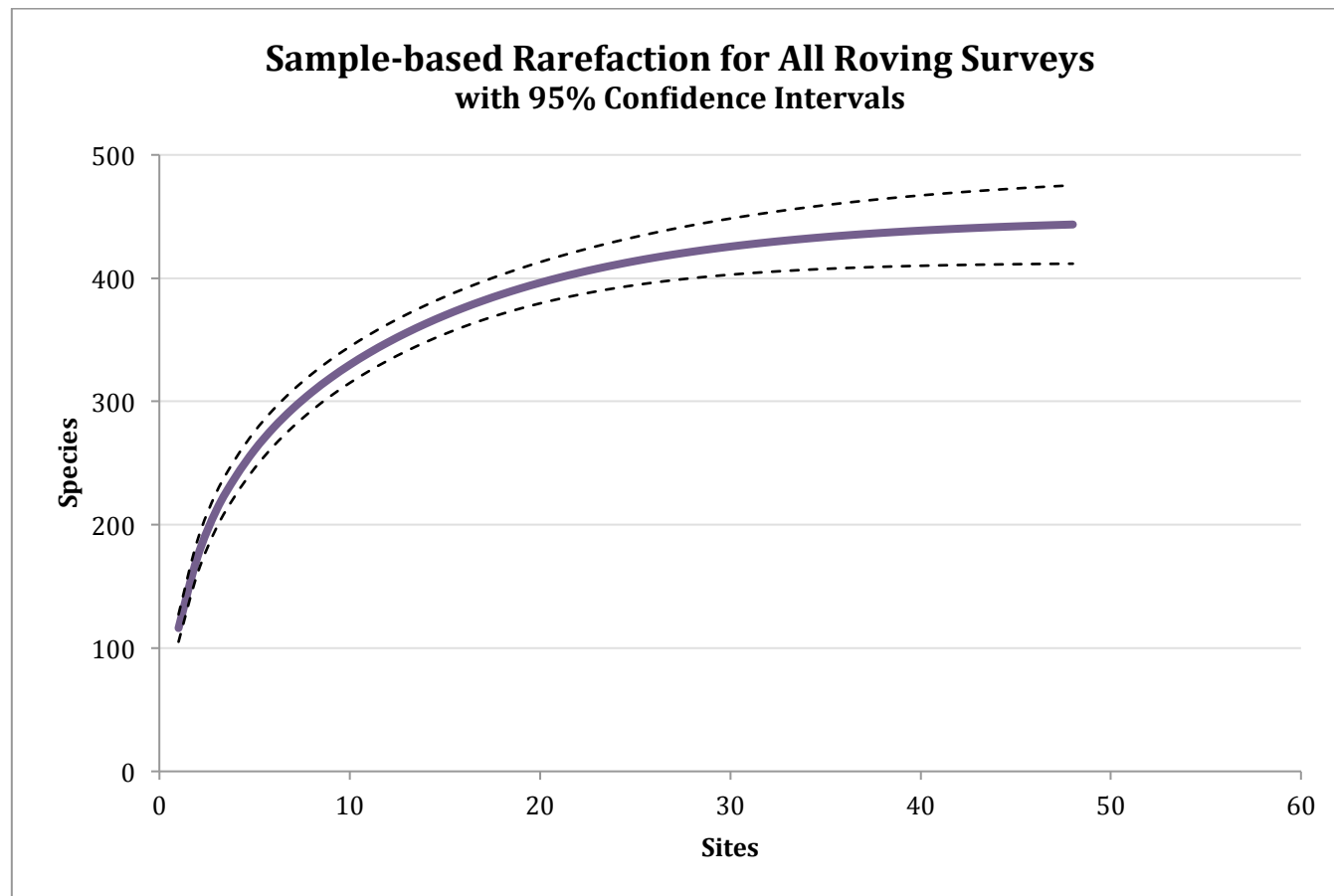
2017 Roving Survey (Romblon) Sample-Based Rarefaction Curve



2017 Roving Survey (Romblon) Sample-Based Extrapolated Rarefaction Curve

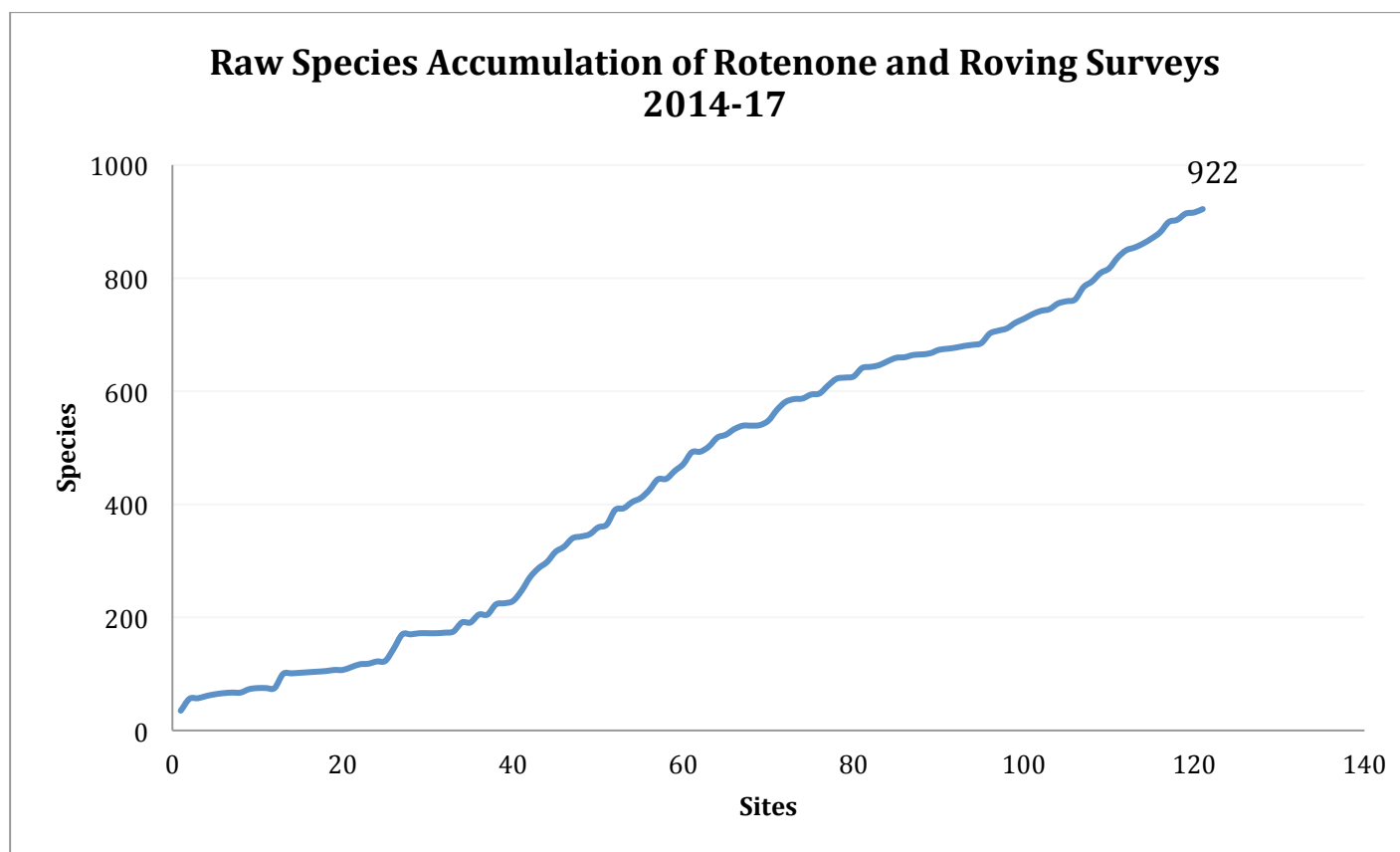


Sample-Based Extrapolated Rarefaction Curve for All Roving Surveys



Sample-based Curves for All Rotenone and Roving Survey Sites in the Verde Island Passage (VIP) for All Four Years

Although combining data from two different survey methods should be done with caution due to biases in the species present in the results, as mentioned previously, we wanted to present the total accumulation curves and an extrapolated rarefaction curve to provide a rough visual of the reef fish diversity of the VIP.



**Sample-based Rarefaction for Rotenone and Roving Surveys
2014-17 Extrapolated to 3x the Number of Sampled Sites
with 95% Confidence Intervals**

