Appendix S2

Strayer, D.L., Adamovich, B.V., Adrian, R., Aldridge, D.C., Balogh, C., Burlakova, L.E., Fried-Petersen, H., G.-Tóth, L., Hetherington, A.L., Jones, T.S., Karatayev, A.Y., Madill, J.B., Makarevich, O.A., Marsden, J.E., Martel, A.L., Minchin, D., Nalepa, T.F., Noordhuis, R., Robinson, T.J., Rudstam, L.G., Schwalb, A.N., Smith, D.R., Steinman, A.D., and J.M. Jeschke. 2019. Long-term population dynamics of dreissenid mussels (*Dreissena polymorpha* and *D. rostriformis*): a cross-system analysis. Ecosphere.

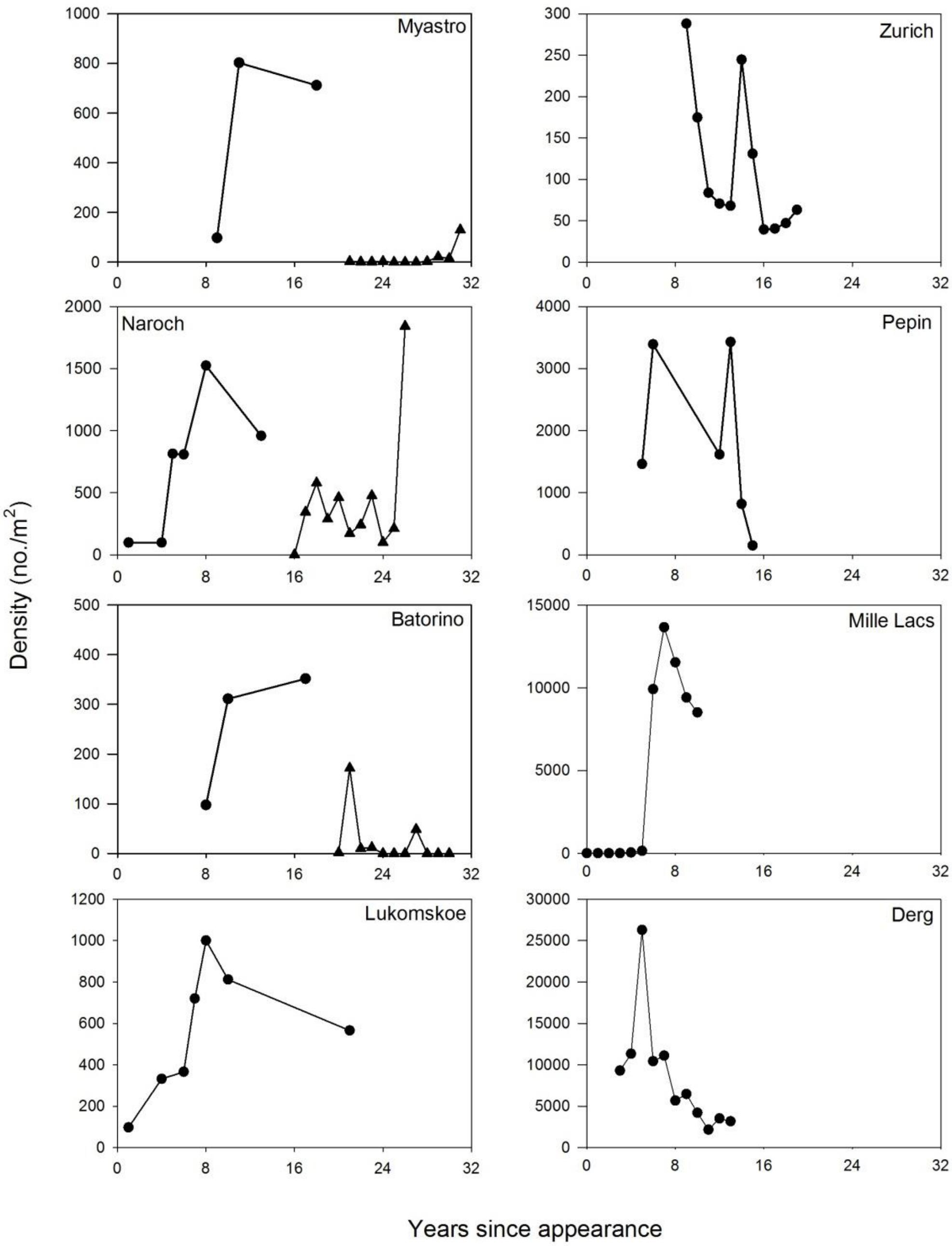

Fig. S1. Population density of zebra mussels early in their invasion, at sites where quaggas have not yet invaded. Note differences in y-axis scales. Different symbols in panels for Lakes Batorino, Myastro, and Naroch indicate that different sampling designs and methods were used in different time-periods, so the two sets of data are not comparable with one another, and were separated in our statistical analyses.

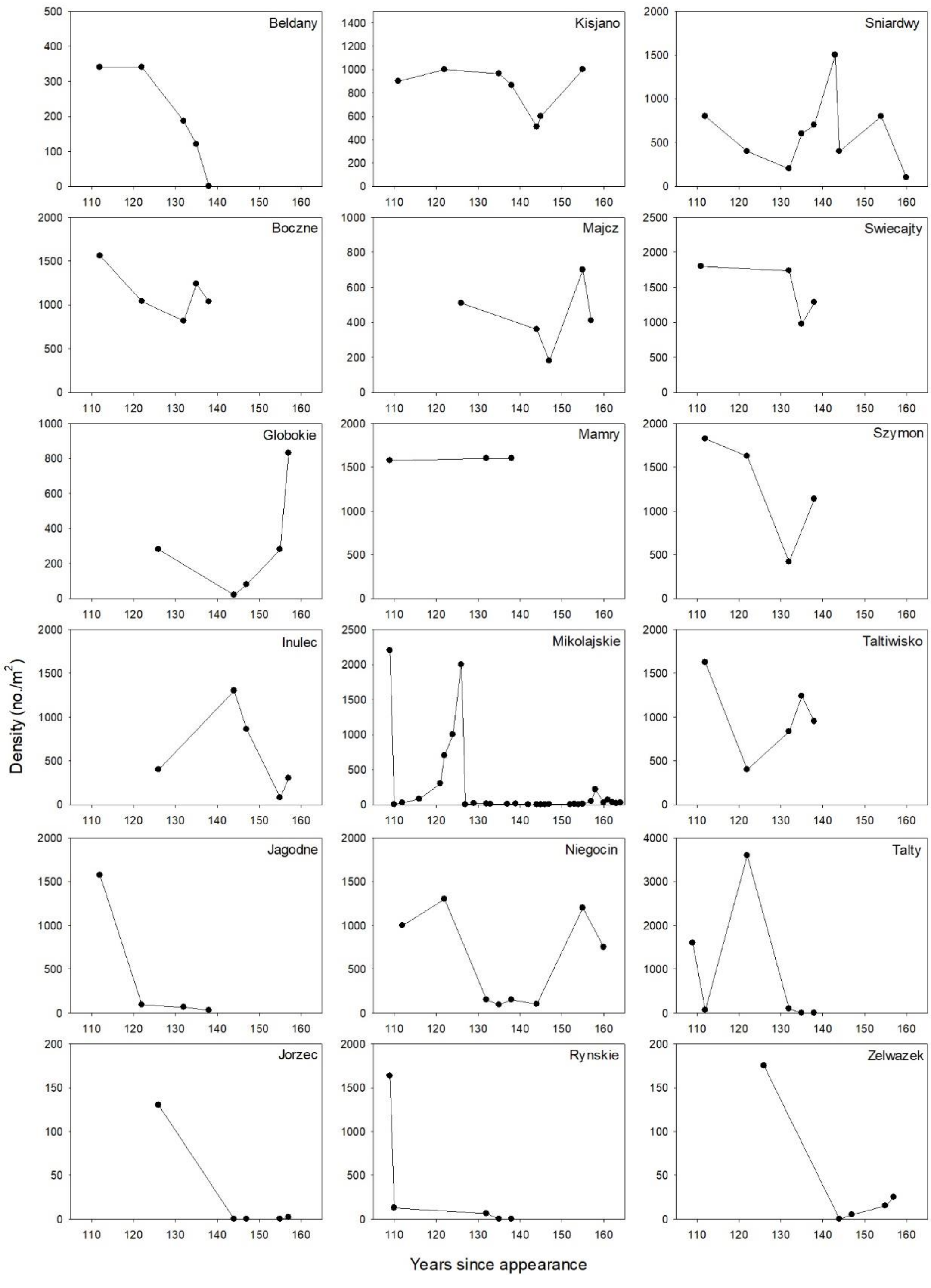

Fig. S2. Population density of zebra mussels later in their invasion, at sites where quaggas have not yet invaded. Note differences in y-axis scales.

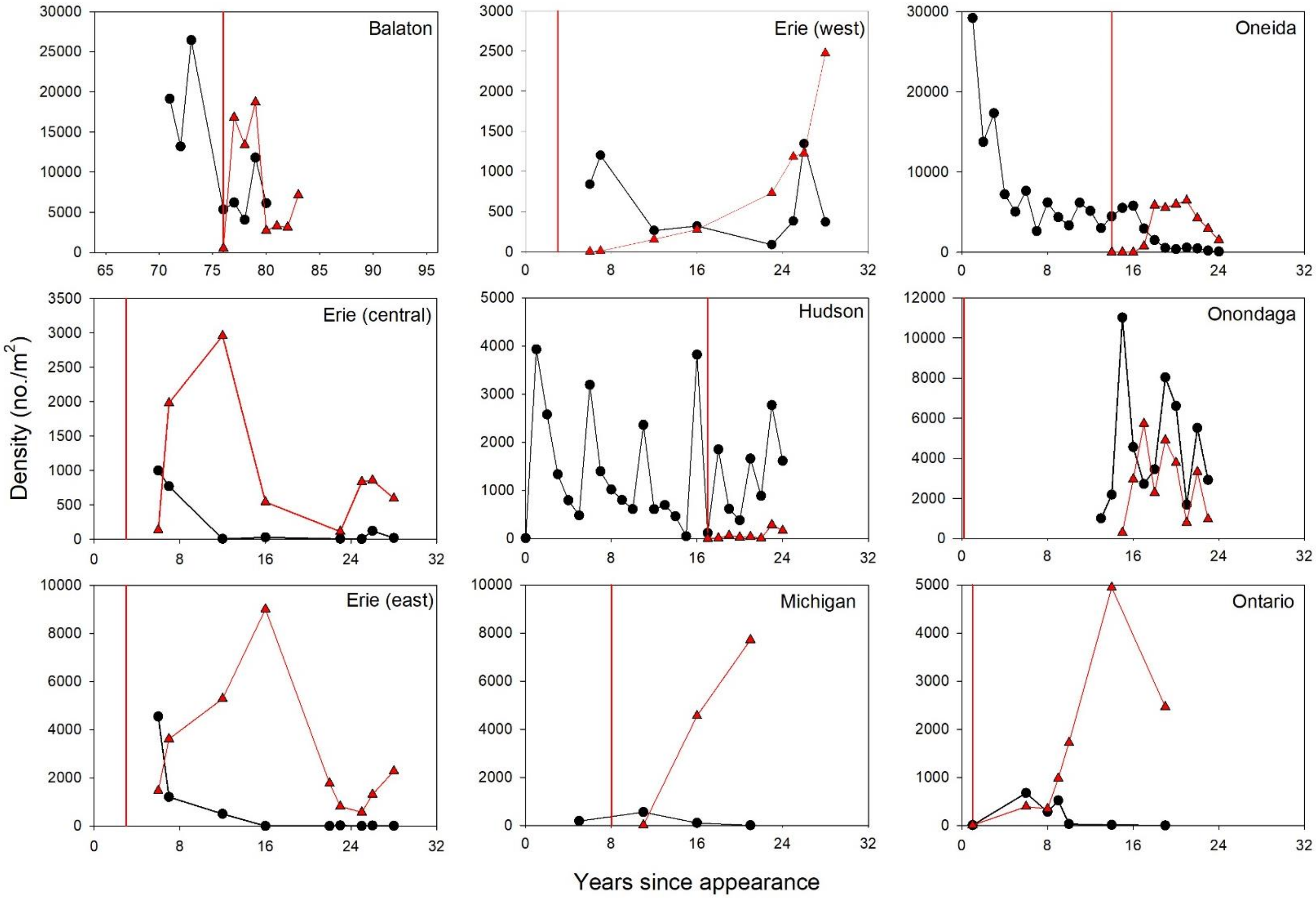

Fig. S3. Population density of zebra (black) and quagga (red) mussels at sites where both species have invaded. The vertical red line shows the first record of quagga mussels. Note differences in y-axis scales, and that the x-axis for Balaton has a different range (but the same scale) than the other panels.

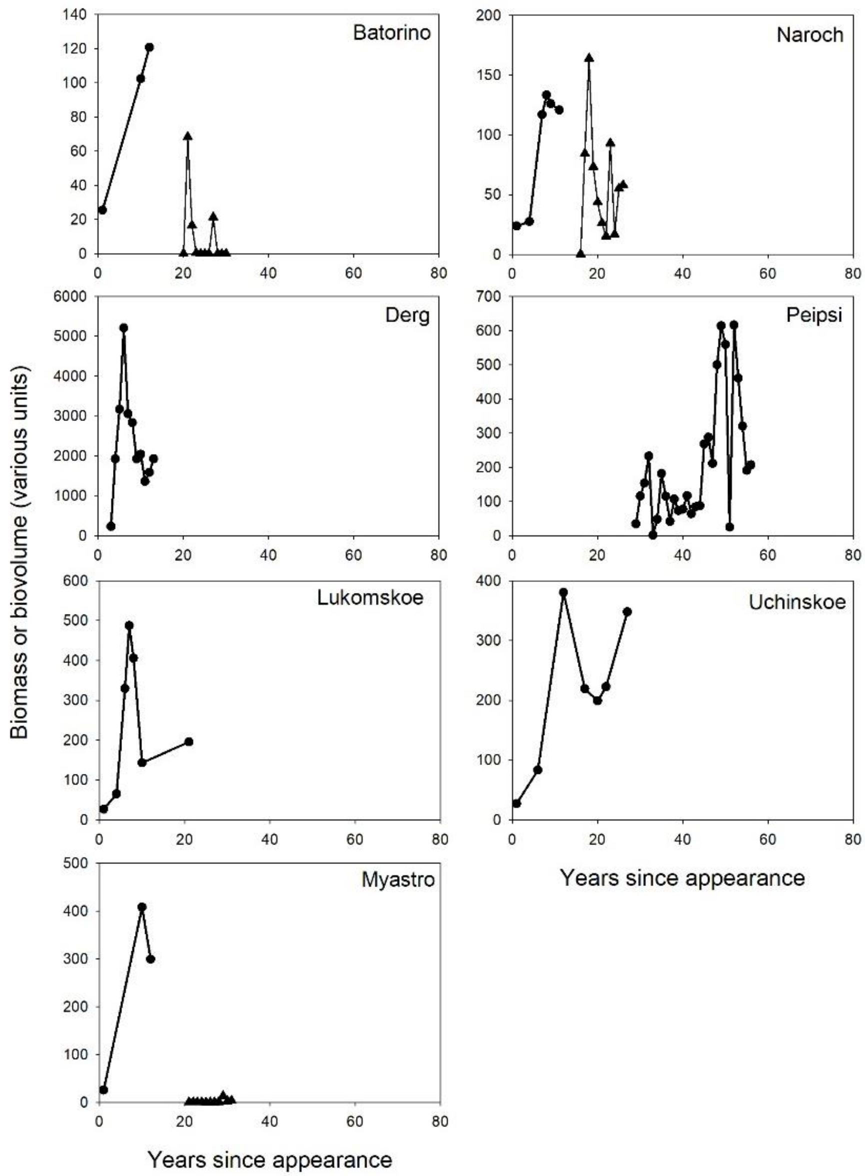

Fig. S4. Biomass dynamics of zebra mussels at sites that have not been invaded by quagga mussels. The measurement units are different in different panels (sometimes wet mass with shells, sometimes dry mass without shells, sometimes ash-free dry mass without shells, sometimes biovolume; see https://doi.org/10.5061/dryad.m3t6764 for details). Different symbols in panels for Lakes Batorino, Myastro, and Naroch indicate that different sampling designs and methods were used in different time-periods, so the two sets of data are not comparable with one another, and were separated in our statistical analyses.

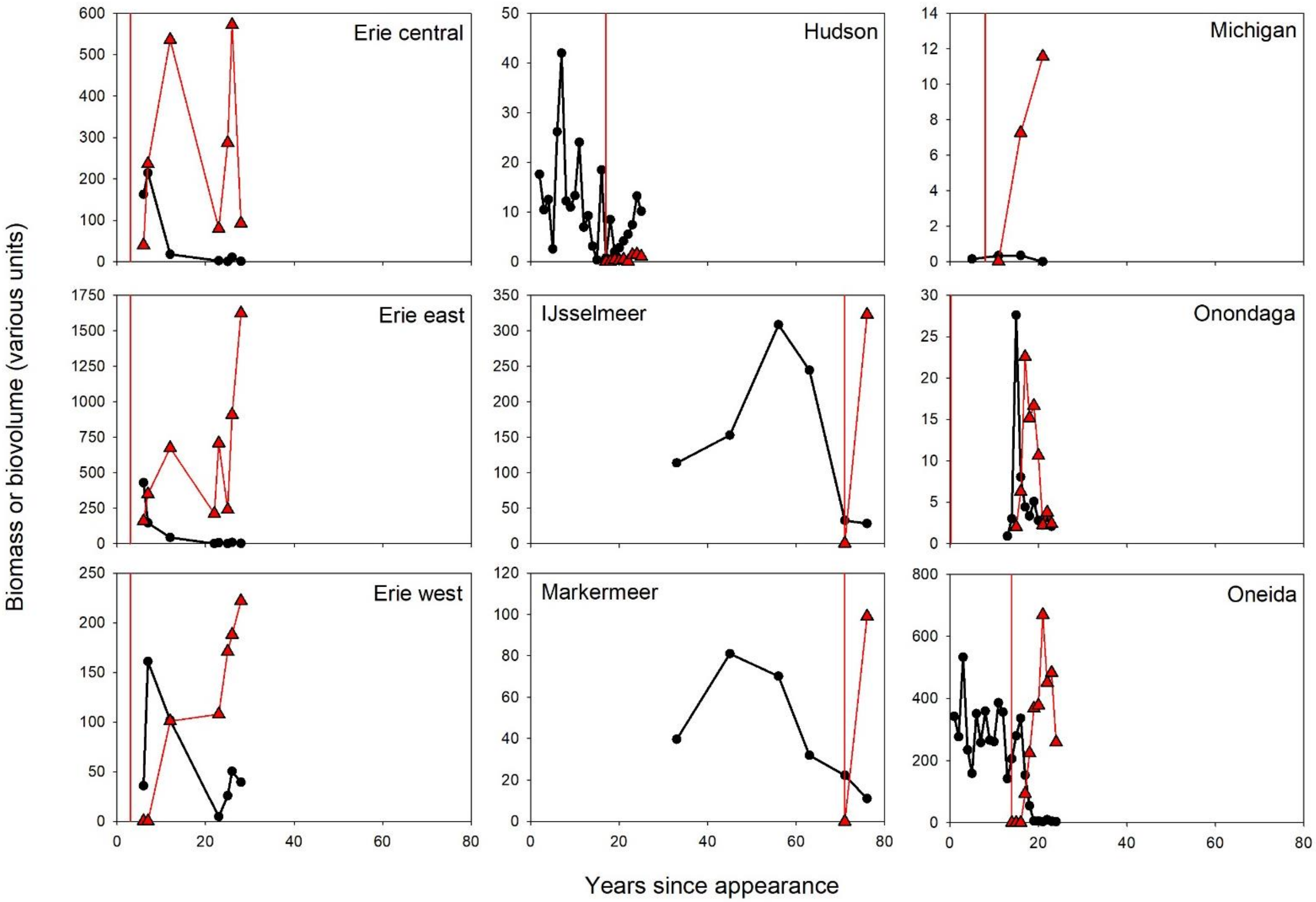

Fig. S5. Biomass dynamics of *Dreissena* species at sites that have been invaded by quagga mussels (zebra = black, quagga = red). The vertical red line shows the first record of quagga mussels. The measurement units are different in different panels (sometimes wet mass with shells, sometimes dry mass without shells, sometimes ash-free dry mass without shells, sometimes biovolume; see https://doi.org/10.5061/dryad.m3t6764 for details).

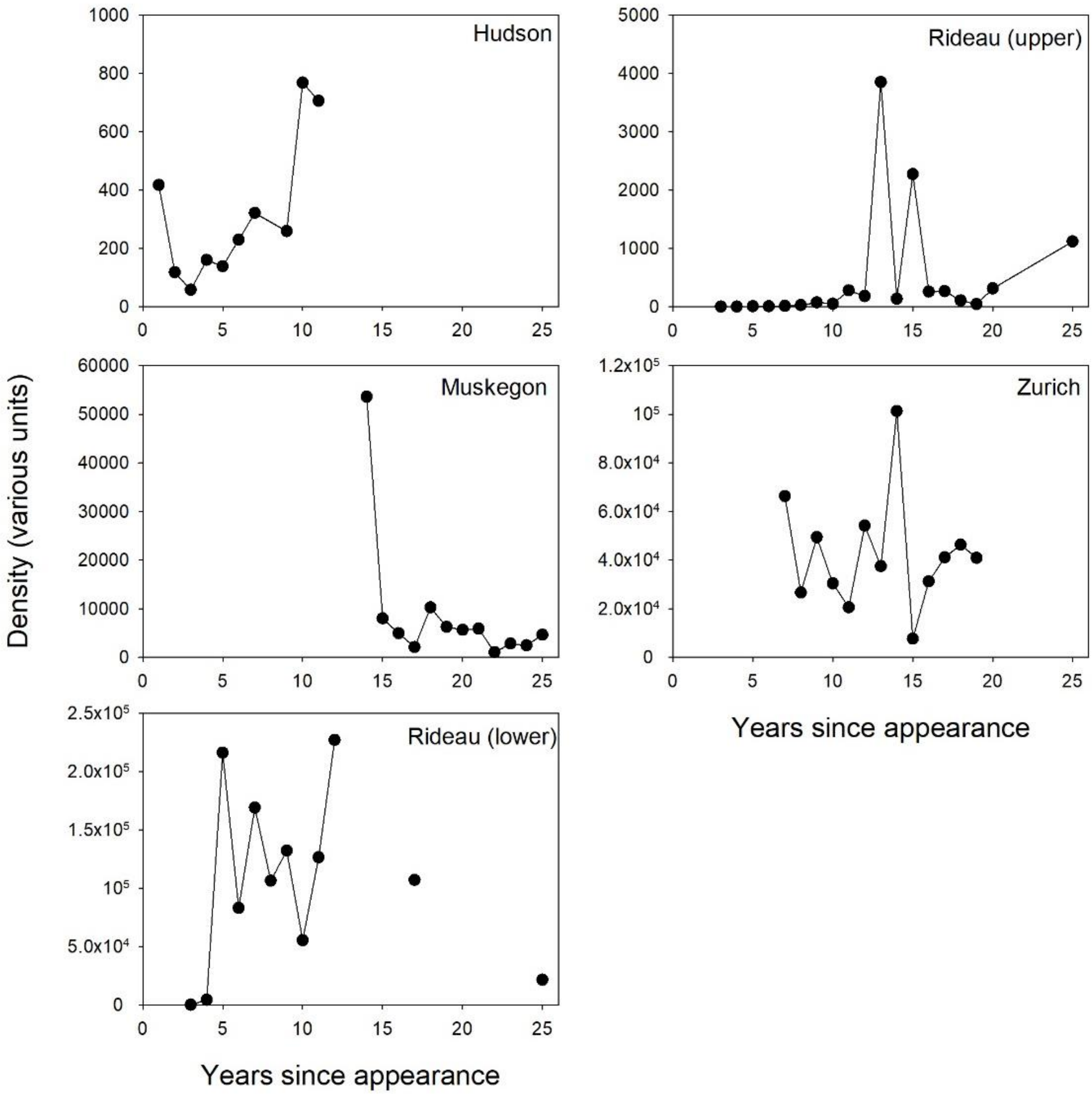

Fig. S6. Recruitment of young-of-year zebra mussels, usually onto artificial substrata, at different sites. Units of measurement differ among sites (see https://doi.org/10.5061/dryad.m3t6764 for details).

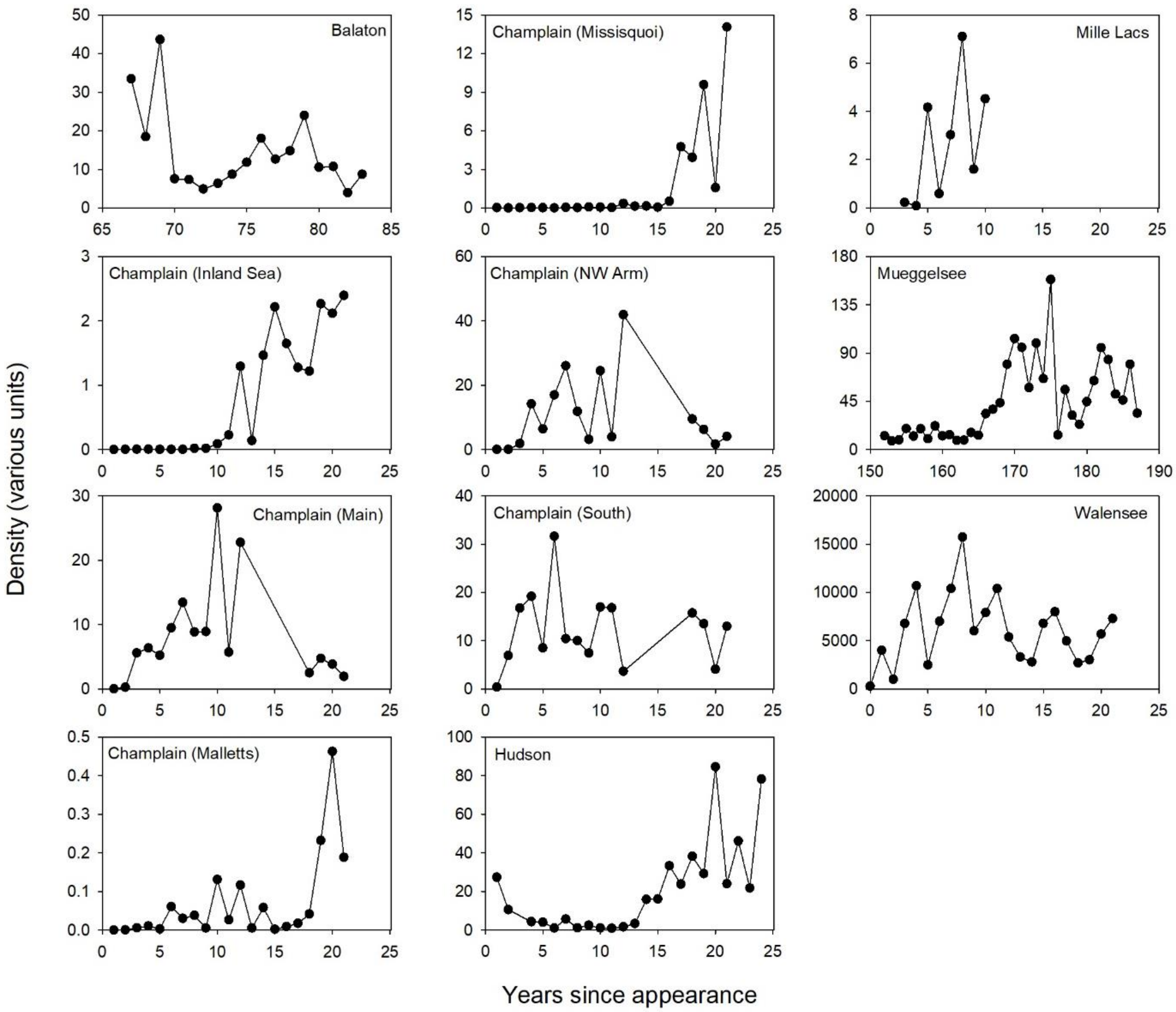

Fig. S7. Veliger dynamics at 11 sites. Data are for *D. polymorpha* only except for the Hudson River (after 2007) and Lake Balaton (after 2007), which include both species combined. Note that the x-axes have different scales for the Müggelsee and Balaton than for the other sites. Units of measurement differ among sites (see https://doi.org/10.5061/dryad.m3t6764 for details).

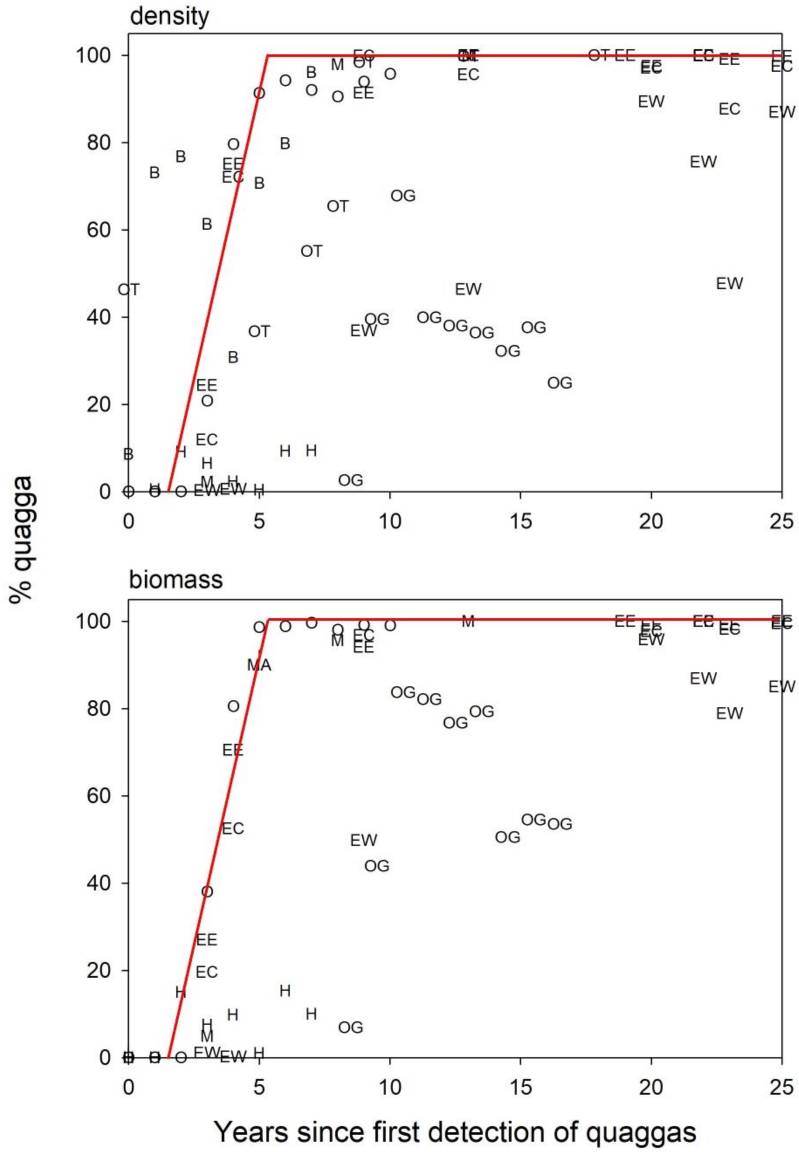

Fig. S8. Dominance of quagga mussels in the dreissenid community as a function of the time since the first quagga was detected, alternative analysis with data from Onondaga Lake shifted 6.5 years to the left (see main text for explanation). The red line shows the predictions of the Heiler et al. (2013) model. Abbreviations: B=Balaton, EC=Erie Central Basin, EE= Erie Eastern Basin, EW=Erie Western Basin, H=Hudson, I=IJsselmeer, Ma=Markermeer, M=Michigan, O=Oneida, OG=Onondaga, OT=Ontario.

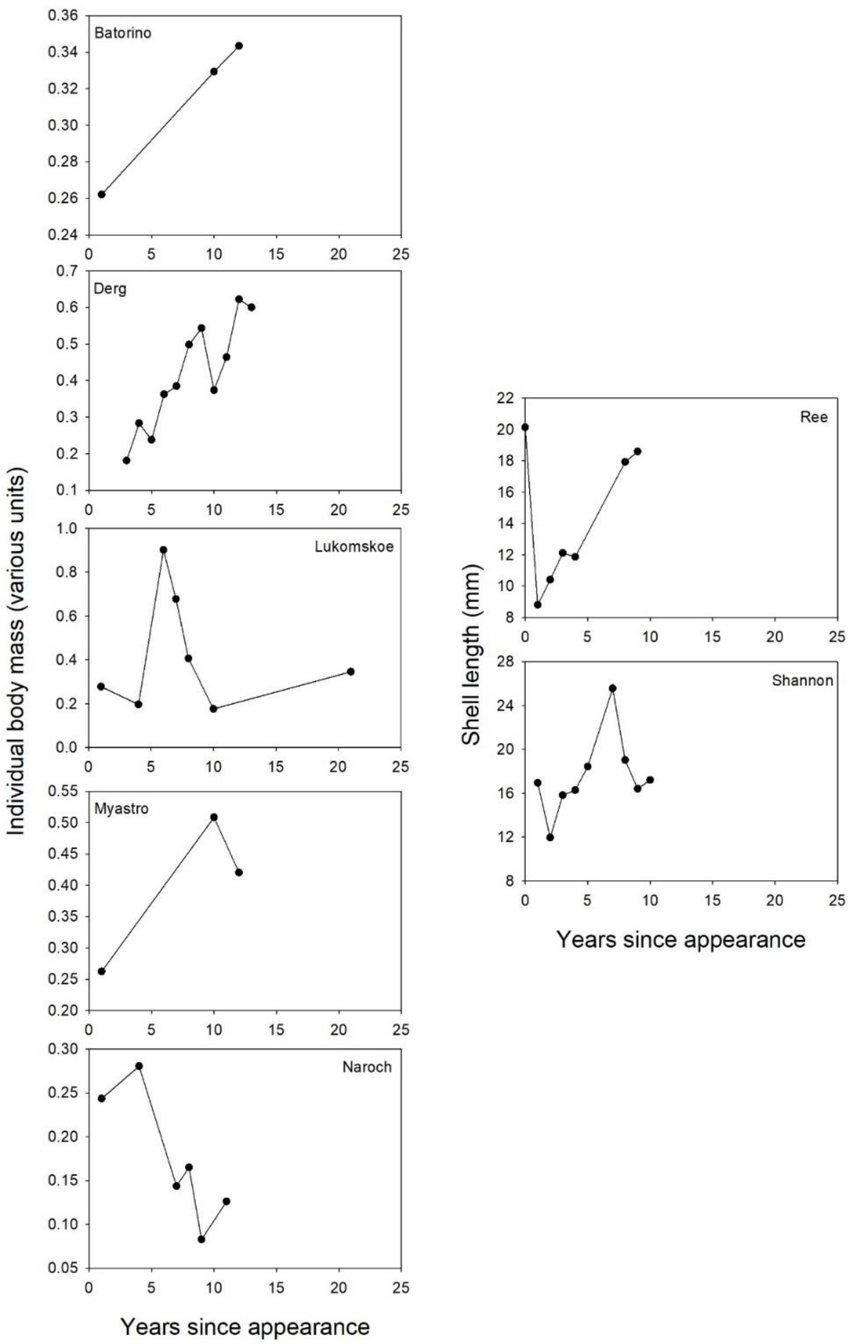

Fig. S9. Temporal changes in mean body size (various measurement units) of zebra mussels at sites that were not later invaded by quagga mussels, as a function of time since dreissenids were first discovered at the site.

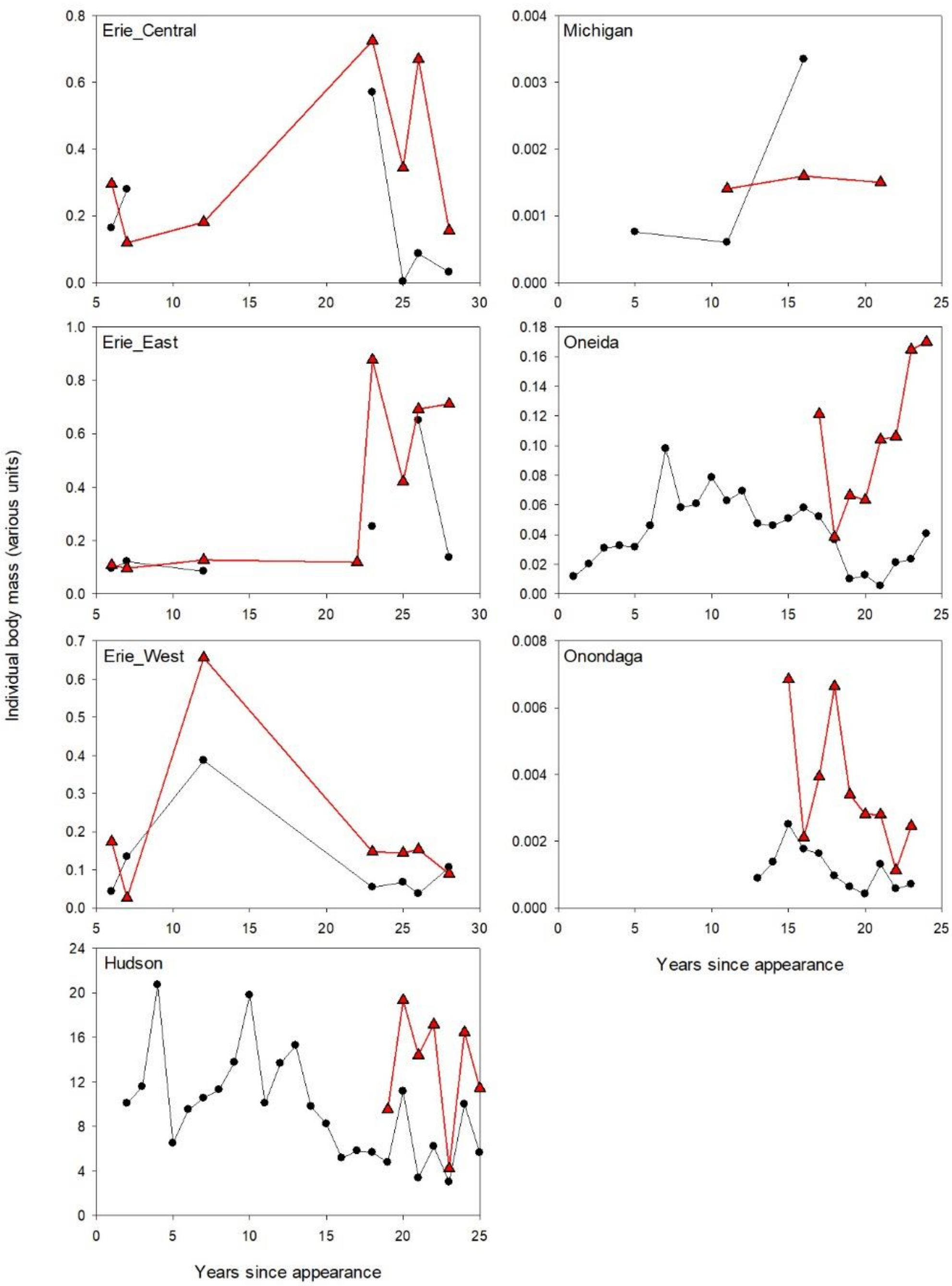

Fig. S10. Temporal changes in mean body size (various measurement units) of zebra (black) and quagga (red) mussels at sites that were invaded by both species, as a function of time since dreissenids were first discovered at the site. A very high value recorded for zebra mussels for Erie Central in year 12 (1998) is apparently based on a sample size of a single animal, and is omitted.

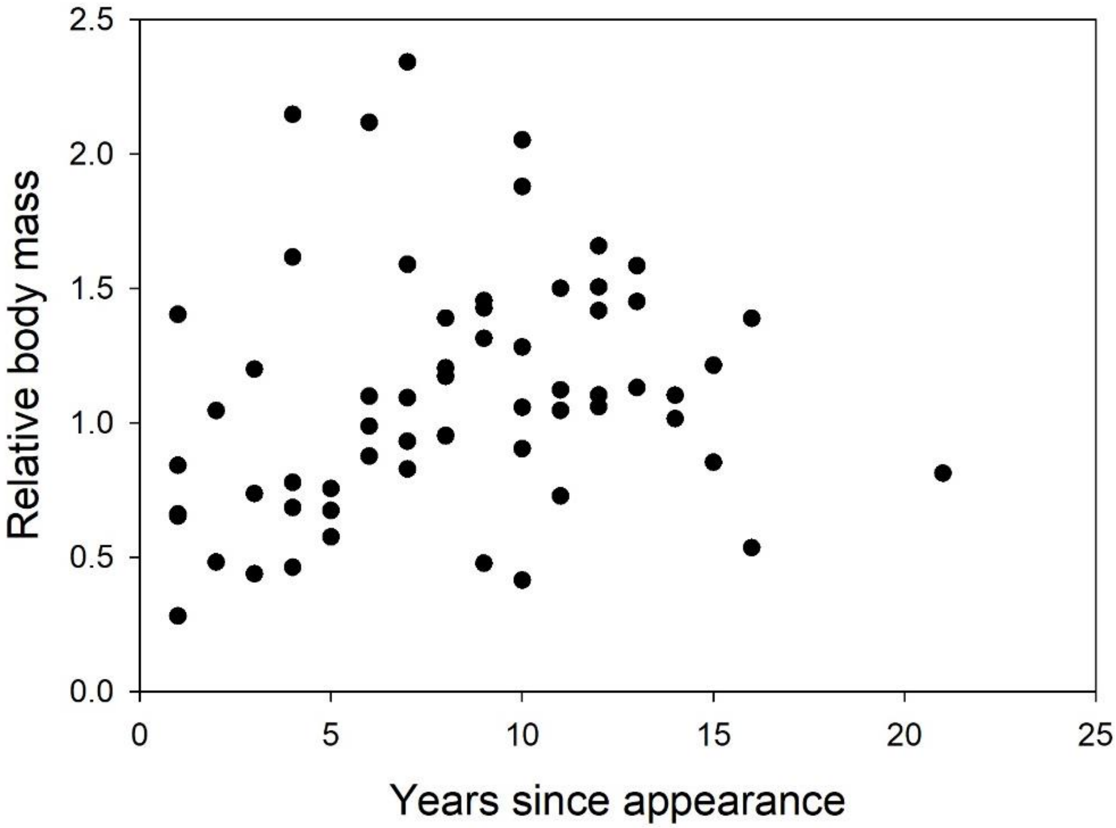

Fig. S11. Trends in standardized zebra mussel body mass (i.e., annual mean body mass divided by the long-term mean body mass for that site) against time since first appearance of *Dreissena* for sites without quagga mussels. A linear regression fit through these data is not significant (*p*=0.09).

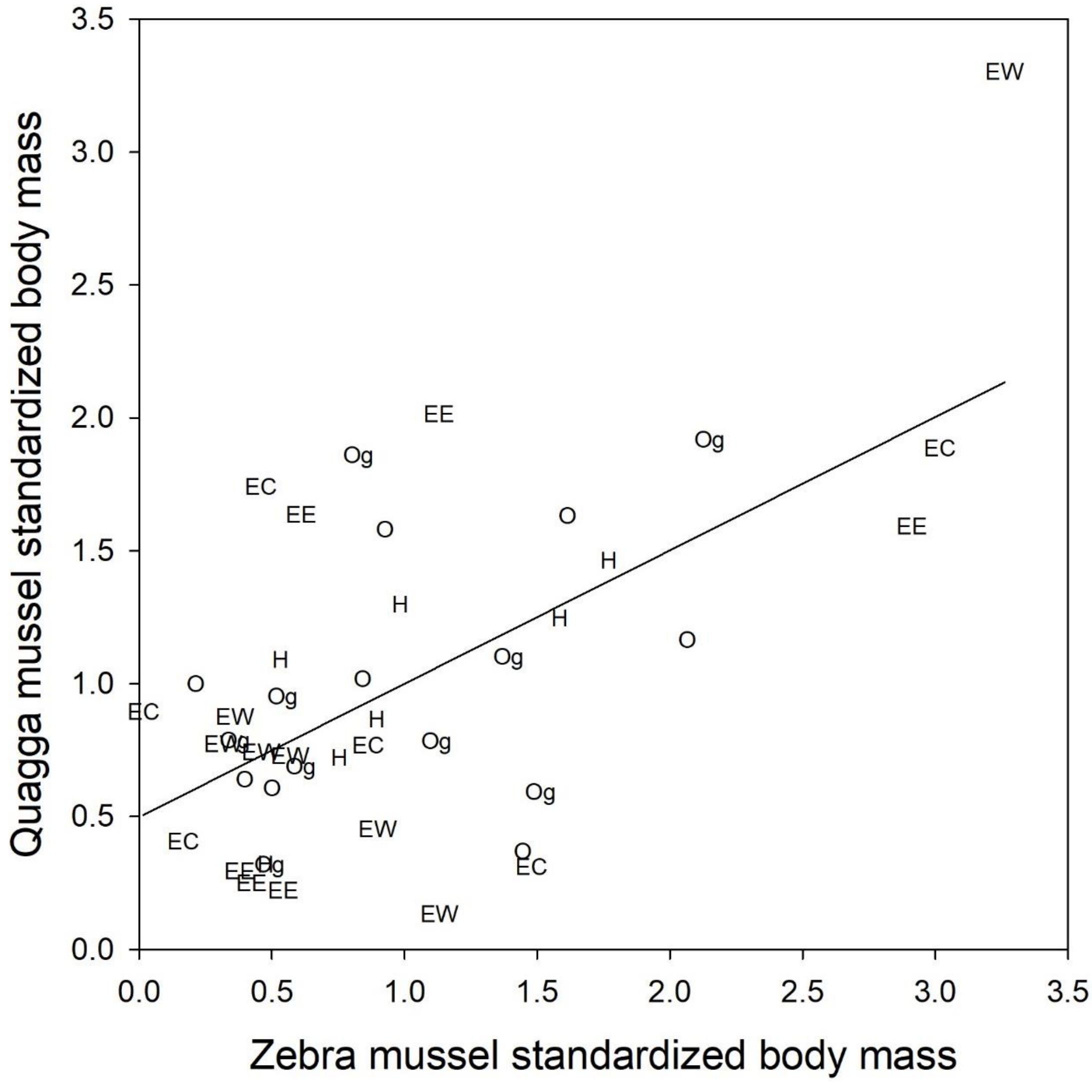

Fig. S12. Correlations between standardized body masses of the two *Dreissena* species at sites for which at least 5 years of body size data for both species are available ($r^2 = 0.37$, $p < 0.0001$). Because measurement units for body size vary across studies, body sizes are standardized to the mean for each species at each site for all years in which both species were present. Each dot represents a single year (Lake Erie Central = EC; Lake Erie East = EE; Lake Erie West = EW; Hudson River = H; Oneida Lake = O; Onondaga Lake = Og). Correlations at individual sites all are positive, but have small *n* (<10), and only Lake Erie West and the Hudson are significant at $p = 0.05$.

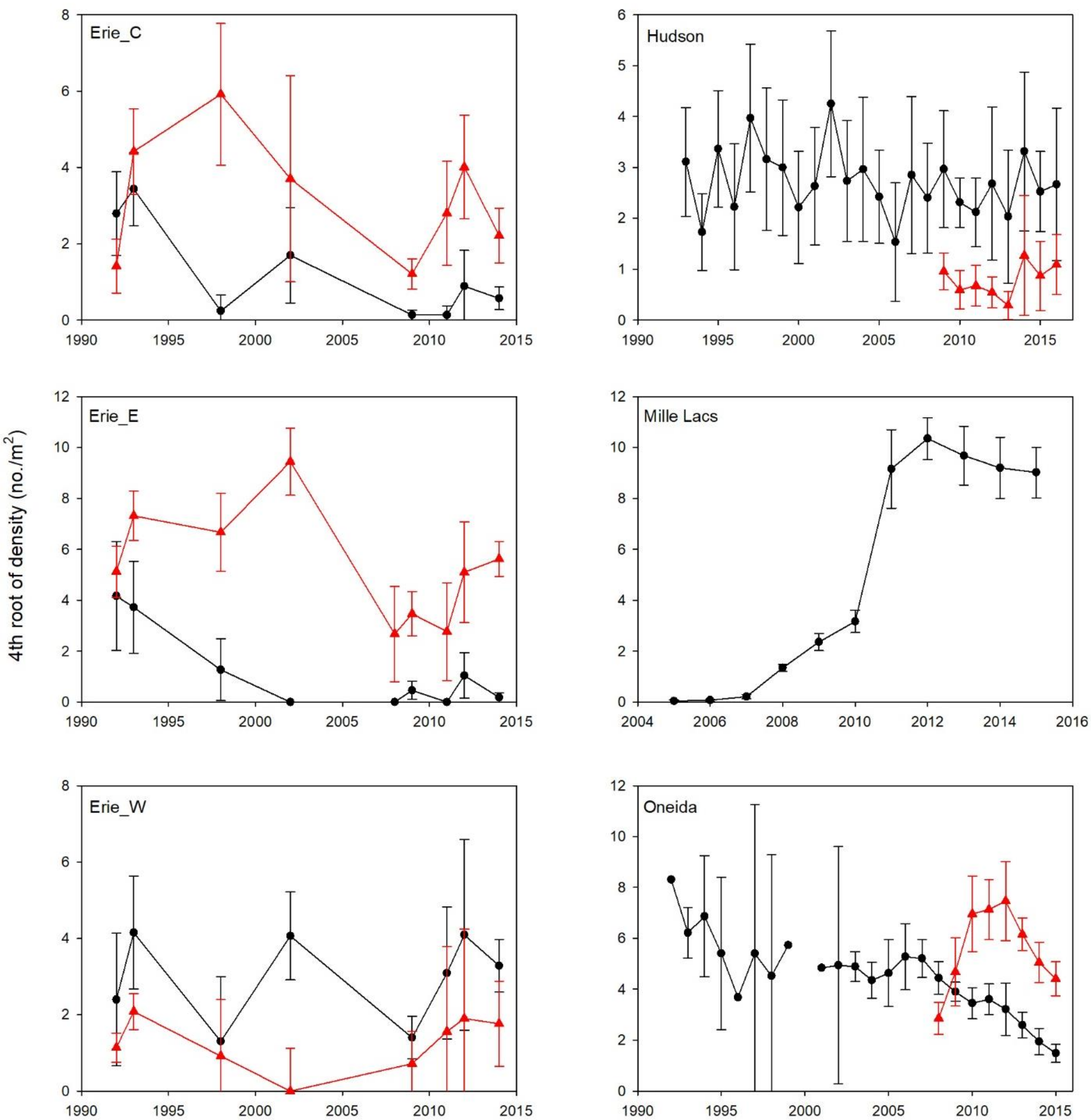

Fig. S13. Estimated means and 90% confidence limits on means for densities of adult *Dreissena* at selected sites. Black = zebra mussels; red = quagga mussels. Note the 4th-root scale on the y-axes.

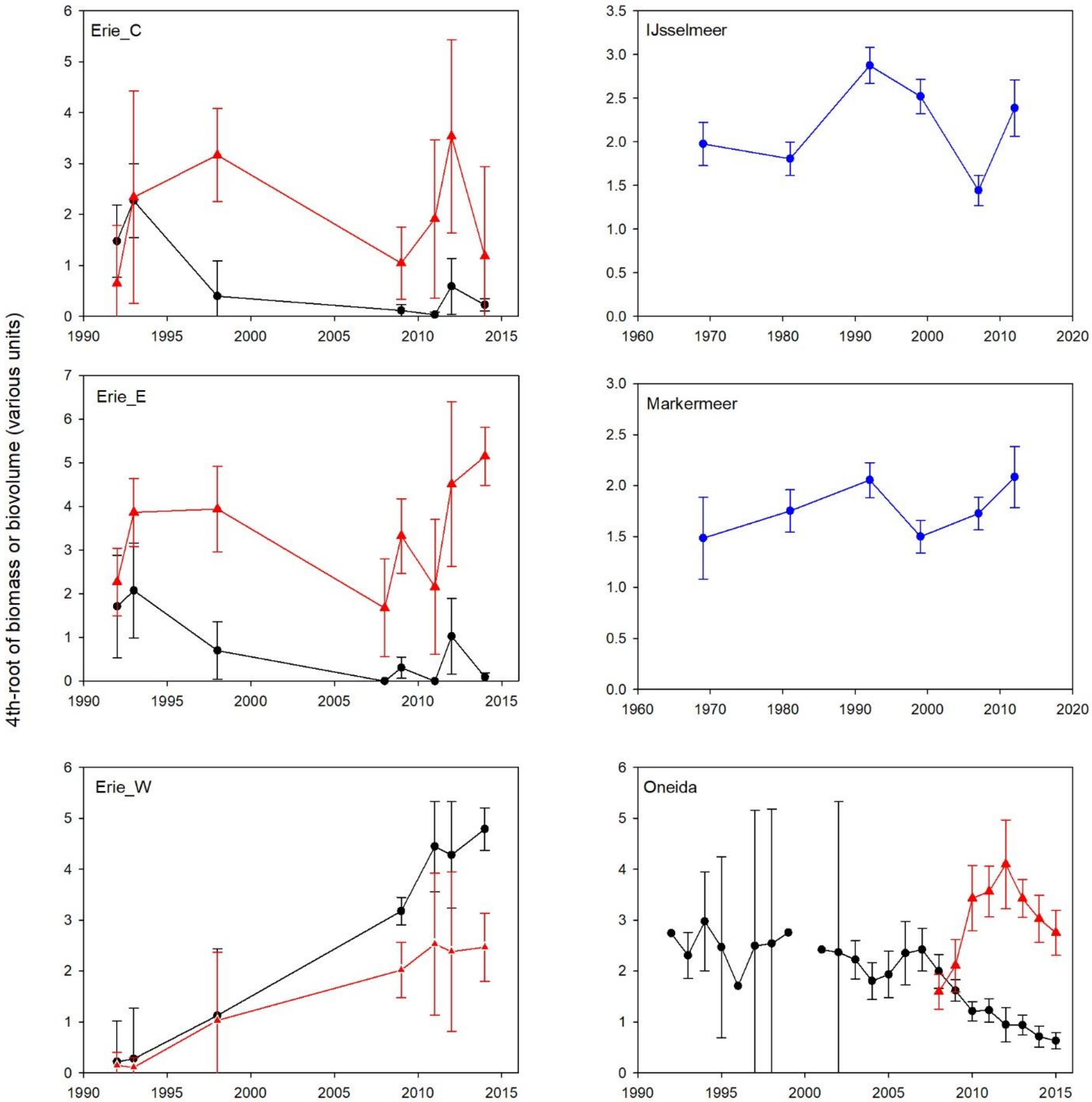

Fig. S14. Estimated means and 90% confidence limits on means for biomass or biovolume of adult *Dreissena* at selected sites. Black = zebra mussels; red = quagga mussels; blue = both species combined. Note the 4th-root scale on the y-axes.