Increased Nutrient Loading of Spring-fed Coastal Rivers: Effects on Habitat and Faunal Communities

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ABSTRACT

This study provided quantitative assessments of fishes and invertebrates within the Chassahowitzka and Homosassa rivers for the purpose of identifying and characterizing broad-scale ecological impacts associated with vegetative habitat loss. Project objectives were to: (1) establish standardized methods for monitoring fishes and invertebrates to complement the long-term water quality and submersed aquatic vegetation monitoring programs, (2) quantitatively characterize the fish and invertebrate assemblages in the Chassahowitzka and Homosassa rivers across multiple seasons and years, (3) examine the diet of fishes to identify predator-prey interactions, and (4) evaluate habitat loss effects on fish and invertebrate community structure using a time-dynamic ecosystem model. We developed standardized methods to estimate fish and invertebrate density and biomass from seine depletion sampling, capture-recapture electrofishing, and invertebrate sampling. Sampling was carried out biannually in the winter and summer during years 1 and 2 in conjunction with the water quality and aquatic vegetation monitoring programs. During year 3, we sampled each river monthly to assess intra-annual patterns in aquatic vegetation, invertebrate and fish biomasses. The Chassahowitzka River maintained perennial macrophyte cover and biomass, and the Homosassa River was largely devoid of vegetative habitat during summer months. Both rivers produced high biomass of filamentous algae during winter and spring. We recorded greater densities of invertebrates associated with vegetation (including amphipods, tanaids, insects and gastropods) coincident with increased filamentous algae cover and biomass in each river. Seine depletion sampling and capture-recapture electrofishing estimates illustrated greater density and biomass of many small- and large-bodied freshwater fish species within the Chassahowitzka River compared to the Homosassa River. In contrast, we estimated higher density and biomass of several saltwater fishes and select freshwater species within the Homosassa River. Seasonal migration patterns of saltwater fishes demonstrated that these systems served as winter refugia for multiple species, including striped mullet, gray snapper, common snook, and red drum. We measured crustaceans in relatively high densities in vegetative habitats, including crabs, crayfish, amphipods and shrimp, and found these taxa to be important food sources for fishes in both systems. Large-bodied fishes consumed freshwater and saltwater fishes that were seasonally abundant in each system in addition to crustaceans. Trophic models corroborated high predation of invertebrates and small-bodied fishes by large-bodied fishes with empirical diet data and observed changes in prey biomass. Time dynamic ecosystem simulations elucidated long-term negative effects of vegetation loss on many freshwater taxa, including grass shrimp, crayfish, *Lepomis* spp., lake chubsucker and largemouth bass; and select saltwater taxa, including blue crabs and pinfish. Predicted mechanisms for species decline included decreased prey availability, increased abundance of saltwater competitors, and increased abundance of large-bodied saltwater predators. Based on trophic dynamic modeling, spatial comparisons of faunal community structure between rivers, and temporal comparison of the historical and current community composition in the Homosassa River, we infer that vegetative habitat loss negatively impacts species that rely on this habitat type for foraging, refuge or reproduction and predict that species that do not have strong affinity for structural habitat (vegetation in particular) will be less affected by large-scale changes in vegetative habitat. The observed differences in biomass and prey composition between the two rivers, coupled with ecosystem modeling and simulation, provide evidence that large-scale changes in vegetative habitat affects individual species disproportionately and continued changes are likely to alter the faunal communities and overall structure of these ecosystems.

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INTRODUCTION

The Homosassa and Chassahowitzka springs represent two of the largest freshwater spring complexes in Florida (FSTF 2000, Scott et al. 2004). The springs serve as the origin of flow for coastal streams which historically supported dense assemblages of submersed aquatic vegetation and associated faunal communities (Herald and Strickland 1949, Odum 1953, Odum 1957). Long-term monitoring of these systems indicates a precipitous decline in macrophyte abundance over the last decade with marked increases in nutrient loading rates and periphyton associated with the plants (Frazer et al. 2006). Of particular concern is the decline of native species such as American eelgrass (*Vallisneria americana*) and strapleaf sagittaria (*Sagittaria kurziana*). In fact, *S. kurziana* appears to have been largely extirpated from both rivers. These changes are legitimate reasons for concern by resource managers. Increased nutrient delivery, loss of native plants and increased periphyton loads are symptomatic of eutrophication related phenomena (Duarte 1995, Smith et al. 1999). The potential broader consequences of nutrient over-enrichment on the ecological health and integrity of the Homosassa and Chassahowitzka rivers are currently unknown. The aforementioned loss of aquatic vegetation which provides both forage and refuge habitat is likely to alter predator/prey relationships and other important species-level interactions. Such alterations may lead to undesirable shifts in fish and invertebrate community composition and possibly the loss of key species.

Quantitative data on the abundance and distribution of fishes and invertebrates within the Homosassa and Chassahowitzka rivers are necessary to predict the longer-term effects of habitat loss on the organisms that presently occupy these and other spring-fed systems. As part of this study, we took advantage of long-term water quality and aquatic vegetation monitoring programs to implement a more comprehensive ecosystem-level assessment for the purpose of providing managers with the data needed to gain a mechanistic understanding of the effects of vegetative habitat loss on the associated fish and invertebrate communities. Project objectives included: (1) the establishment of standardized methods for monitoring large-bodied fishes, small-bodied fishes and invertebrates to complement the long-term water quality and submersed aquatic vegetation monitoring programs in the two rivers, (2) the quantitative characterization of the fish and invertebrate assemblages in the Chassahowitzka and Homosassa rivers biannually across years, (3) the examination of the diets of fishes to identify key predator-prey interactions, and (4) the assessment of vegetative habitat loss effects on fish and invertebrate community structure using a time-dynamic ecosystem model.

METHODS

We stratified each river into three longitudinal reaches associated with long-term water quality and SAV monitoring sites (Figure 1). The study reaches were located within the freshwater portion of the rivers, and represented a gradient of salinity concentration with upstream reaches less influenced by tides than downstream reaches. Reach 1 encompassed the spring run section of each river from below the headwater springs to long-term monitoring transect 3 (average salinity concentration in Reach 1 ranged from 0.9 to 3.6‰ in the Homosassa River and from 0.9 to 3.4‰ in the Chassahowitzka River during 1998 through 2009). Reach 2 encompassed the middle section of each river, between long-term monitoring transects 3 and 7, where tributary confluences are present in both systems (average salinity concentration in Reach 2 ranged from 1.4 to 5.0‰ in the Homosassa River and from 1.5 to 4.3‰ in the Chassahowitzka River during 1998 through 2009). Reach 3 encompassed the lower portion of each river directly upstream of the saltmarsh complex between long-term monitoring transects 7 and 10 (average salinity concentration in Reach 3 ranged from 1.6 to 9.6‰ in the Homosassa River and from 1.6 to 9.0‰ in the Chassahowitzka River during 1998 through 2009).

Nutrients and Submersed Aquatic Vegetation (SAV) Sampling and Analyses

Sampling was carried out in concert with the established water quality and SAV monitoring program (Frazer et al. 2006). All water quality analyses were based on data collected during standardized water quality sampling. We calculated vegetative cover and biomass estimates of vascular plants and filamentous algae for the period of study based on field collected data. Frazer et al. (2006) describe methods of vascular plant and filamentous algae data collection. We calculated the mean and standard deviation of vegetative cover and biomass for each study reach from data collected at transects that coincided with fish and invertebrate sampling sites (Figure 1). We scaled the estimates to 1 m^2 area.

Invertebrate Community Sampling and Analyses

We sampled aquatic invertebrates associated with sediments and above-bottom portions of SAV in the three study reaches of both rivers during August and February of year 1, and collected invertebrates inhabiting SAV in Reaches 1 and 2 during years 2 and 3. Sampling occurred concurrently with SAV monitoring along fixed transects within each of the study reaches (Figure 1). We sampled five stations (equally spaced) along each transect. We collected benthic invertebrates with a 5-cm inner-diameter acrylic push-core (sediment surface area sampled = 20 cm^2). To obtain a sample, the core was firmly pushed into the sediments to a depth of 10 cm (volume sampled = 200 cm^3) and then carefully withdrawn. We then extruded the sample from the push-core into a 1-L container or 1-gallon, sealable, labeled plastic bag and rinsed any sample portions remaining inside the push-core into the sample container.

Macroinvertebrates associated with SAV were collected using a 300-μm mesh, netted ring sampler (inner ring diameter = 252 mm, 0.05 m^2 area). We obtained samples by placing the open bottom ring of the sampler over a portion of SAV, closing the bottom of the net, and cutting the SAV just above the sediment/water interface. We rinsed the sample into a 1-L sample container or 1-gallon sealable plastic bag and labeled it with the sample location and date. All samples were placed on ice immediately after collection and transported to the FWC Gainesville Fisheries Research Laboratory or University of Florida, Florida Rivers Research Laboratory for processing and taxonomic identification. Samples were kept separate (i.e. we did not composite samples) throughout all aspects of field collection and laboratory processing.

In the laboratory, we rinsed individual samples from containers into a 300-µm mesh sieve to remove water, placed them in 1-L, wide-mouth plastic or glass jars and preserved them with 95% ethanol (year 1) or froze them (years 2 and 3). During year 1, we processed entire samples by placing small portions into a petri dish, covering the portion with water, and inspecting the contents under a stereo-dissecting microscope with magnification to 63x. We removed invertebrates from petri dishes with forceps, identified them to major taxonomic group, enumerated them and then preserved them in labeled vials with 95% ethanol. We prepared a laboratory sheet listing taxa and counts for each sample. During years 2 and 3, invertebrate samples were white-panned to remove and enumerate visible macroinvertebrates. We then rinsed the SAV sample over the white pan, sieved it, weighed it and subsampled a portion of the SAV (by wet weight). We removed invertebrates from the SAV subsample and enumerated individual taxa under a stereo-dissecting microscope. We next sieved the fine particles and periphyton remaining in the white pan, weighed the sample and subsampled a portion (by wet weight). We removed the invertebrates from the fine material subsample and enumerated individual taxa under a stereo-dissecting microscope. Invertebrate counts for each subsample were corrected by dividing the count by the proportion of sample measured, and the estimate was then summed with the counts from the white pan. We calculated invertebrate density as the mean number of individuals per taxa per sample divided by the sampled surface area. We calculated the mean density and standard deviation of invertebrates for each study reach and scaled the estimate to 1-m^2 area. We conducted separate analyses for benthic and SAV substrates. During year 1, we calculated biomass estimates of selected taxa by multiplying the estimated density by mean individual mass. We obtained dry mass estimates for taxa with published length-mass regressions (Benke et al. 1999), and calculated dry mass from measurements of mean individual length (total length was measured for amphipods, insects, tanaids, and isopods; and shell length was measured for gastropods). We converted dry mass estimates to wet mass using conversion factors published by Ricciardi and Bourget (1998). During years 2 and 3, we weighed the wet mass of invertebrate taxa picked from each sample, dried the invertebrates in individual aluminum trays, and estimated the average biomass per individual. Estimated taxa densities were then corrected by the average mass per individual to estimate biomass.

Fish Community Sampling and Analyses

We deployed two gear types (electrofishing and seining) to sample small- and large-bodied fishes. Three-day mark-recapture electrofishing events and three-day block-net seine depletion sampling occurred during four sample periods (summer 2007, winter 2008, summer 2008, and winter 2009) in each river. We conducted single-pass electrofishing and seine surveys monthly during year 3 and corrected catch rate indices by catchability estimates calculated from intensive sampling events during years 1 and 2. Standardized sample locations are shown for each gear type in Figure 1. Electrofishing reaches included 4 shoreline transects and 3 mid-stream transects. We defined one shoreline transect as the section of littoral stream bank between long-term SAV monitoring transects and midstream transects overlapped the SAV monitoring transects. We electrofished each reach once per day for three consecutive days. Electrofishing occurred biannually during the second and third weeks of July and January of years 1 and 2, and seining occurred during the second and third weeks of August and February of years 1 and 2. In year 3, we electrofished each reach every month during the second week, and seined each transect during the third week of every month.

During years 1 and 2, we sampled nine multi-pass seine depletion sites in each river to assess the small-bodied fish community and obtain estimates of gear probability of capture. We sampled three sites in each reach at fixed locations that coincided with electrofishing, long-term SAV monitoring, and invertebrate sampling transects. Sites ranged in size between 200 and 600 m^2 during the first sampling event, but were standardized at 20 m in length and 10 m in width during subsequent sampling. We chose the location of each seine depletion site within a reach randomly without replacement and assigned one of three possible locations: river right, mid-stream or river left. We sampled all three locations at separate transects within a study reach. We placed a 2.4-m deep block-net around each site, and executed multiple pass sampling (3-7 passes per site were completed until a decline in catches was observed) with a 21.3-m wide, 1.8-m deep, 3.17-mm delta mesh bag seine with a 1.8 x 1.8-m center bag. During year 3, we conducted monthly single-pass seine surveys at each block-netted site. At several sites, subsampling occurred when either the number of fish captured was too large to count all individuals per species, or the amount of detritus, filamentous algae, and other vegetation was too great to sort fish in a timely manner. When subsampling occurred, we recorded the total weight of the sample and weighed a portion to take back to the lab for processing. We then corrected the number of fish in the subsample by the proportion of sample measured to estimate the total number of fish captured per pass.

We identified all fish captured to species when possible; otherwise we identified fish to the lowest possible taxonomic resolution. We measured all fish for total length and weight (weights were not taken when windy conditions prevented accurate measurement) and released them (with the exception of juvenile fish that were sacrificed for diet analyses). During electrofishing sampling, we tagged every fish greater than 150 mm in the dorsal pterygiophores with a t-bar external tag containing a unique identification number. We clipped the right pelvic fin of every fish greater than 50 mm as a secondary mark for externally-tagged fish and primary batch mark for fish between 50 and 150 mm in total length. We utilized gastric lavage to sample stomach contents of fishes greater than 150 mm. We sacrificed several individuals (up to 50 individuals per species per sampling event) of small-bodied and juvenile fishes for diet analysis by dissection. We flushed gastric lavage samples into a 300-µm funnel filter (500-µm mesh was used during the summer 2007 collection period, and altered in winter 2008 to match invertebrate collection gear mesh size) and washed the sample into a sealable plastic bag. We then transported samples on ice to the laboratory and froze them until processing. In the laboratory, we rinsed diet contents in a 300-µm sieve, and placed the sample in a petri dish for examination under a stereo-dissecting microscope with magnification to 43x. We identified individual diet items to lowest possible taxonomic unit, dried individual items in an oven at 70°C, and weighed the dry sample. When individual diet items could not be separated effectively, we recorded the approximate percent composition of each diet item along with the combined weight of all items. We multiplied the percent composition by total diet weight to approximate the individual weight of each diet item.

We estimated the abundance and probability of capture of small-bodied fish species captured during block-net seine depletion sampling by solving for the maximum likelihood estimate of the $\log_e$-transformed multinomial likelihood depletion equation proposed by Gould and Pollock (1997):

$$LL(N_i, p_i \mid C_i) = LN[\Gamma(N+1)] - LN[\Gamma(\sum_{j=1}^{x} C_{ij} + 1)] - LN[\Gamma(N - \sum_{j=1}^{x} C_{ij} + 1)] +$$
$$\sum_{j=1}^{x} C_{ij} \times LN(1-Q) + (N - \sum_{j=1}^{x} C_{ij}) \times LN(Q) + \sum_{j=1}^{x} \{C_{ij} \times LN[p_i(1-p_i)^{j-1} / (1-Q) - LN[\Gamma(C_{ij} - 1)]\} +$$
$$LN\{\Gamma[\sum_{j=1}^{x} (C_i + 1)]\}$$

where

N_i = abundance of species i,

p_i = probability of capture of species i,

j = pass number,

x = total number of passes,

C_{ij} = catch of species i in pass j,

$\Gamma(x)$ = Gamma function which is used to scale factorials of large numbers,

$Q = 1-\Sigma_{j=1 \text{ to } x}[p_i(1-p_i)^{j-1}]$.

We divided the estimated abundance at each seine depletion site by the block-netted area and scaled the estimate to 100-m^2 area. We averaged the estimated densities at each seine depletion site within a reach for comparison between reaches and rivers. We calculated small-bodied fish biomass by multiplying the estimated density of each group or species within a reach by the mean weight of individuals captured within the reach.

We computed the electrofishing catchability coefficients of fishes based on mark-recapture density estimates (see Table 1 for a list of equations used to calculate catchability from closed mark-recapture sampling). We estimated the overall catchability of freshwater and saltwater large-bodied fishes, as well as individual species marked and recaptured during electrofishing sampling events. We calculated the probability of capture (Equation 8 in Table 1) as a function of the catchability coefficient times electrofishing effort (measured in hours of pedal time) per reach area (measured in km^2). We estimated the catchability of each group or species per recapture event by solving for the maximum likelihood estimate of the $\log_e$-transformed binomial distribution, substituting Equation 8 (Table 1) for the probability of capture (probability of success):

$$LL(p \mid M, R) = LN(\frac{M!}{R!(M-R)!}) + R \times LN(\frac{q \times E}{A}) + (M-R) \times LN(1 - \frac{q \times E}{A})$$

where

q = catchability coefficient

A = reach area in square-kilometers

E = electrofishing effort in hours

R = # of recaptured fish,

M = # of marked fish.

We calculated the mean catchability of freshwater fishes, saltwater fishes and individual species recaptured during multiple events by combining the likelihood statements of each recapture event (events 1…*N*) into a $\log_e$-transformed multinomial likelihood equation and solving for the maximum likelihood estimate:

$$LL(group/species) = LL(event_1) + LL(event_2) + ... + LL(event_N)$$

where *LL(event)* is the log-transformed binomial equation given above.

We estimated upper and lower credible intervals (95%) of mean catchability by likelihood profiling (Hilborn and Mangel 1997). We calculated the estimated mean density of each group and species within a reach by dividing the mean catch-per-unit-effort (catch rate) during each sampling event by the estimated catchability coefficient (Equation 3 in Table 1 solved for density). We estimated the confidence intervals of mean fish density by dividing the catch rate by the lower and upper limits of catchability. We scaled the estimated densities to the number of fish per 100-m^2 area for comparison between reaches and rivers. We calculated fish biomass estimates by multiplying the estimated density of each group or species within a reach by the mean weight of individuals captured within the reach.

We analyzed fish diet data by dry mass to estimate the composition of invertebrates and fishes observed in stomachs. We calculated diet composition as the percent dry weight per prey taxa. We estimated the diet composition for each taxon sampled, and we combined diet information from each species to assess the overall consumption of individual invertebrate and fish taxa.

Ecosystem Modeling and Time-dynamic Simulation

We compiled submersed aquatic vegetation, invertebrate and fish biomass estimates (all estimates were scaled to biomass per 100 m^2); growth information (from otolith analysis, cohort analysis and published literature, Table 2); fish diet information (from empirical data and published literature, Table 2); and production and consumption parameters (derived from growth data or synthesized from published literature, Table 2) to construct an ecosystem trophic mass-balance model utilizing the Ecopath with Ecosim software (Christensen and Walters 2004). Plant taxa were grouped into the following trophic groups: sediment diatoms, macrophytes, periphyton, and filamentous algae; invertebrate trophic groups included sediment macroinvertebrates, vegetation macroinvertebrates, amphipods, mud crabs, shrimp, crayfish, and blue crabs; and fish trophic groups included freshwater small-bodied fishes, saltwater small-bodied fishes, lake chubsucker, *Lepomis* spp., American eel, Florida gar, largemouth bass, striped mullet, pinfish, sheepshead, catfish, gray snapper, red drum, and common snook. Lake chubsucker, *Lepomis* spp., and largemouth bass were modeled using two stage-classes, juveniles (age 0) and adults (age>0). Biomasses were averaged across the upper two study reaches and between annual sampling periods in each river, analyzed separately by winter and summer seasons. The lower study reach was not included in the biomass estimates due to low biomass of aquatic vegetation in the reach and low abundance of freshwater taxa. Biomass inputs into the model for each trophic group were based on the winter or summer average in the Chassahowitzka River, depending on whether the group was more abundant in winter (algae, select invertebrates and saltwater taxa) or summer (freshwater taxa and select invertebrates) in the study reaches. Production to biomass estimates were determined from published literature (Table 2), or estimated from growth and mortality data (select freshwater fishes). Consumption to biomass estimates were determined from published literature (Table 2) or inferred from estimates of taxa within similar trophic guilds.

Diet information for individual fish groups was pooled across all samples in both rivers and summarized by percent dry mass composition. Diet information of invertebrates was synthesized from published literature; a list of references is included in Table 2. To account for seasonality of migratory saltwater taxa foraging within the rivers, a gulf food base prey group was included in the model and diet composition of saltwater taxa was assumed to consist of 50% gulf food base. The contribution of saltwater fishes to the detritus in the rivers was assumed to be zero, and all freshwater taxa were assumed to contribute fully to the detrital pool.

A 60-year time series was simulated for the Chassahowitzka River using the Ecosim module in the Ecopath with Ecosim program. A forcing function was applied to macrophytes and associated periphyton that simulated (1) an initial 20-year period of constant macrophyte biomass equal to the summer average over the study period in the Chassahowitzka River, (2) a

20-year period of steady linear decline in biomass from the initial biomass to complete extirpation, and (3) a 20-year period with macrophytes and associated periphyton extirpated from the system. A second forcing function was applied to filamentous algae that simulated (1) a 20-year period of constant filamentous algae biomass equal to the mean winter estimates in the Chassahowitzka River, and (2) a 40-year period of cyclical blooms of filamentous algae occurring seasonally based on observed monthly biomass trends during year 3 of monitoring in the Homosassa River (peak biomass was set equal to 5-times the observed biomass in the Chassahowitzka River). The relative change in biomass of each trophic group was estimated as the difference between the average annual biomass of the initial 10-year period of the simulation and the average annual biomass of the terminal 10-year period of the simulation. The relative biomass change of each trophic group from the time-dynamic simulation was compared with the observed spatial differences in biomass of each trophic group between the Chassahowitzka and Homosassa rivers.

In addition to simulating macrophyte extirpation, we simulated a long-term restoration scenario to examine the community-level effects of restoring macrophytes to twice the observed mean biomass in the Chassahowitzka River, and reducing filamentous algae to the mean observed summer biomass. Two forcing functions were used in the simulation. The first forcing function simulated (1) an initial 20-year period of constant macrophyte biomass equal to the summer average over the study period in the Chassahowitzka River, (2) a 20-year period of steady linear increase to twice the initial biomass, and (3) a 20-year terminal period with macrophyte biomass equal to twice the initial biomass. The first forcing function was also applied to periphyton associated with macrophytes. A second forcing function was applied to filamentous algae that simulated (1) an initial 20-year time series of filamentous algae equal to the current observed mean during winter in the Chassahowitzka River, (2) a 20-year period with steady linear reduction of filamentous algae to the observed mean summer biomass (approximately one-tenth the initial biomass), and (3) a 20-year terminal period with reduced filamentous algae equal to the observed mean summer biomass in the Chassahowitzka River. The mean annual biomass from the initial 10-year period of the simulation was compared with the terminal 10-year period mean annual biomass for each trophic group.

RESULTS

Nutrients

***Nitrate Concentrations*.—**Mean nitrate concentration ranged between 450 and 610 µg/L in Reach 1, 360 and 570 µg/L in Reach 2, and 140 and 400 µg/L in Reach 3 of the Chassahowitzka River during the study period. Mean concentration in the Homosassa River ranged 470 to 640 µg/L in Reach 1, 150 to 370 µg/L in Reach 2, and 90 to 310 µg/L in Reach 3. We observed higher nitrate concentration in February compared to August each year in both rivers, with the exception of August 2009 in the Chassahowitzka River when concentration was greatest (Figure 2).

***Soluble Reactive Phosphorus (SRP) Concentrations.*—**Mean SRP concentration varied between 11.8 and 14.8 µg/L in Reach 1, 6.3 and 12.7 µg/L in Reach 2, and 4.2 and 13.8 µg/L in Reach 3 of the Chassahowitzka River during the study period. Mean concentration in the Homosassa River varied 8.3 to 21.3 µg/L in Reach 1, 1.3 to 18.5 µg/L in Reach 2, and 1.2 to 19.0 µg/L in Reach 3. SRP concentration increased during February compared to August in Reaches 1 and 2 of the Chassahowitzka River, but steadily decreased in Reach 3 over the period of study until February 2010 when concentration was greatest for all reaches (Figure 2). SRP concentration peaked in

February during each year in Reach 1 of the Homosassa River, and also spiked in August 2008 compared to other summer sampling periods (Figure 2).

Submersed Aquatic Vegetation (SAV)

Percent Cover.**—**Average SAV cover varied between 11 and 52% during August sampling in Reaches 1 and 2 of the Chassahowitzka River, and varied between 47 and 77% during February sampling (Figure 3). We observed minimal SAV cover in Reach 3 of the Chassahowitzka River during August sampling (0-2%), but estimated considerable cover during February of each year (21-30%). Average SAV cover in Reach 1 of the Homosassa River peaked in August 2007 (29%), and ranged between 7 and 25% during the other sample periods. We documented the highest average percent cover in Reaches 2 and 3 of the Homosassa River during February 2008 and 2009 (27-56%).

Biomass.**—**SAV within the Chassahowitzka River during August of each year was comprised primarily of vascular plants (mean plant biomass = 782, 1433, 1728 g/m^2 in 2007, 2008 and 2009, respectively; mean algae biomass = 35, 34, 17 g/m^2 in 2007, 2008 and 2009, respectively). We measured the greatest mean plant biomass in Reach 1 (782-1,728 g/m^2), and lower biomass in Reaches 2 (140-1,246 g/m^2) and 3 (0-9 g/m^2) (Figure 4). The Homosassa River was nearly devoid of vascular plants across all sample periods (0-45 g/m^2) (Figure 4). We documented higher filamentous algae biomass in February compared to August in both rivers (Figure 5).

Invertebrates

Density and Biomass**—**Figure 6 displays the estimated mean density and biomass of common invertebrates associated with SAV. Filamentous algae comprised all SAV samples taken from the Homosassa River, while SAV samples from the Chassahowitzka

River included vascular plants and filamentous algae. We estimated higher densities of invertebrates associated with SAV (measured as the sum of amphipods, gastropods, insects, isopods and tanaids) during February sampling periods compared to August in both rivers (Figure 6, Table 3). Densities of common invertebrates in sediment samples were similar in August 2007 and February 2008, and counts of most taxa were equivalent between the two rivers (Table 4). Sediment samples were not collected after the initial two sample periods. Invertebrate sampling did not effectively capture larger invertebrate taxa, including blue crab (*Callinectes sapidus*), crayfish (Cambaridae), mud crab (Grapsidae and Xanthidae combined) and grass shrimp (*Palaemonetes* spp.), and invertebrate estimates do not include the density and biomass of these groups. Density and biomass estimates of these larger invertebrate taxa were obtained by seining (blue crabs) or throw trap sampling (grass shrimp, crayfish, and mud crabs) as part of a companion SWG project (project number 08008).

Taxa Composition.—Tables 3 and 4 list the counts by taxa of invertebrates associated with SAV and sediment samples in each reach for the August 2007 and February 2008 sample periods. Nematodes, ostracods, oligochaetes, polychaetes, amphipods, copepods, and chironomids were common in sediment samples collected within both rivers during August 2007 and February 2008. The most numerous taxa associated with SAV samples included amphipods, ostracods, gastropods, copepods, isopods, nematodes and chironomids.

Small-bodied Fishes

Density and Biomass.—We estimated greater density and biomass of small-bodied fishes in the upper two study reaches of the Chassahowitzka River during August sampling events compared to the Homosassa River (Figures 7-10). Small-bodied fish density and biomass declined between summer and winter sampling in the Chassahowitzka River during all years, which may be attributed, in part, to decreased density of freshwater species (Figures 7 and 8). We did not observe a higher density and biomass of small-bodied fishes during summer periods in the Homosassa River, contrary to trends in the Chassahowitzka River. Overall, freshwater small-bodied fishes were less abundant in the Homosassa River compared to the Chassahowitzka River (Figure 7); however, several saltwater species showed similar densities between the two rivers with the exception of pinfish (*Lagodon rhomboides*) which occurred in higher densities within the Chassahowitzka River (Appendix A) and gobies (*Gobiosoma bosc, Microgobius gulosus*) which occurred in higher densities in the upper reaches of the Homosassa River (Appendix A). Many small-bodied species showed a strong seasonality in their density and biomass (Appendix A), with the greatest densities observed in late spring through summer, and relatively low densities during fall and winter.

Species Composition.—Scientific and common names of fish species captured during electrofishing and seine sampling within each river are listed in Tables 5-8. Tables 9-12 list the total numbers of each fish species captured by seining within the Chassahowitzka and Homosassa rivers. Seine sampling within the Chassahowitzka River during August primarily captured rainwater killifish (*Lucania parva*), followed by inland silverside (*Menidia beryllina*), tidewater mojarra (*Eucinostomus harengulus*), bluefin killifish (*Lucania goodei*), and young-of-the-year spotted sunfish (*Lepomis punctatus*). February sampling within the Chassahowitzka River predominantly captured rainwater killifish, tidewater mojarra, pinfish, needlefish (*Strongylura* spp.) and gray snapper (*Lutjanus* *griseus*). Seining within the Homosassa River during August produced mostly rainwater killifish, inland silverside, tidewater mojarra, clown goby (*Microgobius gulosus*) and naked goby (*Gobiosoma bosc*). February sampling in the Homosassa River captured tidewater mojarra, rainwater killifish, mosquitofish (*Gambusia holbrooki*), bay anchovy (*Anchoa mitchilli*), inland silverside, clown goby and naked goby.

Large-bodied Fishes

Density and Biomass.**—**Freshwater and saltwater fish densities were greatest in Reach 1 of both rivers with lower densities observed in downstream reaches (Figure 11). The estimated density (Figure 11) and biomass (Figure 12) of freshwater fishes was significantly greater in the upper two reaches of the Chassahowitzka River compared to the upper reaches of the Homosassa River for most sampling periods. We measured a large increase in the densities of *Lepomis* spp. (primarily *Lepomis punctatus*) and lake chubsucker (*Erimyzon sucetta*) between January 2008 and July 2009 within the Chassahowitzka River, corresponding with relatively strong cohorts of young-of-the-year captured during summer 2008 and subsequent sampling events. We estimated significantly lower densities of adult largemouth bass (*Micropterus salmoides*), *Lepomis* spp. and lake chubsucker in the Homosassa River relative to the Chassahowitzka River during most sampling events; however, Florida gar (*Lepisosteus platyrhincus*) were more abundant in the Homosassa River and comprised a large proportion of the freshwater, large-bodied fish biomass (Appendix A). We documented high densities and biomass of saltwater, large-bodied fishes during January of each year in both rivers (Figures 11 and 12), with the greatest density surveyed during January 2008 within Reach 1 of the Homosassa River.

***Species Composition.*—**Scientific and common names of fish species captured during electrofishing and seine sampling within each river are listed in Tables 5-8. Tables 13-16 list the total captures of fishes by species during electrofishing within the Chassahowitzka and Homosassa rivers. A summary of marks and recaptures of fishes greater than 150 mm in total length during each day of sampling is given in Table 17. A summary of marks and recaptures of fishes between 50 and 150 mm in total length, including young-of-the-year large-bodied species, during each day of sampling is given in Table 18. Common fishes captured during August in the both rivers included pinfish, spotted sunfish, largemouth bass, striped mullet (*Mugil cephalus*) and American eel (*Anguilla rostrata*). Lake chubsucker were also commonly captured in the Chassahowitzka River, but were rarely encountered in the Homosassa River (5 total young-of-the-year were captured during the period of study). Gray snapper were the most abundant large-bodied species captured during January within both rivers, followed by spotted sunfish, pinfish, largemouth bass and lake chubsucker within the Chassahowitzka River; and striped mullet, spotted sunfish and common snook (*Centropomus undecimalis*) within the Homosassa River.

***Diet Composition.*—**To date, approximately 7,800 diet samples of freshwater and saltwater fish have been analyzed to characterize prey composition of fishes in the Homosassa and Chassahowitzka rivers. The composition of invertebrates (calculated as the sum of the dry masses) in invertebrate-feeding fish diets is shown in Figure 13. Crustaceans, including amphipods and decapods (crabs, crayfish, and shrimp), comprised a high proportion of prey items across most sampling periods in both rivers (Figure 13). Other common taxa included gastropods, bivalves, insect larvae, isopods, tanaids and polychaetes. Crayfish comprised the highest proportion by weight of prey consumed in the Chassahowitzka River across most sampling events, followed by amphipods and crabs. Fishes in the Homosassa River primarily consumed crabs, along with amphipods, crayfish and shrimp. Piscivorous fishes in both rivers consumed a wide range of freshwater and saltwater fish species (Figure 14). A high proportion of saltwater species were consumed by piscivorous fishes during the winter in the Homosassa River. Diets collected from piscivorous fishes in the summer demonstrated a broader range of freshwater prey species. Large-bodied fishes also consumed a substantial biomass of invertebrates, e.g., crabs and crayfish, in addition to fishes. Piscivorous fishes in the Chassahowitzka River primarily consumed fish species that were present in relatively high densities in the river during the sampling periods including pinfish, killifish (*Lucania* spp.), *Lepomis* spp., tidewater mojarra and gray snapper (during winter).

Ecosystem Modeling and Simulation

The Ecopath trophic mass balance model illustrated the complexity of trophic interactions within the Chassahowitzka River (Figure 15). Parameter inputs for the model are listed in Tables 21-23. To balance the ecosystem model, several production to biomass estimates of invertebrates and small-bodied fishes were adjusted to higher values than reported in published literature (Table 2). These results are not surprising due to the relatively warm water temperatures and the high primary production rates documented in the springs (Odum 1957). The balanced trophic model predicted high transfer of invertebrate and small-bodied fish production to consumers (Figure 16); these results are consistent with empirical diet composition of fishes and observed changes in the biomass of prey taxa. Time dynamic simulation of macrophyte extirpation and increased filamentous algae production predicted a strong negative response by many taxa of fishes and invertebrates, including pinfish, *Lepomis* spp., lake chubsucker, blue crabs, crayfish, and grass shrimp (*Palaemonetes* spp.). Positive responses to changes in submersed aquatic vegetation were predicted for many saltwater fishes (red drum, gray snapper, sheepshead, striped mullet and small-bodied species), select freshwater fishes (Florida gar, American eel, largemouth bass, and small-bodied species), and select invertebrates (mud crabs, amphipods and sediment invertebrates). Comparisons of model predictions with observed differences in biomass between the Chassahowitzka and Homosassa rivers (Figure 17) validated the direction of predicted responses for many taxa, including red drum (*Sciaenops ocellatus*), gray snapper, sheepshead (*Archosargus probatocephalus*), striped mullet, saltwater small-bodied fishes, Florida gar, American eel, *Lepomis* spp., lake chubsucker, blue crabs (*Callinectes sapidus*), crayfish (Cambaridae), mud crabs (Grapsidae/Xanthidae), grass shrimp, and sediment invertebrates. The predicted magnitude of biomass change was relatively accurate for several taxa, including pinfish, *Lepomis* spp., lake chubsucker, and blue crabs. The observed increase in biomass between the two systems were considerably greater than predicted by the trophic dynamics model for multiple taxa (Figure 17); the observed increase in biomass was often orders of magnitude greater than the predicted change. For many taxa (common snook, catfish, largemouth bass, freshwater small-bodied fishes, amphipods and vegetative invertebrates), the predicted response was opposite the observed differences in biomass.

Time-dynamic simulation of macrophyte restoration indicated a strong positive response by the majority of trophic groups (Figure 18), with the strongest responses predicted for pinfish, lake chubsucker, blue crabs, crayfish, grass shrimp, and vegetative invertebrates. Restoration of aquatic vegetation was predicted to result in a decrease in biomass of gray snapper, young-of-the-year largemouth bass, freshwater small-bodied fishes, mud crabs, and amphipods.

Surprisingly, a couple of taxa were predicted to respond positively under either scenario of macrophyte extirpation or restoration, including red drum, sheepshead, saltwater small-bodied fishes, Florida gar, American eel, adult largemouth bass, and sediment invertebrates.

DISCUSSION

Nitrate concentrations exceeded 400 μg/L in the upper reaches of both rivers and decreased longitudinally downstream, indicating depletion of this nutrient as a consequence of uptake by vegetation and other biogeochemical processes. We observed a similar trend for soluble reactive phosphorus during winter sampling periods when filamentous algae were prolific, but this pattern was less apparent during summer months. For example, we measured similar phosphorus concentrations in Reaches 1 and 3 of the Chassahowitzka River during August 2007 and February 2010, and estimated relatively high concentrations in all reaches of the Homosassa River during August 2009 and February 2010 coincident with low filamentous algae biomass. We observed higher nutrient concentrations during winter sampling periods, which may be a result of seasonal residential use patterns along the river and/or decreased stream flow. Soluble reactive phosphorus concentration increased in the Homosassa River between 2007 and 2010, and decreased over the period of study in the Chassahowitzka River until February 2010 when concentrations peaked.

The Chassahowitzka River maintained greater vegetative habitat cover and biomass year-round in the upper reaches compared to the Homosassa River as a result of the perennial cover and biomass of vascular plants. Filamentous algae were prevalent in both systems during winter sampling periods and during spring of year 3, creating a seasonally abundant habitat for invertebrates and small-bodied fishes, such as amphipods, isopods, gastropods, and killifish, which serve as prey for larger fish species, including *Lepomis* spp., gray snapper and juvenile largemouth bass. Vegetative habitat is intermittent in the Homosassa River, corresponding to the seasonal availability of filamentous algae. In areas with higher flows, algae mats are transported to downstream reaches where they senesce in areas with lower velocity. This may result in displacement of organisms utilizing the vegetative habitat in the Homosassa River to alternative habitats such as littoral areas or benthic substrates, whereas invertebrates and fishes in the Chassahowitzka River may use alternative vegetative habitats.

We documented relatively large declines in freshwater species density and biomass during winter sampling periods, coincident with immigration of saltwater species that utilize these systems, likely as thermal refugia, including gray snapper, common snook and red drum. Declines in large-bodied freshwater species density are due, in part, to migration into tributaries, canals and headwater areas, as evidenced by resighting observations of marked fish outside of the study reaches during subsequent months after sampling. The sharp decline in small-bodied fishes during winter may be a result of increased predation by saltwater piscivores or migration out of the study area, which, in turn, may release predation pressure on small invertebrates and increase the density and biomass of taxa that are exploited as prey by small-bodied fishes. Additionally, filamentous algae mats may provide temporary refuge for small invertebrates allowing populations densities to increase under lower predation pressure; however, mortality estimates of invertebrates were not conducted as part of this study. Diet information of large-bodied fishes demonstrated that amphipods, crayfish, crabs and shrimp were consumed in relatively high proportions by both freshwater and saltwater species, with considerable differences in the dominant prey type between systems (i.e., crayfish and amphipods were the primary food item for invertebrate feeding fishes in the Chassahowitzka River; crabs, amphipods and shrimp were the primary invertebrate food items for fishes in the Homosassa River). It is possible that predation by fishes influences the density and biomass of several invertebrate taxa associated with vegetative habitat.

Overall, we observed similar trends in fish density and biomass as those observed for estimated biomass of SAV in the study systems (i.e. reaches and sampling periods with higher biomass of SAV, including vascular plants and filamentous algae, had a greater estimated density and biomass of invertebrates and fishes). A comparison of invertebrate and fish assemblages between rivers provided insight into community level changes that may occur if vegetative habitat is lost from a system. Species that rely on vegetation for foraging, refuge or reproduction will likely be negatively affected by large-scale habitat loss. For example, we estimated greater densities and biomass of multiple freshwater species in the Chassahowitzka River (Appendix A), including crayfish (companion SWG Project 08008, Camp et al. 2009), grass shrimp (companion SWG Project 08008, Camp et al. 2009), rainwater killifish, bluefin killifish, *Notropis* spp., spotted sunfish, lake chubsucker and largemouth bass, that were less abundant in the Homosassa River. Furthermore, we documented large cohorts of fishes surviving to older age classes in the Chassahowitzka River over the study period. In the Homosassa River, cohorts of age-0 largemouth bass and spotted sunfish were observed (Appendix A); however, few individuals were captured in subsequent sampling events at older age classes, contrary to observations in the Chassahowitzka River. Few age-0 lake chubsucker were captured in the Homosassa River during the first sampling event and none were captured in the study reaches during the following sampling periods with the exception of June 2010 following high production of filamentous algae in March and April 2010 (Figure 5). We observed the greatest densities of juvenile fishes in Reach 1 of the Homosassa River during June 2010 (Appendix A), subsequent to the increased biomass of filamentous algae. These data indicate that vegetative habitat may be important for recruitment of many species in coastal rivers by providing forage and refuge habitat.

Several key findings from the ecosystem model included the predicted extirpation of select freshwater and marine species, the increase in biomass of select fishes and invertebrates, and the resultant shift in faunal community composition. The model results also demonstrated cyclical population dynamics associated with boom-and-bust algae production and corresponding responses of select invertebrate and fish populations. The observed trends in estimated biomass of select species between the Chassahowitzka and Homosassa rivers validated several model predictions, including the near extirpation of lake chubsucker and crayfish in the Homosassa River; the decreased biomass of pinfish, *Lepomis* spp., blue crabs, and grass shrimp; the increased biomass of saltwater fishes, Florida gar, American eel, mud crabs and sediment invertebrates; and the observed boom-and-bust dynamics of invertebrates associated with filamentous algae and fishes that forage on these invertebrates. Year 3 of monitoring in the Homosassa River demonstrated that large-scale algal production in the spring resulted in a sharp increase in young-of-the-year freshwater and saltwater fishes (Appendix A); however, it is unknown if this increase resulted in a higher rate of recruitment than previously observed since we did not continue monitoring past June of Year 3.

The anomalous predictions in species biomass trends provide interesting cases of counterintuitive population responses. The increase in biomass of select saltwater fishes is not surprising since their recruitment is independent of the habitat and trophic dynamics within the rivers; and the Homosassa River is deeper, has greater discharge, and provides a larger volume of freshwater that serves as winter habitat for thermally sensitive species. The contradictory responses of freshwater taxa, on the other hand, present areas of potential future ecological research. For example, the observed biomass of Florida gar in the Homosassa River was 72 times greater than in the Chassahowitzka River; however, the ecosystem model predicted a change in biomass that was several degrees of magnitude less than the observed difference. One possible explanation is increased spawning success of Florida gar; we observed gar successfully spawning on filamentous algae patches during the spring of year 3 and captured a higher abundance of young-of-the-year in the following sampling events. The model incorrectly predicted strong positive responses of largemouth bass and freshwater small-bodied fishes. It is possible that diet sampling of Florida gar did not adequately capture the predator-prey dynamics for this species due to difficultly in sampling the stomach contents using gastric lavage. The observed decrease in largemouth bass and small-bodied fish biomass could be explained by high vulnerability to gar predation (i.e. juvenile largemouth bass) in an unstructured river. This hypothesis would explain the large increase in biomass of Florida gar and suppression of largemouth bass and small-bodied species resulting from increased mortality and decreased recruitment. Other hypotheses for ecosystem change that were not captured in the trophic dynamic model include shifts in system energy dynamics, such as increased allochtonous input and terrestrial food base. Diet information for several species of freshwater fishes (e.g., largemouth bass and *Lepomis* spp.) indicated that individuals within the Homosassa River consumed a greater proportion of terrestrial organisms, including bullfrogs, lizards, waterfowl and terrestrial insects than fishes within the Chassahowitzka River. Additional studies that would increase our understanding of trophic dynamics in the coastal rivers and likely improve the predictability of the ecosystem model include diet composition of small-bodied fishes and invertebrates, and annual production estimates of invertebrates.

MANAGEMENT RECOMMENDATIONS

We advocate periodic monitoring of the fish and invertebrate communities in the Chassahowitzka and Homosassa rivers in conjunction with established SAV and water quality monitoring programs to identify ecosystem responses to recently completed wastewater treatment systems and assess long-term community trends. Long-term ecosystem monitoring may provide greater insight into responses of invertebrate and fish populations to vegetative habitat availability, including crayfish, grass shrimp, blue crab, lake chubsucker, *Lepomis* spp., largemouth bass, pinfish, and freshwater small-bodied species. Ecosystem-level monitoring in conjunction with experimental habitat modifications could help define the relationship between habitat availability, fish recruitment and population abundance. We recommend using passive integrative transponder tags in future monitoring to create long-term tagging databases that may be used to estimate the survival, growth and migration of freshwater fish species of interest over decadal time scales. We observed considerable tag-loss of external t-bar tags between biannual sampling events which inhibited the estimation of survival and emigration using the robust-design capture-recapture framework. We advise periodic estimation of gear catchability to examine the longer-term temporal and spatial trends in gear efficiency. We recommend that minimum channel depth during winter months be considered a key factor in determining minimum flows and levels in these rivers. Sufficient channel depth is important to allow access to upstream reaches by thermally sensitive species, such as common snook, gray snapper and red drum, as well as freshwater species that may use these areas as predation refuges during winter.

CONCLUSIONS

Spring-fed systems in Florida have been historically described as homeostatic in their chemical, physical and biological characteristics (Odum 1957). The data collected during this study demonstrated that spring-fed, coastal rivers are spatially and temporally dynamic in available nutrients, vegetative habitat cover and biomass, invertebrate composition and biomass, and fish community composition and biomass. Vegetative habitat was prevalent year-round in the Chassahowitzka River and was dominated primarily by vascular plants during the summer, with filamentous algae abundant during winter sampling periods. The Homosassa River was nearly devoid of vegetative habitat during summer months when filamentous algae biomass was low. Based on river-wide comparisons of faunal community composition, density, biomass, diet of fishes, and ecosystem time-dynamic simulation, we infer that vegetative habitat loss negatively impacts species that rely on this habitat type for foraging, refuge or reproduction, including crayfish, grass shrimp, *Lucania* spp., *Notropis* spp., lake chubsucker, pinfish, spotted sunfish and largemouth bass. Species that do not have a strong affinity for structural habitat (SAV in particular) will be less affected by large-scale changes in vegetation, such as mud crabs, clown goby, naked goby, tidewater mojarra, inland silverside, hogchoker (*Trinectes maculatus*), gray snapper, Florida gar and longnose gar (*Lepisosteus osseus*). The observed differences in population densities, biomass and diet of fishes are evidence that changes in vegetative habitat impacts individual species disproportionately, and continued changes are likely to alter the fish and invertebrate communities in these systems.

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APPENDIX A

SPECIES INFORMATION

Sheepshead (*Archosargus probatocephalus*)

***Density and Biomass.*—**Mean sheepshead density ranged between 0 and 1 fish per 1,000-m^2 in both rivers (Figure 19). We observed sheepshead year-round in the Homosassa River during year 3, with increased density in the upstream reach during January through April 2010. We recorded seasonally high densities of juveniles in the Chassahowitzka River and detected adult sheepshead in the Homosassa River year-round. The mean biomass of sheepshead was greater in the Homosassa River (Figure 20) due to the presence of larger individuals.

Common Snook (*Centropomus undecimalis*)

***Density and Biomass.*—**Mean snook density and biomass was highest in reach 3 of the Chassahowitzka River compared to the upstream reaches where snook were infrequently observed (Figures 21 and 22). We estimated greater snook density and biomass in reach 2 of the Homosassa River compared to the Chassahowitzka River for most sample periods (Figures 21 and 22). We observed a large cohort of juvenile snook in reach 2 of the Homosassa River during January 2009, some of which were observed in subsequent sampling events. One fish that we tagged in the Homosassa River was caught and reported by an angler at Caladesi Island, Florida (greater than fifty miles from the mark location) six months later. The individual was tagged as a juvenile below the recreational slot limit and recruited to the recreational fishery, suggesting that fishes utilizing the Homosassa River as juveniles contribute to the fishery in the Gulf of Mexico. Snook migrated into the upper reach of the Homosassa River during October and November, density peaked in the reach during January and numbers steadily declined through March (Figure 21).

Lake Chubsucker (*Erimyzon sucetta*)

***Density and Biomass.*—**We observed lake chubsucker in higher density and biomass in the Chassahowitzka River compared to the Homosassa River (Figures 24 and 25). We observed a total of five individual young of the year fish in the Homosassa River over the entire period of study. We documented a large cohort of juveniles within the Chassahowitzka River during July 2008, some of which survived and were captured in following sampling events. Lake chubsucker were seasonally abundant in the Chassahowitzka River, with greater density and biomass observed during March through August corresponding with increased juvenile abundance. The presence of juveniles in reach 1 of the Homosassa River was recorded following the large-scale blooms of filamentous algae during April and May 2010.

Tidewater mojarra (*Eucinostomus harengulus*)

***Density and Biomass.*—**We estimated seasonally high density and biomass of mojarra during winter compared to summer periods across all sampling years (Figures 26-29). During year 3, mojarra migrated into the rivers during August and September, density peaked in September through December and declined during late winter and spring with the lowest densities observed during June and July.

***Fundulus* spp. (*F. seminolis and F. grandis*)**

Density and Biomass.*—Fundulus* spp. were encountered less frequently than other small-bodied freshwater species, and occurred in similar densities (Figure 30) and biomasses (Figure 31) in both rivers, when encountered. *Fundulus seminolis* and *Fundulus grandis* were modeled as a single taxa group due to uncertainty in species identification during the first year's sampling and possible misidentification of individuals in the field during those sample periods. Similar to many young-of-the-year and freshwater small-bodied fishes, *F. seminolis* showed a strong response to increased filamentous algae habitat in the Homosassa River during spring 2010.

Gobies (*Gobiosoma bosc and Microgobius gulosus*)

Density and Biomass.**—**Gobies were captured more frequently in the Homosassa River than the Chassahowitzka River, particularly in the upper two reaches. *Gobiosoma bosc* and *Microgobius gulosus* were modeled as a single taxa group due to uncertainty in species identification during the first year's sampling and possible misidentification of individuals in the field from those sampling periods. Gobies density (Figure 32) and biomass (Figure 33) were similar between all three reaches in the Homosassa River. Gobies were more abundant in summer compared to winter in both systems, and monthly sampling demonstrated strong seasonality in density and biomass, with the lowest densities observed between November and April.

Pinfish (*Lagodon rhomboides*)

Density, Biomass, Size Structure and Diet.**—**We observed pinfish in greater density and biomass in the upstream reaches of the Chassahowitzka River for all biannual sampling periods compared to the Homosassa River (Figures 34-37). Monthly surveys in the Chassahowitzka River demonstrated seasonal variability in density, with the highest mean densities observed in August and March and low densities recorded for December and May. In the Homosassa River, we measured the highest density of pinfish in June 2010 following high production of filamentous algae. Length frequency analyses verified differences in seasonal use by separate size classes of pinfish (Figures 38 and 39). July electrofishing captured pinfish between 50 and 200 mm in total length, and January electrofishing captured pinfish between 70 and 160 mm in total length. Few large individuals were captured in the Homosassa River over the study period.

Florida Gar (*Lepisosteus platyrhincus*)

Density and Biomass.—Electrofishing sampling indicated greater density and biomass of Florida gar within the Homosassa River compared to the Chassahowitzka River (Figures 41 and 42). We commonly encountered Florida gar in the upper reaches of the Homosassa River and we rarely captured the species within the Chassahowitzka River. Florida gar accounted for a considerable proportion of the biomass of freshwater fishes in the Homosassa River.

Bluegill (*Lepomis macrochirus*)

Density and Biomass.—Bluegill were more prevalent in the Homosassa River in comparison to the Chassahowitzka River, as illustrated by greater estimated density (Figure 43). We captured the more bluegill in the Homosassa River in June 2010 compared to other sampling events, and estimated the greatest biomass (Figure 44) following large-scale increases in ilamentous algae biomass. Bluegill were infrequently encountered in the Chassahowitzka River in comparison to the Homosassa River.

Redear Sunfish (*Lepomis microlophus*)

Density and Biomass.—Redear sunfish density ranged between 0 and 5 fish per 1,000 m^2 area in both rivers during biannual monitoring (Figure 45). We detected a sharp increase in the density of juvenile redear sunfish in the Homosassa River following large-scale production of filamentous algae in spring 2010. We estimated greater biomass in the Chassahowitzka River during several sampling events (Figure 46), due to the capture of larger individuals compared to the sampled population in the Homosassa River.

Spotted Sunfish (*Lepomis punctatus*)

Density, Biomass and Size Structure.**—**Spotted sunfish occurred in higher density and biomass within the Chassahowitzka River than the Homosassa River for most sampling periods (Figures 47 and 48). Spotted sunfish were common in the upper reaches of the Chassahowitzka River and exhibited similar densities in those reaches, but we rarely captured the species outside of Reach1 within the Homosassa River. We observed a large cohort of juvenile spotted sunfish during July 2008 in the Chassahowitzka River and captured individuals from this cohort in later sampling efforts (Figure 49). We documented the highest density of spotted sunfish within the Homosassa River following large-scale filamentous algae production in spring 2010, as a result of increased juvenile abundance, detected in June 2010 (Figures 47 and 50).

Gray Snapper (*Lutjanus griseus*)

Density and Biomass.**—**Gray snapper demonstrated the highest density (Figure 52) and biomass (Figure 53) of all large-bodied fishes within the Chassahowitzka and Homosassa Rivers during winter sampling periods. We infrequently captured the species during July monitoring, although a few individuals were captured during summer months, especially in the Homosassa River. Monthly sampling during year 3 demonstrated the seasonal migration and use patterns of this species within the rivers (Figure 52). Gray snapper began migrating into the rivers during November; density peaked in both rivers during January and February and steadily declined through May (Figure 52). Gray snapper showed similar densities within the upper two reaches of the Chassahowitzka River during winter; however, snapper within the Homosassa River resided in Reach 1 in relatively high density compared to the other sample reaches. We documented a large cohort of juveniles (age 1) within the rivers during January 2008 and detected the presence of this cohort during the following January sampling (Figure 54). In fact, three distinct age classes (aged by otolith analysis) were observed during January 2009, including young-of-the-year, age 1 and age 2 individuals. Monthly length-frequency analysis indicated that gray snapper growth was minimal during October through April and that the largest shift in length frequency was observed during May through September (Figure 55).

Lucania **spp. (*L. goodei and L. parva*)**

Density and Biomass.—*Lucania parva* was the most abundant small-bodied fish in both rivers with densities up to 5,000 individuals per 100 m^2 observed during August seine sampling in the Chassahowitzka River (Figure 57). *Lucania goodei* was also common, but less abundant in comparison to *L. parva*. Similar to many young-of-the-year and small-bodied fishes, density and biomass (Figure 58) of *Lucania* spp. was greatest during summer months with sharp declines observed in the fall through winter. The cyclical trend in population abundances of these species, and other small-bodied fishes, could be a result of predation by saltwater migratory fishes, particularly gray snapper, whose diets contained a high proportion of *Lucania* spp. and other small fishes.

Inland Silverside (*Menidia beryllina*)

Density and Biomass.—The observed densities (Figure 59) and biomasses (Figure 60) of inland silverside was similar between the Chassahowitzka and Homosassa rivers, and monthly sampling in both systems showed a seasonal increase in density and biomass in late spring and early summer and decreasing density in the fall and winter, similar to *Lucania* spp. and other small-bodied fishes. The high production of filamentous algae in the Homosassa during spring 2010 did not result in a sharp increase in silverside abundance, contrary to many other small-bodied fishes. Silversides were frequently observed in large schools in midstream and near docks in the Homosassa River.

Largemouth Bass (*Micropterus salmoides*)

Density and Biomass.**—**We estimated similar densities of largemouth bass within the upper reach of both rivers during summer monitoring (Figure 61); however, estimated densities decreased noticeably between summer and winter sampling periods in the Homosassa River. This pattern was not apparent in the Chassahowitzka River. Length frequency analysis provided insight into the size structure of the populations, and indicated that the seasonal difference in densities within the Homosassa River are driven by large cohorts of young-of-the-year (Figure 62), of which relatively few were detected in subsequent sampling events. In contrast, the population of the Chassahowitzka River is comprised of a relatively high proportion of larger individuals. Monthly monitoring during year 3 demonstrated a rapid decline in juvenile bass density between July and October 2009 in the Homosassa River, indicating relatively low apparent survival. We observed the highest density of juvenile largemouth bass during June 2010 within the Homosassa River following high filamentous algae production in the upper reach. Monthly length frequency analysis indicated that juvenile growth is greatest during April through October, with less change observed in length frequency modes between November through March (Figure 63). We estimated greater biomass of largemouth bass in the Chassahowitzka River compared to the Homosassa River due to the presence of larger individuals (Figure 64), and calculated relatively high biomass in Reach 2 of the

Chassahowitzka River compared to Reach 2 of the Homosassa River where bass were infrequently captured.

Striped Mullet (*Mugil cephalus*)

***Density and Biomass.*—**Striped mullet density estimates ranged between 0 and 5 fish per 1,000 m^2 in the Chassahowitzka River and ranged between 0 and 9 fish per 1,000 m^2 in the Homosassa River (Figure 66). Mullet utilized all three reaches of both rivers, with variable density and biomass (Figure 67) between sampling events. During some sample periods, striped mullet were more abundant in the upper reaches and during other periods they were denser in the lower reaches. This variability may be a result of large-scale movement patterns of mullet within the rivers, as we frequently observed large schools of mullet migrating upstream and downstream during sampling. We typically recaptured individuals utilizing shoreline habitat, including docks and snags, and rarely recaptured individuals in large schools during midstream transects. Therefore, the movement of striped mullet into and out of the study reaches during closed mark-recapture sampling likely resulted in positively biased density and biomass estimates.

***Notropis* spp. (*N. harperi and N. petersoni*)**

Density and Biomass.*—Notropis* spp. were observed in significantly higher density (Figure 68) and biomass (Figure 69) in the Chassahowitzka River compared to the Homosassa River. In fact, *Notropis* spp. were rarely captured in any reaches within the Homosassa River, with the exception of Reach 1 during May 2010 following large-scale blooms of filamentous algae. Similar to other small-bodied fishes, density and biomass of *Notropis* spp. in the Chassahowitzka River peaked in spring and summer and declined to low densities in the fall and winter.

Red Drum (*Sciaenops ocellatus*)

***Density and Biomass.*—**We captured few red drum in the lower reach of the Chassahowitzka River and did not capture any in the upper two reaches. In the Homosassa River, we electrofished red drum in all three reaches, but observed the highest densities (Figure 70) and biomass (Figure 71) in reach 2. Monthly electrofishing indicated that red drum were most abundant in July through September, with no individuals captured during April through June of 2010.

***Strongylura* spp. (*S. marina, S. notata and S. timucu*)**

***Density and Biomass.*—**Needlefishes were measured in similar density (Figure 72) and biomass (Figure 73) in both systems, with the highest density observed during February 2009. Monthly sampling indicated that needlefish were most abundant during winter months. Additionally, unlike other small-bodied fishes, no peak in density and biomass was observed during periods of high algae production in the rivers.

Gulf pipefish (*Syngnathus scovelli*)

***Density and Biomass.*—**We observed gulf pipefish in higher density (Figure 74) and biomass (Figure 75) within the Chassahowitzka River compared to the Homosassa River for most sampling periods. Pipefish demonstrated a similar seasonal trend in density as other small-bodied fishes, with peak density and biomass observed during late spring and summer.

Hogchoker (*Trinectes maculatus*)

***Density and Biomass.*—**Hogchoker were more abundant in the upper reaches of the Homosassa River compared to the Chassahowitzka River (Figure 76). Densities in the lower reach of the Chassahowitzka River were similar to observed densities in the

Homosassa River. Monthly sampling within the Homosassa River did not demonstrate a sharp decline in density and biomass (Figure 77) associated with increased saltwater predators, contrasting with other species abundance trends.

Invertebrate Taxa

Density and Biomass.**—**The density and biomass of invertebrates associated with SAV was greatest during winter sampling periods when filamentous algae biomass was high (Figures 78-86). Many taxa demonstrated a higher abundance during periods with high biomass of filamentous algae, with the exception of insect larvae and pupae (Figure 84). In fact, insect density and biomass was similar across all sampling periods in the Chassahowitzka River; however, we observed a relatively high biomass of insects in the Homosassa River during February 2008 when filamentous algae mats were prevalent. Insects, particularly chironomids, were abundant in both filamentous algae and macrophyte samples, which may explain why density and biomass remains high during summer periods in the Chassahowitzka River which provides year-round SAV habitat. Of the taxa measured in invertebrate samples, amphipods and blue crabs demonstrated the greatest biomass, with peak biomass occurring during winter periods. Additionally, blue crabs demonstrated an increase in biomass during May and June, coincident with large-scale production of filamentous algae in the Homosassa River. One surprising result was the observed increase in density and biomass of gastropods associated with filamentous algae in the Homosassa River.

APPENDIX B

REPORT TABLES

Table 1. List of Equations used to Estimate Electrofishing Catchability from Closed Mark-Recapture Sampling.

#	Parameter	Equation	Definition of terms
1	Population abundance (N):	$N = \frac{C \times M}{R}$	C = total captures during a sample pass M = number of marked fish within a study reach R = number of marked fish recaptured within a study reach
2	Population density (D):	$D = \frac{N}{A}$	A = area of the study reach (kilometers^2)
3	Catchability equation:	$\frac{C}{E} = q \times D$	E = effort applied during a sample pass (hours)
4	Cacthability coefficient (q):	$q = \frac{C}{E \times D}$	
5*		$q = \frac{R \times A}{M \times E}$	
6	Probability of capture (p):	$p = \frac{C}{N}$	
7**		$p = \frac{R}{M}$	
8***		$p = \frac{q \times E}{A}$	

NOTES: *Substitution of Equation 1 into Equation 2 and Equation 2 into Equation 4 solves to Equation 5
**Substitution of Equation 1 into Equation 6 solves to Equation 7,
***Substitution of Equation 7 into Equation 5 solves to Equation 8

Table 2. Data Sources for Ecopath Trophic Mass Balance Model of the Chassahowitzka River.

Trophic Group	Biomass	P/B	Q/B	Diet
Common Snook	Empirical capture-recapture	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
Red Drum	Empirical capture-recapture	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
Gray Snapper	Empirical capture-recapture	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
Catfish	Empirical capture-recapture	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
Sheepshead	Empirical capture-recapture	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
Pinfish	Empirical capture-recapture	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
Striped Mullet	Empirical capture-recapture	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
Florida Gar	Empirical capture-recapture	Equal to 1/2 Adult Bass	Equal to Adult Bass	Empirical gut analysis
American Eel	Empirical capture-recapture	Equal to 1/2 Adult Bass	Equal to Adult Bass	Empirical gut analysis
Largemouth Bass Adults	Empirical capture-recapture	Estimated from growth	Estimated from growth	Empirical gut analysis
Largemouth Bass Juveniles	Empirical capture-recapture	Estimated from growth	Estimated from growth	Empirical gut analysis
Lepomis Adults	Empirical capture-recapture	Estimated from growth	Estimated from growth	Empirical gut analysis
Lepomis Juveniles	Empirical capture-recapture	Estimated from growth	Estimated from growth	Empirical gut analysis
Lake Chubsucker Adults	Empirical capture-recapture	Estimated from growth	Estimated from growth	Empirical gut analysis
Lake Chubsucker Juveniles	Empirical capture-recapture	Estimated from growth	Estimated from growth	Empirical gut analysis
SW Small-bodied Fishes	Empirical seine removal	Walters et al. 2008	Walters et al. 2008	Empirical gut analysis
FW Small-bodied Fishes	Empirical seine removal	Assumed equal to SWSB Fishes	Assumed equal to SWSB Fishes	Empirical gut analysis
Blue Crabs	Empirical seine removal	Walters et al. 2008 (adjusted)	Walters et al. 2008 (adjusted)	Dittel et al. 2006, Reichmuth et al. 2009, Seitz et al. 2005, Mascaro et al., Rosas et al. 1994
Crayfish	SWG project 08008	Equal to Blue Crabs	Equal to Blue Crabs	Gutierrez-Yurrita et al. 1998
Mud Crabs	SWG project 08008	Equal to Blue Crabs (adjusted)	Equal to Blue Crabs (adjusted)	Kneib and Weeks 1990
Shrimp	SWG project 08008	Walters et al. 2008	Walters et al. 2008	Collins 1999, Morgan 1980, Costantini and Rossi 2001
Amphipods	Empirical invert samples	Kevrekidis et al. 2009, Subida et al. 2005	Equal to Shrimp	MacNeil et al. 1997, Duffy and Harvilicz 2001
Vegetative Inverts	Empirical invert samples	Robertson 1979 (adjusted)	Estimate 2x P/B)	Assumed 100% Grazers
Benthic Inverts	Empirical invert samples	Robertson 1979 (adjusted)	Estimate 2x P/B	Assumed 50% Detritivores/ 50% Grazers
Periphyton	Frazer et al. 2006	Assumed Equal to 10	NA	NA
Filamentous Algae	Empirical quadrat samples	Assumed Equal to 20	NA	NA
Plants	Empirical quadrat samples	Walters et al. 2008	NA	NA
Sediment Diatoms	Frazer et al. unpublished data	Literature	NA	NA

Table 3. Counts of Invertebrates Collected from Submersed Aquatic Vegetation within the Chassahowitzka and Homosassa rivers during August 2007 and February 2008 (Sampled Area = 0.05 m^2 per sample).

	Chassahowitzka R.						Homosassa R.					
	August 2007			February 2008			August 2007			February 2008		
Taxa	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3
Hydrozoa	0	0	0	0	15	24	0	0	0	0	0	0
Turbellaria	3	0	0	0	10	0	1	0	0	80	0	2
Nemertea	1	0	6	0	0	0	7	1	0	0	0	0
Nematoda	698	892	207	143	2,828	683	148	7	0	2,000	1,776	968
Oligochaeta	216	104	11	54	1,460	56	173	1	0	368	64	48
Polychaeta	41	48	5	72	11	24	98	0	0	16	0	35
Hirudinia	1	3	4	6	16	0	3	1	0	0	8	0
Gastropoda	86	155	2,594	72	318	3,727	269	26	0	1,974	4,055	405
Pelecypoda	0	4	4	0	13	1,016	47	3	0	119	270	159
Amphipoda	212	1,018	457	9,896	4,668	2,371	2,763	89	0	2,523	2,009	3,324
Cumacea	0	23	0	534	92	40	7	2	0	0	0	72
Palaemonidae	8	11	33	4	0	0	0	0	0	0	0	0
Decapoda	0	3	4	0	1	0	1	0	0	32	1	0
Isopoda	59	113	13	1,787	814	2,354	37	1	0	1,168	90	475
Cambaridae	1	0	0	0	0	0	0	0	0	0	0	0
Mysidacea	1	0	0	20	23	36	1	0	0	0	0	0
Tanaidacea	284	65	16	402	169	10	105	0	0	17	1	403
Cladoceran	0	0	0	12	100	64	0	0	0	0	16	0
Ostracoda	557	1,675	43	4,446	7,889	2,795	1,393	296	0	10,048	2,728	684
Acari	7	24	2	210	220	152	14	1	0	0	952	433
Copepoda	131	301	15	2,071	2,963	1,524	525	0	0	1,040	1,496	426
Ephemeroptera	0	0	0	12	44	0	14	0	0	96	16	0
Zygoptera	1	0	3	8	1	0	0	0	0	0	0	0
Trichoptera	0	1	0	12	9	0	0	0	0	0	0	0
Lepidoptera	0	0	0	10	0	0	0	0	0	0	0	0
Coleoptera	0	0	0	0	0	0	0	0	0	0	0	0
Ceratopogonidae	5	5	3	1	30	8	15	0	0	17	0	0
Chironomidae	914	597	26	890	332	267	545	6	0	374	628	27
Diptera	0	0	0	0	0	0	0	0	0	0	0	0

Table 4. Counts of Invertebrates Collected from Sediment within the Chassahowitzka and Homosassa rivers during August 2007 and February 2008 (Sampled Area = 0.002 m^2 per sample).

	Chassahowitzka R.						Homosassa R.					
	August 2007			February 2008			August 2007			February 2008		
Taxa	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3
Hydrozoa	0	0	0	2	0	11	0	0	0	0	1	0
Turbellaria	0	0	0	4	0	1	1	0	0	4	0	1
Nemertea	6	5	15	0	0	0	23	8	17	0	0	0
Nematoda	964	1,932	2,004	835	1,845	682	750	2,063	1,360	835	1,909	817
Oligochaeta	333	1,013	201	672	1,050	63	1,002	149	677	672	1,081	63
Polychaeta	163	166	27	119	149	16	74	36	24	119	150	19
Hirudinia	9	5	1	15	2	0	2	1	0	15	3	0
Gastropoda	47	42	22	13	12	80	48	96	19	13	14	111
Pelecypoda	0	0	62	2	38	226	0	12	33	2	38	256
Amphipoda	41	152	309	250	176	333	148	265	126	250	184	389
Cumacea	6	36	1	145	43	3	1	17	6	145	51	6
Palaemonidae	0	0	0	0	0	0	0	2	0	0	0	0
Decapoda	0	0	1	0	0	0	0	0	0	0	0	0
Isopoda	22	20	66	72	29	11	2	14	13	72	32	34
Cambaridae	0	0	0	0	0	0	0	0	0	0	0	0
Mysidacea	1	2	0	0	3	0	0	1	0	0	3	0
Tanaidacea	5	6	7	31	12	1	7	0	1	32	27	1
Cladoceran	0	0	0	1	13	0	0	0	0	1	14	0
Ostracoda	222	3,078	1,081	517	672	537	885	1,521	874	517	722	617
Acari	0	5	7	6	15	45	3	12	19	6	15	52
Copepoda	22	115	570	34	79	375	157	1,008	1,501	34	104	488
Ephemeroptera	0	0	0	0	0	0	0	0	0	0	0	0
Zygoptera	0	0	0	0	0	0	0	0	0	0	0	0
Trichoptera	0	0	0	0	0	0	0	0	0	0	0	0
Lepidoptera	0	0	0	0	0	0	0	0	0	0	0	0
Coleoptera	0	0	0	0	2	0	0	0	0	0	2	0
Ceratopogonidae	0	5	5	3	4	1	6	3	1	3	4	1
Chironomidae	149	156	8	201	107	24	220	3	2	201	109	43
Diptera	0	0	0	1	0	0	0	0	0	1	0	0

Table 5. Freshwater fish species captured between July 2007 and June 2010 within the Chassahowitzka River, Florida.

Scientific Name	Common Name
Ameiurus natalis	Yellow bullhead
Ameiurus nebulosus	Brown bullhead
Anguilla rostrata	American eel
Cyprinodon variegatus	Sheepshead minnow
Erimyzon sucetta	Lake chubsucker
Fundulus seminolis	Seminole killifish
Gambusia holbrooki	Eastern mosquitofish
Heterandria formosa	Least killifish
Lepisosteus osseus	Longnose gar
Lepisosteus platyrhincus	Florida gar
Lepomis gulosus	Warmouth
Lepomis macrochirus	Bluegill
Lepomis microlophus	Redear sunfish
Lepomis punctatus	Spotted sunfish
Lucania goodei	Bluefin killifish
Lucania parva	Rainwater killifish
Menidia beryllina	Inland silverside
Micropterus salmoides	Largemouth bass
Notemigonus crysoleucas	Golden shiner
Notropis harperi	Redeye chub
Notropis petersoni	Coastal shiner
Poecilia latipinna	Sailfin molly

Table 6. Saltwater fish species captured between July 2007 and June 2010 within the Chassahowitzka River, Florida.

Scientific Name	Common Name
Anchoa mitchilli	Bay anchovy
Archosargus probatocephalus	Sheepshead
Ariopsis felis	Hardhead catfish
Bairdiella chrysoura	Silver perch
Brevoortia sp.	Menhaden
Caranx hippos	Crevalle jack
Centropomus undecimalis	Common snook
Cynoscion nebulosus	Spotted seatrout
Dasyatis sp.	Stingray
Elops saurus	Ladyfish
Eucinostomus harengulus	Tidewater mojarra
Eucinostomus gula	Silver jenny
Fundulus confluentus	Marsh killifish
Fundulus grandis	Gulf killifish
Gobiosoma bosc	Naked goby
Lagodon rhomboides	Pinfish
Leiostomus xanthurus	Spot
Lutjanus griseus	Gray snapper
Microgobius gulosus	Clown goby
Mugil cephalus	Striped mullet
Mugil curema	White mullet
Oligoplites saurus	Leatherjacket
Opsanus beta	Gulf toadfish
Sciaenops ocellatus	Red drum
Strongylura marina	Atlantic needlefish
Strongylura notata	Redfin needlefish
Strongylura timucu	Timucu
Syngnathus scovelli	Gulf pipefish
Synodus foetens	Lizardfish
Trinectes maculatus	Hogchoker

Table 7. Freshwater fish species captured between July 2007 and June 2010 within the Homosassa River, Florida.

Scientific Name	**Common Name**
Ameiurus natalis	Yellow bullhead
Ameiurus nebulosus	Brown bullhead
Anguilla rostrata	American eel
Cyprinodon variegatus	Sheepshead minnow
Erimyzon sucetta	Lake chubsucker
Esox niger	Chain pickerel
Fundulus seminolis	Seminole killifish
Gambusia holbrooki	Eastern mosquitofish
Heterandria formosa	Least killifish
Lepisosteus osseus	Longnose gar
Lepisosteus platyrhincus	Florida gar
Lepomis macrochirus	Bluegill
Lepomis microlophus	Redear sunfish
Lepomis punctatus	Spotted sunfish
Lucania goodei	Bluefin killifish
Lucania parva	Rainwater killifish
Menidia beryllina	Inland silverside
Micropterus salmoides	Largemouth bass
Notemigonus crysoleucas	Golden shiner
Notropis harperi	Redeye chub
Notropis petersoni	Coastal shiner
Poecilia latipinna	Sailfin molly

Table 8. Saltwater fish species captured between July 2007 and June 2010 within the Homosassa River, Florida.

Scientific Name	Common Name
Anchoa mitchilli	Bay anchovy
Archosargus probatocephalus	Sheepshead
Ariopsis felis	Hardhead catfish
Bagre marinus	Gafftopsail catfish
Bairdiella chrysoura	Silver perch
Brevoortia sp.	Menhaden
Caranx hippos	Crevalle jack
Centropomus undecimalis	Common snook
Cynoscion nebulosus	Spotted seatrout
Dasyatis sp.	Stingray
Eugerres plumieri	Striped mojarra
Echeneis sp.	Sharksucker
Elops saurus	Ladyfish
Eucinostomus gula	Silver jenny
Eucinostomus harengulus	Tidewater mojarra
Fundulus confluentus	Marsh killifish
Fundulus grandis	Gulf killifish
Gobiosoma bosc	Naked goby
Lagodon rhomboides	Pinfish
Leiostomus xanthurus	Spot
Lutjanus griseus	Gray snapper
Microgobius gulosus	Clown goby
Mugil cephalus	Striped mullet
Mugil curema	White mullet
Oligoplites saurus	Leatherjacket
Opsanus beta	Gulf toadfish
Pogonias cromis	Black drum
Sciaenops ocellatus	Red drum
Sphyraena barracuda	Barracuda
Strongylura marina	Atlantic needlefish
Strongylura notata	Redfin needlefish
Strongylura timucu	Timucu
Syngnathus scovelli	Gulf pipefish
Synodus foetens	Lizardfish
Trinectes maculatus	Hogchoker

Table 9. Total Numbers of Freshwater Fishes Captured with Seines during August and February 2007 through 2010 within the Chassahowitzka River, Florida. Note: Multiple-pass Depletions were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	August 2007			February 2008			August 2008			February 2009			August 2009		February 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
American eel	0	0	0	0	0	1	0	0	12	0	0	0	0	0	0	0
Bluefin killifish	1,404	57	0	23	19	2	1,963	86	0	52	3	0	91	0	0	0
Florida gar	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Gulf killifish	0	0	0	0	0	0	8	12	0	0	11	29	0	0	0	2
Inland silverside	347	1,383	2,091	0	0	40	537	1,432	15,072	0	0	0	113	683	0	0
Lake chubsucker	19	1	0	0	0	0	14	7	0	1	0	0	0	1	0	0
Largemouth bass	49	4	1	3	6	1	19	12	1	8	7	0	1	1	1	1
Least killifish	0	0	0	0	2	4	0	0	0	0	0	0	0	0	0	0
Longnose gar	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Mosquitofish	6	0	9	0	0	0	0	0	0	0	5	0	0	0	0	0
Notropis spp.	2,069	783	0	1	74	0	1,145	255	19	17	6	0	416	161	0	5
Rainwater killifish	41,150	16,373	454	201	1,051	226	12,714	20,157	1,489	111	109	78	224	2,123	37	113
Redear sunfish	1	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Sailfin molly	0	0	0	0	0	0	0	1	17	0	4	0	0	0	0	0
Seminole killifish	1	0	0	0	0	11	1	55	1	0	0	0	1	1	0	0
Spotted sunfish	102	256	9	8	10	0	1,245	543	45	28	42	0	6	3	0	3

Table 10. Total Numbers of Saltwater Fishes Captured with Seines during August and February 2007 through 2010 within the Chassahowitzka River, Florida. Note: Multiple-pass Depletions were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	August 2007			February 2008			August 2008			February 2009			August 2009		February 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
Bay anchovy	0	0	355	0	0	4	0	0	11	0	0	0	0	0	0	0
Clown goby	109	183	385	0	0	0	5	194	771	1	0	9	7	123	0	1
Goby, unspecified	11	237	68	0	1	66	10	18	0	2	4	0	0	0	0	1
Gray snapper	0	0	6	162	25	1	0	0	0	5	4	0	1	0	3	1
Gulf pipefish	125	40	1	0	8	0	150	121	103	8	7	3	6	40	0	26
Gulf toadfish	0	4	3	0	0	0	0	9	44	1	0	1	0	1	0	0
Hardhead catfish	0	5	1	0	0	0	0	0	12	0	0	0	0	0	0	0
Hogchoker	19	19	87	1	3	9	1	54	190	0	1	5	0	0	8	0
Leatherjacket	0	0	2	0	0	0	0	1	0	0	0	0	0	1	0	0
Lizardfish	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0
Menhaden	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0
Naked goby	0	1	20	0	0	0	1	2	70	0	0	9	0	5	0	0
Pinfish	850	156	66	4	29	142	221	100	101	9	20	167	52	93	8	2
Red drum	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0
Sheepshead	0	0	6	0	0	0	1	1	19	0	0	7	0	0	0	0
Sheepshead minnow	0	0	0	0	0	0	0	26	0	0	1	1	0	15	0	0
Spot	0	3	2	0	0	0	0	0	48	0	0	0	0	0	0	0
Spotted seatrout	0	0	0	0	0	0	0	0	32	0	0	0	0	4	0	0
Stingray	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Striped mullet	0	0	0	0	0	2	0	1	0	0	0	0	0	0	0	0
Strongylura spp.	163	0	10	1	13	58	29	3	0	218	20	2	38	3	45	5
Tidewater mojarra	767	1,954	2,006	30	295	907	554	1,128	2,292	30	293	211	611	887	31	3

Table 11. Total Numbers of Freshwater Fishes Captured with Seines during August and February 2007 through 2010 within the Homosassa River, Florida. Note: Multiple-pass Depletions were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	August 2007			February 2008			August 2008			February 2009			August 2009		February 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
American eel	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0
Bluefin killifish	350	0	0	240	3	0	149	0	0	112	0	0	61	0	0	0
Bluegill	34	9	0	0	0	0	0	3	0	0	0	0	0	0	0	0
Florida gar	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0
Inland silverside	342	172	17	0	29	0	591	395	6,656	14	107	309	895	138	0	0
Largemouth bass	10	17	0	2	0	1	0	0	0	0	0	1	0	0	0	0
Least killifish	0	0	0	13	0	2	0	0	0	0	0	0	0	0	0	0
Longnose gar	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Marsh killifish	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0
Mosquitofish	0	0	0	144	0	107	0	0	0	848	0	0	0	0	0	0
Notropis spp.	0	0	0	0	0	0	6	0	0	0	0	0	1	0	0	0
Rainwater killifish	4,420	280	0	2,913	1,769	257	2,380	183	58	1,324	892	39	1,682	259	121	27
Redear sunfish	9	17	0	0	0	0	2	1	0	0	0	0	0	0	0	0
Sailfin molly	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0
Seminole killifish	22	0	0	4	0	3	1	0	0	0	0	0	0	0	0	0
Spotted sunfish	17	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0

Table 12. Total Numbers of Saltwater Fishes Captured with Seines during August and February 2007 through 2010 within the Homosassa River, Florida. Note: Multiple-pass Depletions were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	August 2007			February 2008			August 2008			February 2009			August 2009		February 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
Bay anchovy	0	0	45	0	0	0	0	0	0	0	846	1	0	0	0	36
Clown goby	253	0	0	0	0	0	580	386	682	39	22	7	105	82	0	14
Flounder	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Goby, unspecified	50	39	48	114	111	184	0	0	190	76	24	0	0	0	0	0
Gray snapper	0	1	2	17	47	1	0	0	1	3	2	4	0	0	1	0
Gulf pipefish	35	0	0	4	13	0	6	7	1	4	11	8	0	0	0	19
Gulf toadfish	0	0	1	0	0	7	0	0	2	0	2	0	0	0	0	0
Hardhead catfish	0	6	0	0	0	0	0	7	1	0	0	0	1	2	0	0
Hogchoker	0	0	4	0	1	0	2	3	0	22	30	1	1	1	9	101
Ladyfish	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Leatherjacket	0	0	2	0	0	0	0	5	0	0	0	0	0	2	0	0
Lizardfish	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Naked goby	71	0	0	0	0	0	77	232	482	66	46	83	27	4	30	23
Pinfish	0	9	114	0	2	31	3	1	75	0	75	36	21	1	1	6
Red drum	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
Sheepshead	0	3	0	0	0	0	0	0	1	0	0	0	0	1	0	0
Sheepshead minnow	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0
Silver jenny	0	0	0	0	0	4	0	0	0	0	3	0	0	0	0	0
Spot	0	0	0	0	0	0	0	0	0	0	203	11	0	0	0	1
Spotted seatrout	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Stingray	0	17	2	0	0	0	0	0	4	0	0	0	1	0	0	0
Striped mullet	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Strongylura spp.	3	0	5	16	0	8	0	4	11	7	55	33	0	2	0	21
Tidewater mojarra	478	720	482	414	450	285	195	511	663	4,399	2,118	1,306	1,189	1,153	585	972

Table 13. Total Numbers of Freshwater Fishes Captured by Electrofishing during August and February 2007 through 2010 within the Chassahowitzka River, Florida. Note: Multiple-pass, Capture-recapture Surveys were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	July 2007			January 2008			July 2008			January 2009			July 2009		January 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
American eel	12	9	1	8	4	3	17	19	17	9	20	2	7	1	2	1
Bluefin killifish	8	1	0	1	0	0	17	4	0	4	0	0	3	2	0	0
Bluegill	1	0	0	0	0	0	7	14	1	0	0	0	4	1	0	0
Florida gar	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Golden shiner	2	0	0	0	0	0	5	6	0	1	1	0	7	0	0	0
Gulf killifish	0	0	0	0	0	0	0	0	1	2	17	38	0	3	0	3
Inland silverside	0	2	0	0	0	1	0	59	24	0	0	3	1	10	0	0
Lake chubsucker	5	15	0	25	3	0	81	73	0	77	12	0	27	8	4	4
Largemouth bass	136	145	1	61	67	5	139	125	2	163	94	3	102	53	16	19
Least killifish	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Longnose gar	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Mosquitofish	20	1	0	1	0	0	6	7	0	0	0	0	3	1	0	1
Notropis spp.	1	0	0	1	0	0	2	3	5	20	16	0	13	5	0	0
Rainwater killifish	19	1	0	0	0	0	34	284	14	16	10	3	15	1	1	8
Redear sunfish	12	4	0	0	1	0	5	5	0	6	2	0	4	0	0	0
Sailfin molly	0	0	0	0	0	0	2	2	3	0	2	9	0	0	0	0
Seminole killifish	4	2	0	1	1	1	1	42	7	11	3	0	0	0	1	1
Spotted sunfish	83	100	0	158	107	0	355	282	2	479	299	0	169	62	103	55
Warmouth	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Yellow bullhead	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 14. Total Numbers of Saltwater Fishes Captured by Electrofishing during August and February 2007 through 2010 within the Chassahowitzka River, Florida. Note: Multiple-pass, Capture-recapture Surveys were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	July 2007			January 2008			July 2008			January 2009			July 2009		January 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
Bay anchovy	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0
Clown goby	0	0	0	0	0	0	0	1	0	2	0	0	1	1	1	0
Common snook	0	4	12	0	0	8	0	0	7	0	0	23	0	3	0	0
Crevalle jack	0	2	0	0	0	2	0	0	0	0	0	4	0	0	0	0
Gray snapper	2	5	5	522	725	228	0	0	38	669	382	10	4	6	109	153
Gulf pipefish	2	2	0	0	0	0	0	9	0	0	0	1	1	0	0	0
Gulf toadfish	0	1	0	0	5	0	0	1	2	0	5	1	0	0	0	3
Hardhead catfish	0	0	0	0	0	3	0	0	7	0	0	11	0	0	0	0
Hogchoker	9	1	0	22	15	1	11	5	0	26	2	1	7	2	17	0
Ladyfish	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	1
Menhaden	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Mugil spp.	50	43	2	0	1	9	0	13	12	2	2	18	8	12	0	10
Naked goby	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Pinfish	123	58	1	113	248	27	273	355	71	130	35	10	147	75	81	10
Red drum	0	0	2	0	0	4	0	0	2	0	0	9	0	0	0	0
Sheepshead	0	1	0	0	3	1	0	2	7	32	34	22	3	3	1	4
Sheepshead minnow	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0
Silver jenny	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Silver perch	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Spot	0	0	0	0	0	15	0	0	29	0	0	0	1	0	0	0
Spotted seatrout	0	0	0	0	0	4	0	0	3	0	0	6	0	0	0	0
Strongylura spp.	1	0	0	12	4	7	1	1	3	23	7	8	1	3	23	0
Tidewater mojarra	6	24	0	134	574	179	6	13	34	349	281	565	9	10	110	34

Table 15. Total Numbers of Freshwater Fishes Captured by Electrofishing during August and February 2007 through 2010 within the Homosassa River, Florida. Note: Multiple-pass, Capture-recapture Surveys were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	July 2007			January 2008			July 2008			January 2009			July 2009		January 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
American eel	43	28	3	20	8	0	29	15	3	28	7	1	7	3	2	2
Bluefin killifish	5	0	0	2	0	0	48	0	0	10	0	0	12	0	0	0
Bluegill	90	18	0	1	19	0	56	15	0	27	9	0	13	1	12	1
Brown bullhead	3	0	0	0	0	0	4	1	0	0	0	0	0	0	1	0
Chain pickerel	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
Florida gar	66	28	4	17	5	3	18	9	4	22	17	3	5	2	5	3
Golden shiner	23	0	0	0	0	0	45	0	0	0	0	0	49	0	0	0
Gulf killifish	0	0	0	0	1	0	0	0	0	0	1	4	0	0	1	0
Inland silverside	16	13	0	0	0	0	3	32	3	20	5	4	13	1	0	4
Lake chubsucker	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Least killifish	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0
Longnose gar	3	0	2	0	0	0	0	4	0	0	2	0	1	0	0	0
Largemouth bass	252	53	16	39	33	4	369	73	5	42	13	2	145	12	23	3
Mosquitofish	13	0	0	2	0	0	26	0	0	41	0	0	29	1	8	0
Notropis spp.	4	0	0	0	0	0	19	4	0	0	0	0	1	0	0	0
Rainwater killifish	4	0	0	6	4	0	48	8	0	40	1	0	18	1	1	0
Redear sunfish	22	4	0	2	4	0	32	2	1	13	0	0	1	4	2	0
Sailfin molly	0	0	0	0	0	0	4	0	1	27	0	0	2	0	38	10
Seminole killifish	3	2	0	4	8	0	7	5	2	2	1	0	3	13	4	0
Spotted sunfish	145	19	20	17	34	14	203	36	2	142	18	1	45	2	108	1
Warmouth	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Yellow bullhead	9	1	0	3	1	0	1	0	0	2	0	0	1	0	1	1

Table 16. Total Numbers of Saltwater Fishes Captured by Electrofishing during August and February 2007 through 2010 within the Homosassa River, Florida. Note: Multiple-pass, Capture-recapture Surveys were Conducted in Reaches 1-3 during Years 1 and 2, and Single-pass Surveys were Conducted in Reaches 1 and 2 during Year 3.

	July 2007			January 2008			July 2008			January 2009			July 2009		January 2010	
Species	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 3	Reach 1	Reach 2	Reach 1	Reach 2
Bay anchovy	0	0	0	0	0	1	0	0	2	0	176	0	0	0	0	86
Barracuda	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Black drum	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0
Clown goby	0	1	0	2	0	0	17	2	0	8	0	0	2	0	0	0
Common snook	1	10	2	6	1	1	1	42	5	1	144	15	0	7	6	0
Crevalle jack	0	0	0	1	11	0	0	0	0	0	3	3	0	0	0	0
Flounder	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Gafftopsail catfish	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray snapper	7	2	1	2102	316	111	5	8	17	288	133	33	29	20	319	60
Gulf pipefish	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
Gulf toadfish	0	3	4	0	0	2	0	0	2	0	0	1	0	0	0	0
Hardhead catfish	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	0
Hogchoker	7	0	1	0	0	0	11	5	0	1	0	0	10	3	1	1
Ladyfish	0	0	1	0	4	0	0	6	0	0	0	0	0	0	1	10
Leatherjacket	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
Menhaden	0	0	1	0	0	0	0	39	8	0	0	0	0	0	0	0
Mugil spp.	5	29	22	22	67	40	3	196	77	10	102	100	91	14	1	5
Naked goby	0	0	0	0	0	0	0	0	0	4	0	0	1	1	1	0
Pinfish	36	5	1	1	2	12	39	42	73	26	3	0	65	13	9	7
Stingray	1	2	0	2	0	0	0	1	1	0	0	0	2	0	0	0
Red drum	0	3	0	2	13	6	0	14	2	1	14	0	0	7	0	0
Sheepshead	0	7	2	4	8	10	7	59	5	19	24	16	1	11	4	2
Sheepshead minnow	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Silver perch	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Spot	0	0	0	0	0	0	0	0	3	0	0	0	2	1	0	0
Spotted seatrout	0	0	0	0	2	0	0	4	8	0	0	4	0	0	0	0
Striped mojarra	0	0	0	0	0	0	0	0	0	3	0	0	0	0	1	0
Sharksucker	0	0	0	2	1	0	1	0	0	0	0	1	0	0	4	0
Strongylura spp.	24	2	2	17	22	5	10	6	3	6	51	5	4	0	12	7
Tidewater mojarra	55	6	1	200	301	188	64	393	74	934	648	236	37	26	386	529

Table 17. Summary Table of Fishes Marked (M) and Recaptured (R) Fishes (> 150 mm in Total Length) during Electrofishing within the Chassahowitzka (CHA) and Homosassa (HOM) Rivers. BLUE=Bluegill, BULL=Brown and Yellow Bullhead, COSN=Common Snook, FGAR=Florida Gar, GRSN=Gray Snapper, LACH=Lake Chubsucker, LMB=Largemouth Bass, PIN=Pinfish, REDR=Red Drum, RESU=Redear Sunfish, SHEE=Sheepshead, SPSU=Spotted Sunfish, STMU=Striped Mullet, SALT=Total Saltwater Fishes, FRESH=Total Freshwater Fishes, TOTAL=All Fishes.

		BLUE		BULL		COSN		FGAR		GRSN		LACH		LMB		PIN		REDR		RESU		SHEE		SPSU		STMU		SALT		FRESH		TOTAL	
River	Date	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R
CHA	7/10/2007	0	0	1	0	2	0	0	0	2	0	2	0	112	0	6	0	0	0	7	0	0	0	20	0	19	0	29	0	142	0	171	0
	7/11/2007	0	0	0	0	6	0	0	0	0	0	3	1	33	4	0	0	0	0	3	0	0	0	6	0	40	1	46	1	45	5	91	6
	7/12/2007	0	0	0	0	8	0	0	0	1	0	4	0	94	10	6	0	1	0	5	0	1	0	20	0	25	0	44	0	124	10	168	10
	1/8/2008	0	0	0	0	1	0	0	0	268	0	14	0	35	0	1	0	1	0	0	0	0	0	16	0	6	0	277	0	65	0	342	0
	1/9/2008	0	0	0	0	6	0	0	0	590	4	5	0	27	4	0	0	0	0	0	0	0	0	15	1	2	0	600	4	47	5	647	9
	1/10/2008	0	0	0	0	1	0	0	0	0	24	1	2	36	7	0	0	3	0	1	0	1	0	5	2	1	0	10	24	43	11	53	35
	7/7/2008	1	0	0	0	2	0	0	0	8	0	15	0	58	0	58	0	0	0	4	0	0	0	18	0	8	0	76	0	96	0	172	0
	7/8/2008	1	0	0	0	0	0	0	0	0	0	13	3	45	4	46	3	0	0	0	0	0	0	15	2	10	0	57	3	74	9	131	12
	7/9/2008	1	0	0	0	1	0	0	0	0	0	7	1	34	6	30	1	2	0	3	0	0	0	14	0	2	0	35	1	59	7	94	8
	7/10/2008	0	0	0	0	0	0	0	0	0	0	0	3	4	9	0	0	0	0	0	0	0	0	0	2	0	0	0	0	4	14	4	14
	1/11/2009	0	0	0	0	18	0	0	0	224	0	14	0	60	0	0	0	0	0	4	0	2	0	22	0	13	0	266	0	100	0	366	0
	1/12/2009	0	0	0	0	1	0	0	0	134	13	22	1	48	4	0	0	8	0	2	0	1	0	22	1	5	1	163	14	94	6	257	20
	1/13/2009	0	0	0	0	0	0	0	0	0	9	0	4	2	7	0	0	0	0	0	0	0	0	0	8	0	0	0	9	2	19	2	28
HOM	7/16/2007	3	0	5	0	6	0	39	0	1	0	0	0	47	0	0	0	2	0	6	0	2	0	4	0	10	0	22	0	108	0	130	0
	7/17/2007	10	1	3	1	6	0	28	7	2	0	0	0	40	3	0	0	0	0	6	1	3	0	2	0	16	0	28	0	90	13	118	13
	7/18/2007	12	2	3	1	1	0	11	10	3	1	0	0	50	9	0	0	0	0	6	3	1	0	4	0	17	0	22	1	86	25	108	26
	1/15/2008	0	0	1	0	1	0	10	0	565	0	0	0	19	0	0	0	3	0	2	0	3	0	4	0	31	0	609	0	36	0	645	0
	1/16/2008	0	0	1	0	1	0	8	0	683	11	0	0	15	0	0	0	8	1	1	0	4	0	3	0	20	0	716	12	28	0	744	12
	1/17/2008	3	0	2	0	5	0	2	0	0	33	0	0	36	2	0	0	7	1	1	0	12	1	3	0	67	0	95	35	47	2	142	37
	7/14/2008	2	0	1	0	20	0	7	0	4	0	0	0	26	0	0	0	5	0	0	0	18	0	3	0	62	0	124	0	40	0	164	0
	7/15/2008	1	0	0	0	9	1	6	0	1	0	0	0	28	5	1	0	1	0	0	0	10	1	2	0	64	3	86	5	37	5	123	10
	7/16/2008	2	0	2	0	9	4	7	0	15	0	0	0	38	9	2	0	7	1	2	0	11	3	3	2	48	4	101	12	54	11	155	23
	7/17/2008	0	0	0	0	0	0	1	0	0	0	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	6	0	7	1	3	1	10
	1/5/2009	0	0	2	0	60	0	13	0	84	0	0	0	10	0	0	0	7	0	0	0	12	0	1	0	72	0	239	0	26	0	265	0
	1/6/2009	0	0	0	0	40	6	13	1	62	5	0	0	9	1	0	0	1	1	2	0	8	1	2	0	50	3	163	16	26	2	189	18
	1/7/2009	0	0	0	0	0	4	1	4	0	10	0	0	3	3	0	0	0	3	0	0	0	4	0	0	0	3	0	24	4	7	4	31

Table 18. Summary Table of Fishes Marked (M) and Recaptured (R) Fishes (between 50 and 149 mm in Total Length) during Electrofishing within the Chassahowitzka (CHA) and Homosassa (HOM) Rivers. BLUE=Bluegill, FUND=*Fundulus* spp., GRSN=Gray Snapper, LACH=Lake Chubsucker, LMB=Largemouth Bass, MOJA=Tidewater Mojarra, PIN=Pinfish, SHEE=Sheepshead, SPSU=Spotted Sunfish.

		BLUE		FUND		GRSN		LACH		LMB		MOJA		PIN		SHEE		SPSU		SALT		FRESH		TOTAL	
River	Date	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R	M	R
CHA	7/10/2007	0	0	0	0	0	0	0	0	1	0	0	0	5	0	0	0	33	0	5	0	34	0	39	0
	7/11/2007	0	0	0	0	1	0	0	0	3	0	1	0	12	0	0	0	13	0	14	0	16	0	30	0
	7/12/2007	0	0	2	0	2	0	0	0	10	0	5	0	61	1	0	0	46	0	69	1	59	0	128	1
	1/8/2008	0	0	0	0	31	0	0	0	0	0	84	0	41	1	0	0	24	0	156	1	24	0	180	1
	1/9/2008	0	0	0	0	67	0	0	0	6	0	198	3	63	3	0	0	43	2	329	6	49	2	378	8
	1/10/2008	0	0	0	0	1	4	0	0	0	0	0	3	0	0	0	0	17	3	1	7	17	3	18	10
	7/7/2008	0	0	0	0	3	0	4	0	1	0	0	0	39	0	0	0	62	0	52	0	67	0	119	0
	7/8/2008	0	0	12	0	0	0	15	0	5	0	0	0	78	0	1	0	80	1	79	0	115	1	194	1
	7/9/2008	0	0	4	0	0	0	15	0	3	0	1	0	81	0	1	0	89	0	85	0	117	0	202	0
	7/10/2008	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0	5	0	1	0	6	0	7
	1/11/2009	0	0	3	0	140	0	12	0	8	0	477	0	24	0	6	0	161	0	662	0	185	0	847	0
	1/12/2009	0	0	27	1	147	7	10	1	23	0	301	3	39	0	22	0	206	4	515	10	266	6	781	16
	1/13/2009	0	0	0	1	0	22	0	2	0	3	0	6	0	0	0	1	0	15	0	29	0	21	0	50
HOM	7/16/2007	6	0	0	0	0	0	0	0	9	0	1	0	1	0	0	0	12	0	2	0	27	0	29	0
	7/17/2007	14	0	0	0	0	0	0	0	37	0	8	0	2	0	0	0	39	0	10	0	90	0	100	0
	7/18/2007	28	3	1	0	1	0	1	0	73	1	33	0	15	0	0	0	68	4	51	0	173	8	224	8
	1/15/2008	0	0	0	0	17	0	0	0	0	0	179	0	0	0	0	0	5	0	198	0	5	0	203	0
	1/16/2008	10	0	1	0	30	2	0	0	1	0	204	1	7	0	1	0	14	0	242	3	26	0	268	3
	1/17/2008	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	0	0	0	4	1	0	1	4
	7/14/2008	1	0	0	0	0	0	0	0	26	0	28	0	1	0	0	0	2	0	49	0	31	0	80	0
	7/15/2008	5	0	0	0	0	0	0	0	38	0	76	0	9	0	1	0	11	0	89	0	66	0	155	0
	7/16/2008	3	0	5	0	1	0	0	0	84	3	74	0	6	0	0	0	48	0	106	0	142	3	248	3
	7/17/2008	0	0	0	0	0	0	0	0	0	5	0	1	0	0	0	0	0	10	0	1	0	15	0	16
	1/5/2009	0	0	0	0	49	0	0	0	0	0	190	0	1	0	1	0	23	0	241	0	27	0	268	0
	1/6/2009	3	0	1	0	30	2	0	0	1	0	180	0	0	0	0	0	29	0	215	3	42	0	257	3
	1/7/2009	0	0	0	0	0	5	0	0	0	0	0	2	0	0	0	0	0	1	0	7	0	1	0	8

Table 19. Electrofishing catchability estimates of fishes marked and recaptured during multiple-pass sampling events within the Chassahowitzka and Homosassa Rivers. The sample size (n), mean catchability (q), and 95th lower (95%LL) and upper (95%UL) quantiles around the mean are listed. Effort was measured in hours of electrofishing and area was measured in square kilometers. Note that electrofishing probability of capture can be calculated by multiplying q by the effort (hours) applied to a reach and dividing by the area (square-kilometers) of the reach (Equation 8 in Table 1).

Taxa	n	q	95%LL	95%UL
Lake chubsucker	9	0.0025	0.0015	0.0039
Lepomis spp.	28	0.0015	0.0011	0.0019
Largemouth bass	35	0.0025	0.0020	0.0030
Florida gar	5	0.0141	0.0091	0.0202
Yellow bullhead	2	0.0085	0.0012	0.0239
All Freshwater Large-bodied Fishes	81	0.0022	0.0019	0.0025
Striped Mullet	8	0.0065	0.0039	0.0098
Pinfish	7	0.0011	0.0005	0.0021
Tidewater mojarra	13	0.0006	0.0003	0.0009
Gray snapper	27	0.0015	0.0013	0.0018
Sheepshead	6	0.0178	0.0086	0.0308
Common snook	5	0.0094	0.0052	0.0153
Red drum	6	0.0294	0.0131	0.0517
All Saltwater Large-bodied Fishes	73	0.0015	0.0013	0.0018

Table 20. Seine catchability estimates of fishes captured during multiple-pass removal sampling events within the Chassahowitzka and Homosassa Rivers. The sample size (n), mean catchability (q), and 95th lower (95%LL) and upper (95%UL) quantiles around the mean are listed. Effort and site area were measured in square meters. Note that the probability of capture is equal to the estimated catchability since effort was equal to the site area (Equation 8 in Table 1).

Taxa	n	q	95%LL	95%UL
Blue crab	45	0.365	0.296	0.428
Tidewater mojarra	66	0.739	0.732	0.746
Fundulus spp.	15	0.739	0.659	0.805
Clown/naked goby	61	0.214	0.185	0.239
Pinfish	47	0.406	0.378	0.433
Lepomis spp.	33	0.497	0.468	0.524
Lucania spp.	65	0.409	0.404	0.413
Inland silverside	41	0.873	0.869	0.878
Notropis spp.	17	0.462	0.443	0.481
Strongylura spp.	36	0.774	0.741	0.806
Gulf pipefish	36	0.261	0.192	0.323
Hogchoker	32	0.488	0.423	0.545
Freshwater Small-bodied Fishes	67	0.486	0.482	0.49
Saltwater Small-bodied Fishes	63	0.614	0.607	0.62

Table 21. Basic Inputs Parameters for the Ecopath Trophic Mass Balance Model of the Chassahowitzka River.

Group name	Habitat area (fraction)	Biomass (g/100m2)	P/B (annual)	Q/B (annual)
Common Snook	1	15	1.5	4.0
Red Drum	1	1	1.0	3.0
Gray Snapper	1	1050	2.5	40.0
Catfish	1	10	0.8	7.6
Sheepshead	1	1	1.0	3.0
Pinfish	1	160	1.0	8.0
Striped Mullet	1	131	0.8	8.0
Florida Gar	1	1	0.5	5.0
American Eel	1	42	0.5	5.0
Largemouth Bass Adults	1	510	1.0	5.0
Largemouth Bass Juveniles	1	121	5.0	18.2
Lepomis Adults	1	205	1.0	5.0
Lepomis Juveniles	1	122	6.0	16.9
Lake Chubsucker Adults	1	45	1.0	20.0
Lake Chubsucker Juveniles	1	38	6.0	59.7
SW Small-bodied Fishes	1	890	2.8	15.0
FW Small-bodied Fishes	1	800	2.8	15.0
Blue Crabs	1	1520	3.0	8.5
Crayfish	1	2270	2.5	8.5
Mud Crabs	1	2050	4.0	12.0
Shrimp	1	535	2.4	20.0
Amphipods	1	2350	9.0	20.0
Vegetative Inverts	1	850	20.0	40.0
Benthic Inverts	1	250	42.0	85.0
Gulf Foodbase	1	40000	1.0	NA
Periphyton	1	29150	10.0	NA
Filamentous Algae	1	53150	20.0	NA
Plants	1	116500	9.0	NA
Sediment Diatoms	1	26200	100.0	NA
Detritus	1	30000	NA	NA

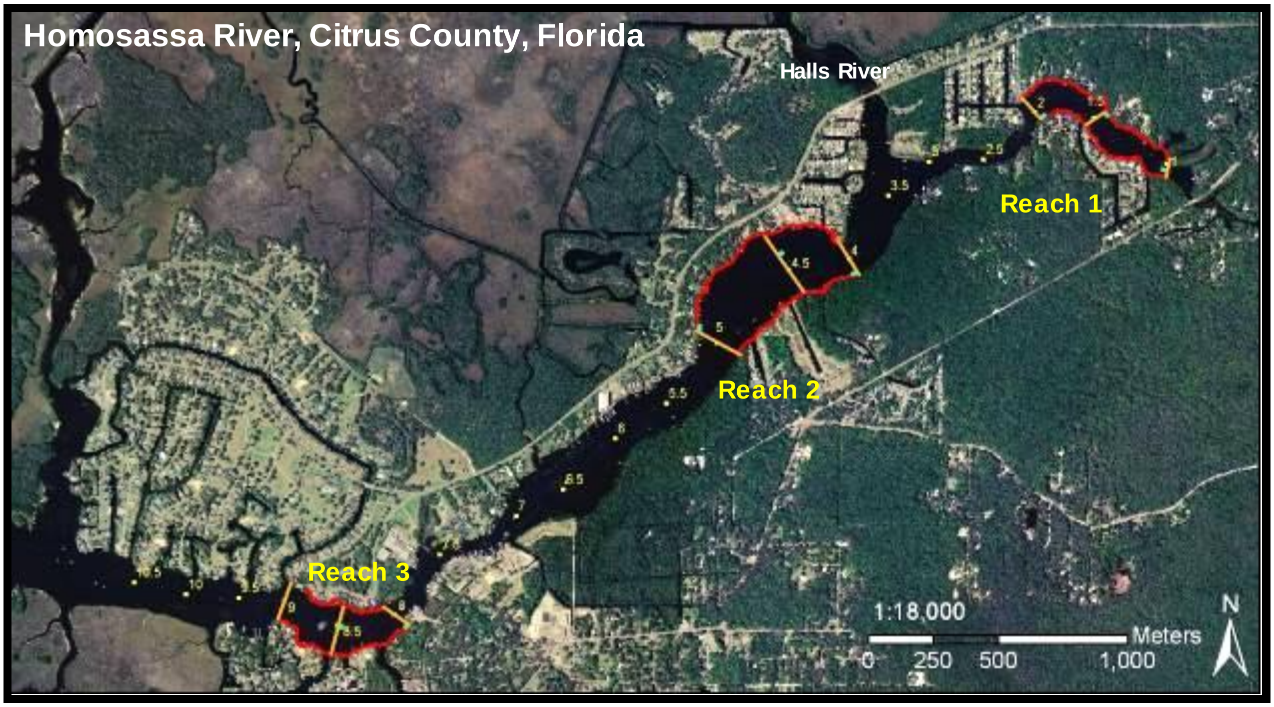
Table 22. Diet Composition Matrix for Ecopath Trophic Mass Balance Model of the Chassahowitzka River.

	Prey \ Predator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	Common Snook																								
2	Red Drum																								
3	Gray Snapper	0.065									0.080														
4	Catfish																								
5	Sheepshead																								
6	Pinfish	0.020									0.050														
7	Striped Mullet	0.005							0.100																
8	Florida Gar																								
9	American Eel																								
10	Largemouth Bass Adults																								
11	Largemouth Bass Juveniles										0.020														
12	Lepomis Adults	0.035	0.005								0.026														
13	Lepomis Juveniles	0.035	0.005								0.026	0.019													
14	Lake Chubsucker Adults										0.006														
15	Lake Chubsucker Juveniles										0.006														
16	SW Small-bodied Fishes	0.271	0.278	0.039	0.100				0.150		0.148	0.204													
17	FW Small-bodied Fishes	0.030	0.010	0.020					0.400	0.010	0.100	0.487		0.035											
18	Blue Crabs	0.025	0.075	0.057		0.014	0.001		0.250	0.115	0.080		0.036				0.069	0.019							
19	Crayfish		0.005	0.035			0.021		0.070	0.433	0.418	0.039	0.056	0.017			0.028								
20	Mud Crabs	0.010	0.075	0.173		0.034	0.012			0.336	0.020	0.048	0.127	0.052				0.028							
21	Shrimp	0.005	0.014	0.011	0.400		0.001		0.020		0.020	0.097	0.018	0.017			0.004								
22	Amphipods		0.024	0.162		0.060	0.085			0.049		0.095	0.235	0.282	0.351	0.207	0.256	0.641							
23	Vegetative Inverts		0.005	0.004		0.019	0.025		0.010	0.029		0.010	0.472	0.495			0.037	0.293	0.167	0.400		0.100			
24	Benthic Inverts		0.005			0.374	0.014	0.010		0.029			0.056	0.102	0.098	0.119	0.107	0.019	0.167	0.100	0.100	0.100			
25	Gulf Foodbase	0.500	0.500	0.500	0.500	0.500	0.500	0.500									0.500		0.500						
26	Periphyton														0.539	0.661						0.300	0.050	0.500	
27	Filamentous Algae							0.190							0.012	0.013					0.800	0.300	0.950	0.400	
28	Plants						0.340																	0.100	
29	Detritus							0.300											0.167	0.500	0.100	0.200			1.000

Table 23. Detritus Fate Matrix for Ecopath Trophic Mass Balance Model of the Chassahowitzka River.

Source \ Fate	Detritus	Export	Sum
Common Snook	0	1	1
Red Drum	0	1	1
Gray Snapper	0	1	1
Catfish	0	1	1
Sheepshead	0	1	1
Pinfish	0	1	1
Striped Mullet	0	1	1
Florida Gar	1	0	1
American Eel	1	0	1
Largemouth Bass Adults	1	0	1
Largemouth Bass Juveniles	1	0	1
Lepomis Adults	1	0	1
Lepomis Juveniles	1	0	1
Lake Chubsucker Adults	1	0	1
Lake Chubsucker Juveniles	1	0	1
SW Small-bodied Fishes	0	1	1
FW Small-bodied Fishes	1	0	1
Blue Crabs	1	0	1
Crayfish	1	0	1
Mud Crabs	1	0	1
Shrimp	1	0	1
Amphipods	1	0	1
Vegetative Inverts	1	0	1
Benthic Inverts	1	0	1
Gulf Foodbase	0	1	1
Periphyton	1	0	1
Filamentous Algae	1	0	1
Plants	1	0	1
Detritus	0	1	1

APPENDIX C
REPORT FIGURES



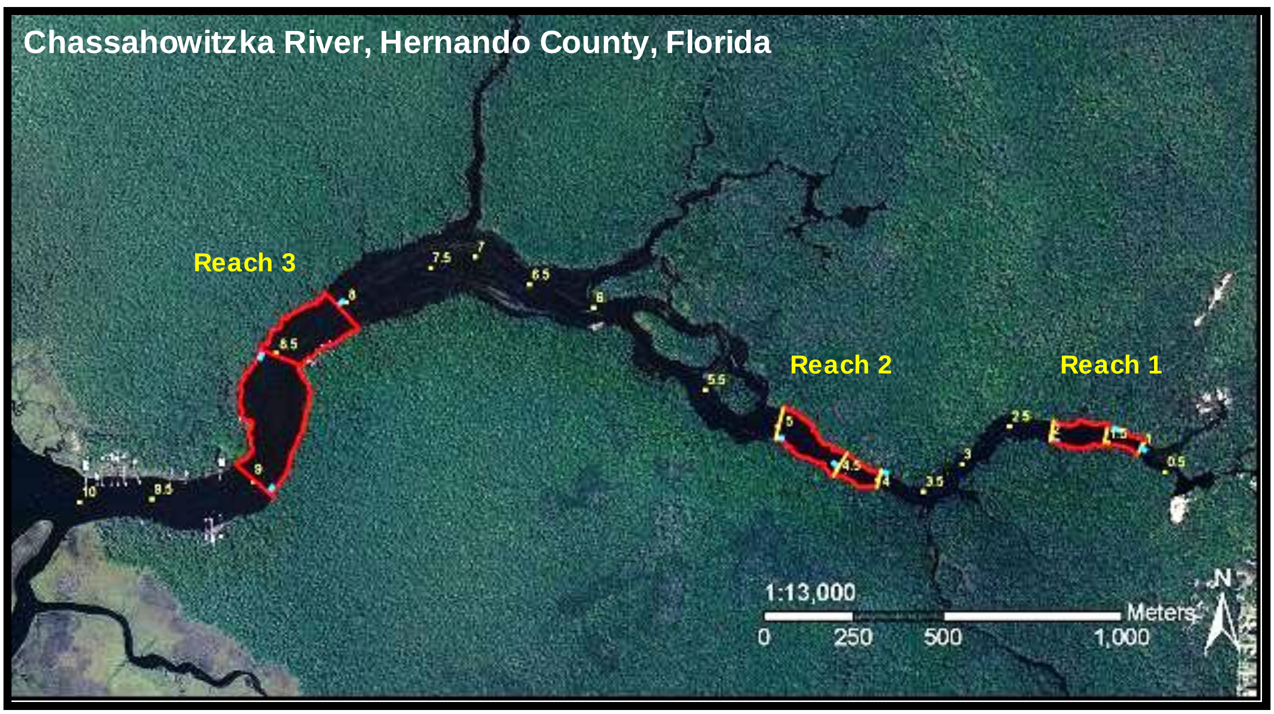


Figure 1. Homosassa and Chassahowitzka rivers study reaches. Long-term water quality and submersed aquatic vegetation transect locations are denoted (yellow points), along with invertebrate sampling and mid-stream electrofishing transects (orange lines), shoreline electrofishing transects (red lines), and seine depletion sites (blue rectangles).

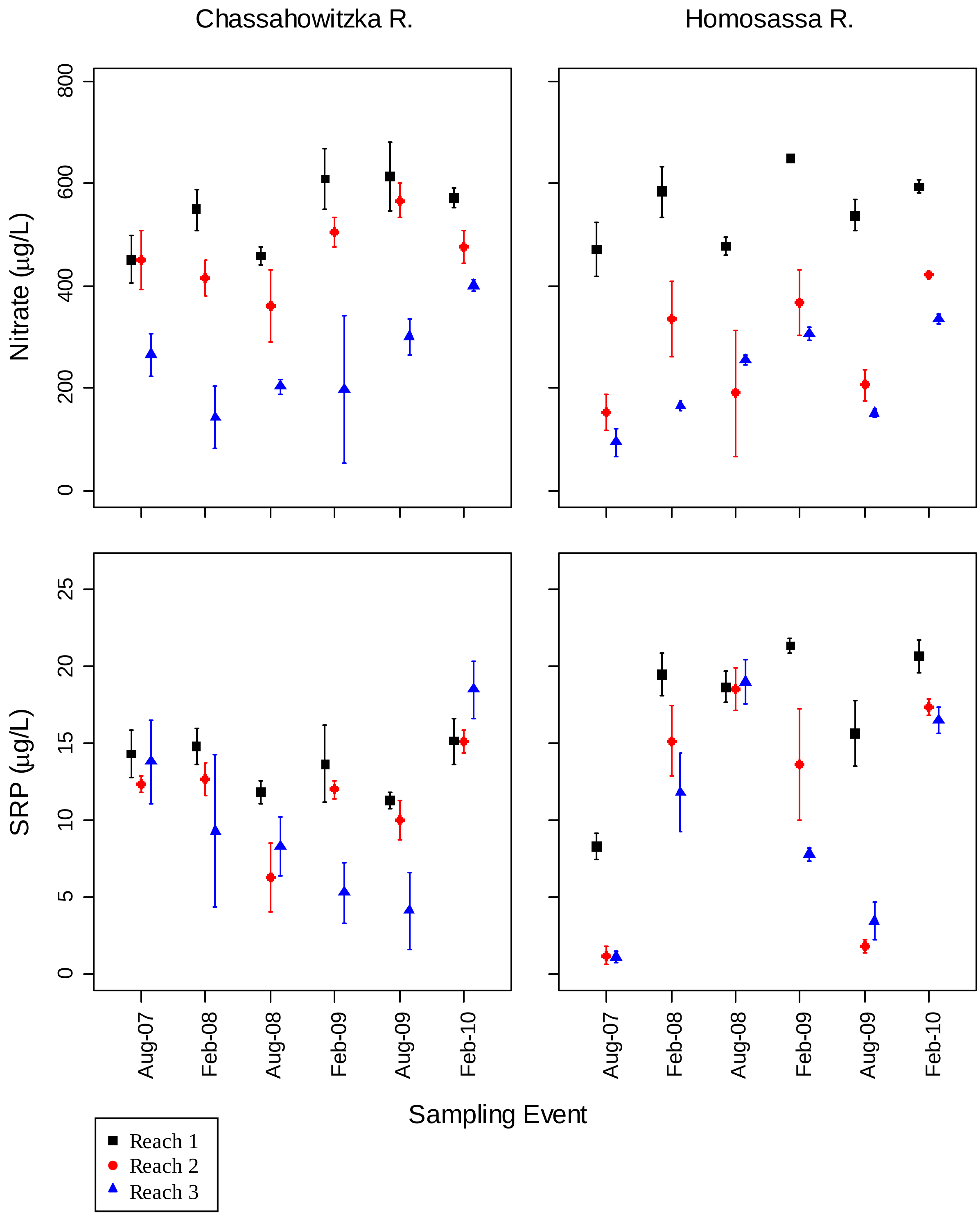


Figure 2. Average concentration of nitrate (upper panels) and soluble reactive phosphorus (SRP) (lower panels) in the Chassahowitzka and Homosassa rivers during August 2007 through February 2010. Error bars represent one standard deviation.

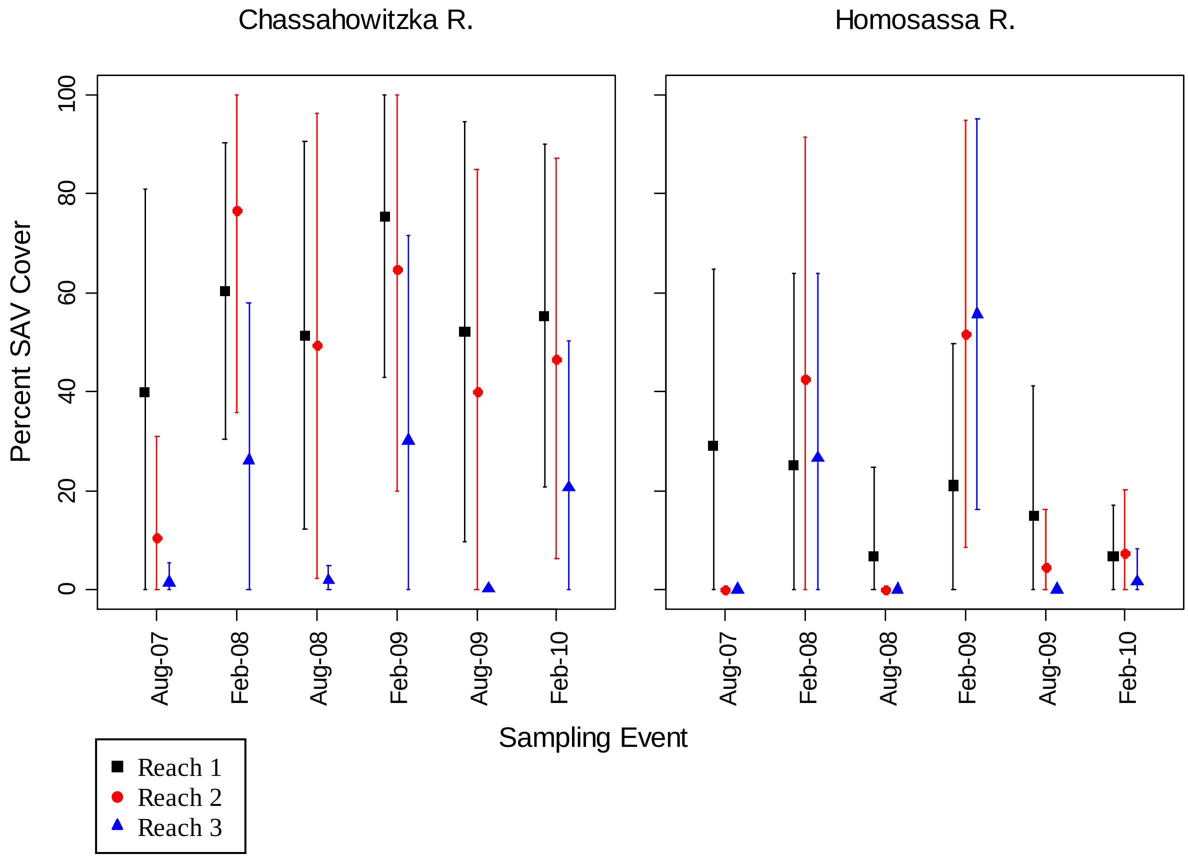


Figure 3. Average percent cover of submersed aquatic vegetation (vascular plants and filamentous algae) within the Homosassa and Chassahowitzka rivers during August 2007 through February 2010 (n=15 samples per reach in each river). Error bars represent one standard deviation.

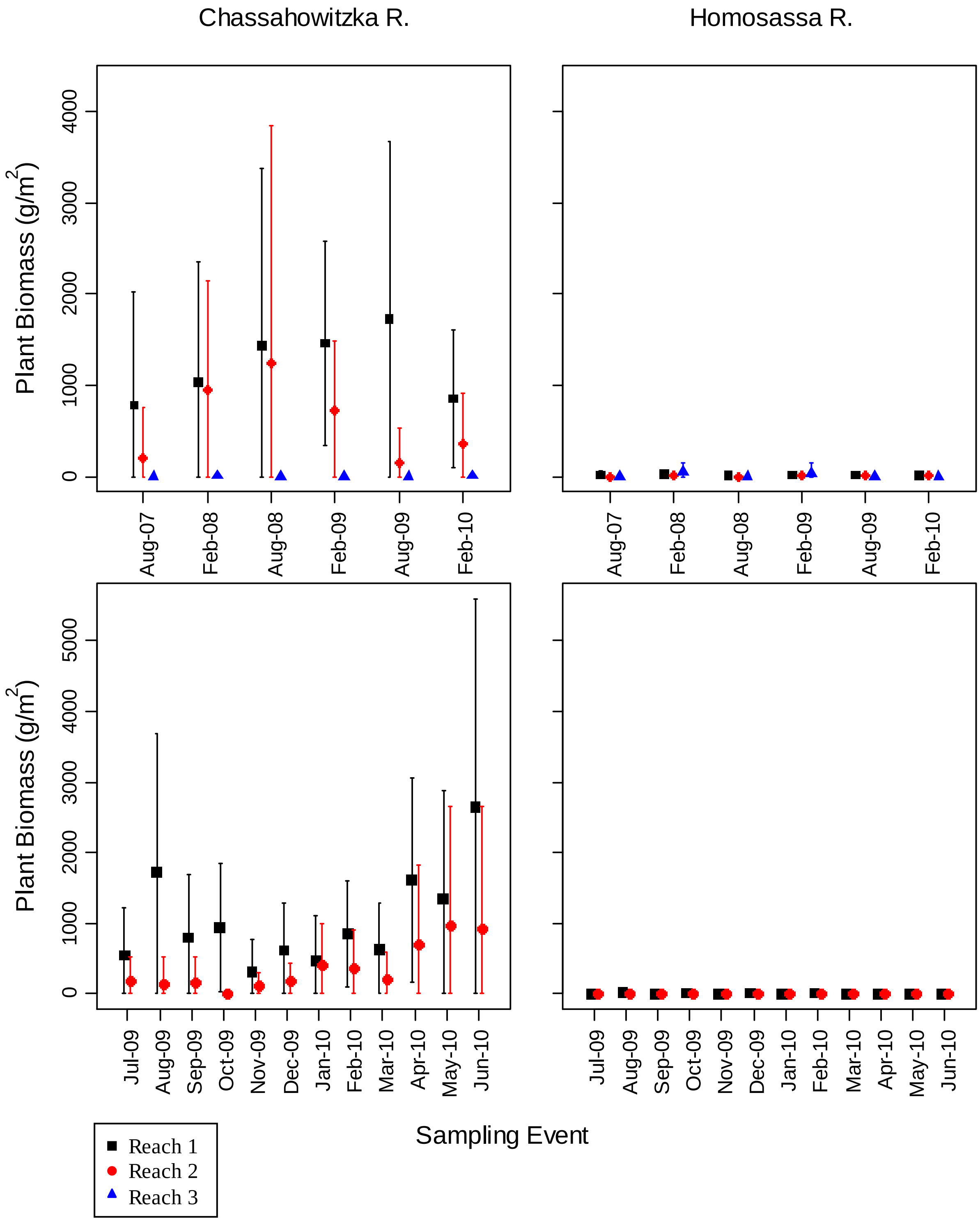


Figure 4. Average biomass (mean wet weight per meter-squared plus/minus standard deviation) of vascular plants within the Homosassa and Chassahowitzka rivers during August 2007 through June 2010 (n=15 samples per reach in each river). Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

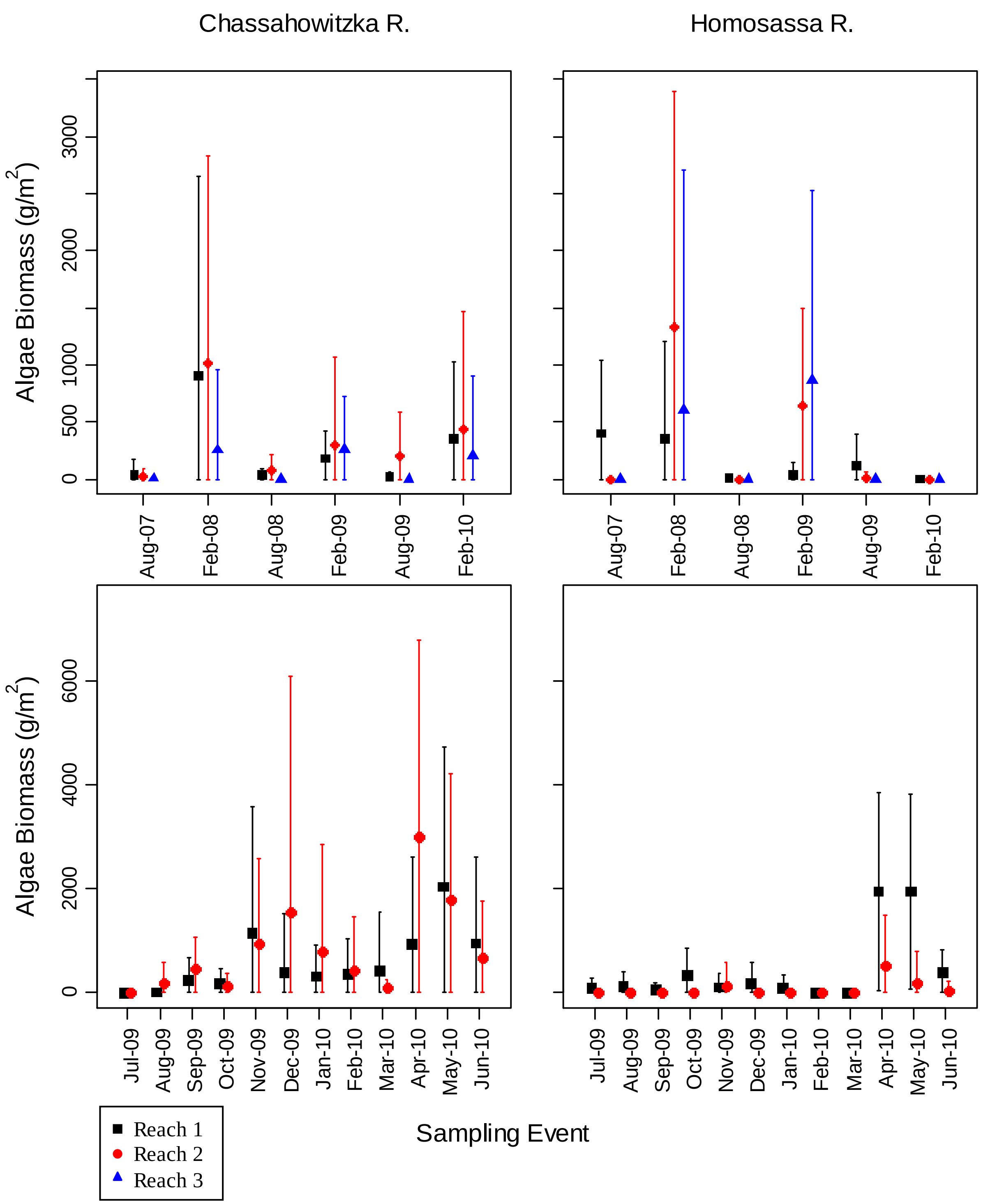


Figure 5. Average biomass (mean wet weight per meter-squared plus/minus standard deviation) of filamentous algae within the Homosassa and Chassahowitzka rivers during August 2007 through June 2010 (n=15 samples per reach in each river). Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

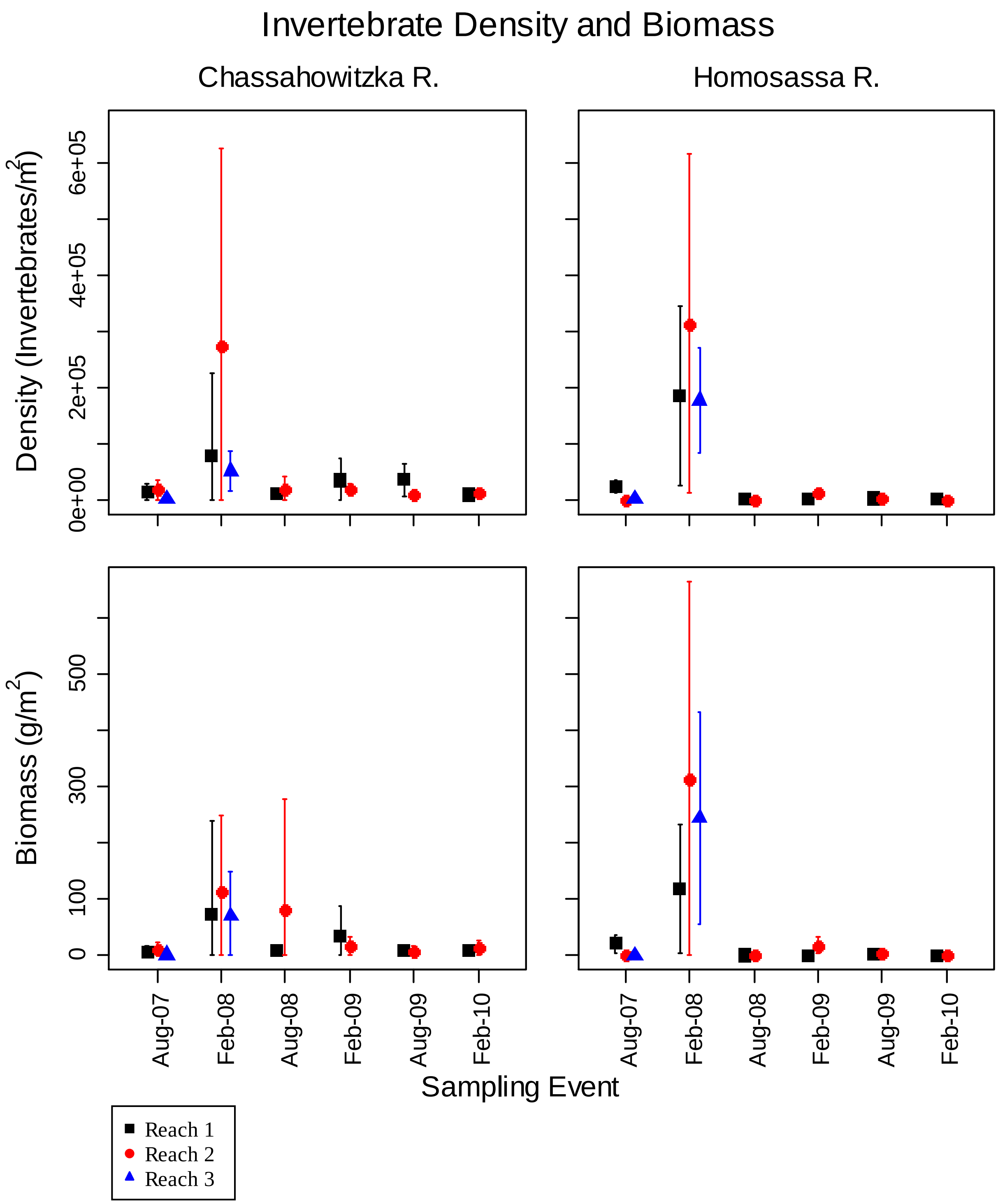


Figure 6. Average total density (upper panels) and biomass (lower panels) of common invertebrates associated with submersed aquatic vegetation, including amphipods, gastropods, insects, isopods, and tanaids collected within the Homosassa and Chassahowitzka rivers during August 2007 through February 2010. Error bars represent one standard deviation.

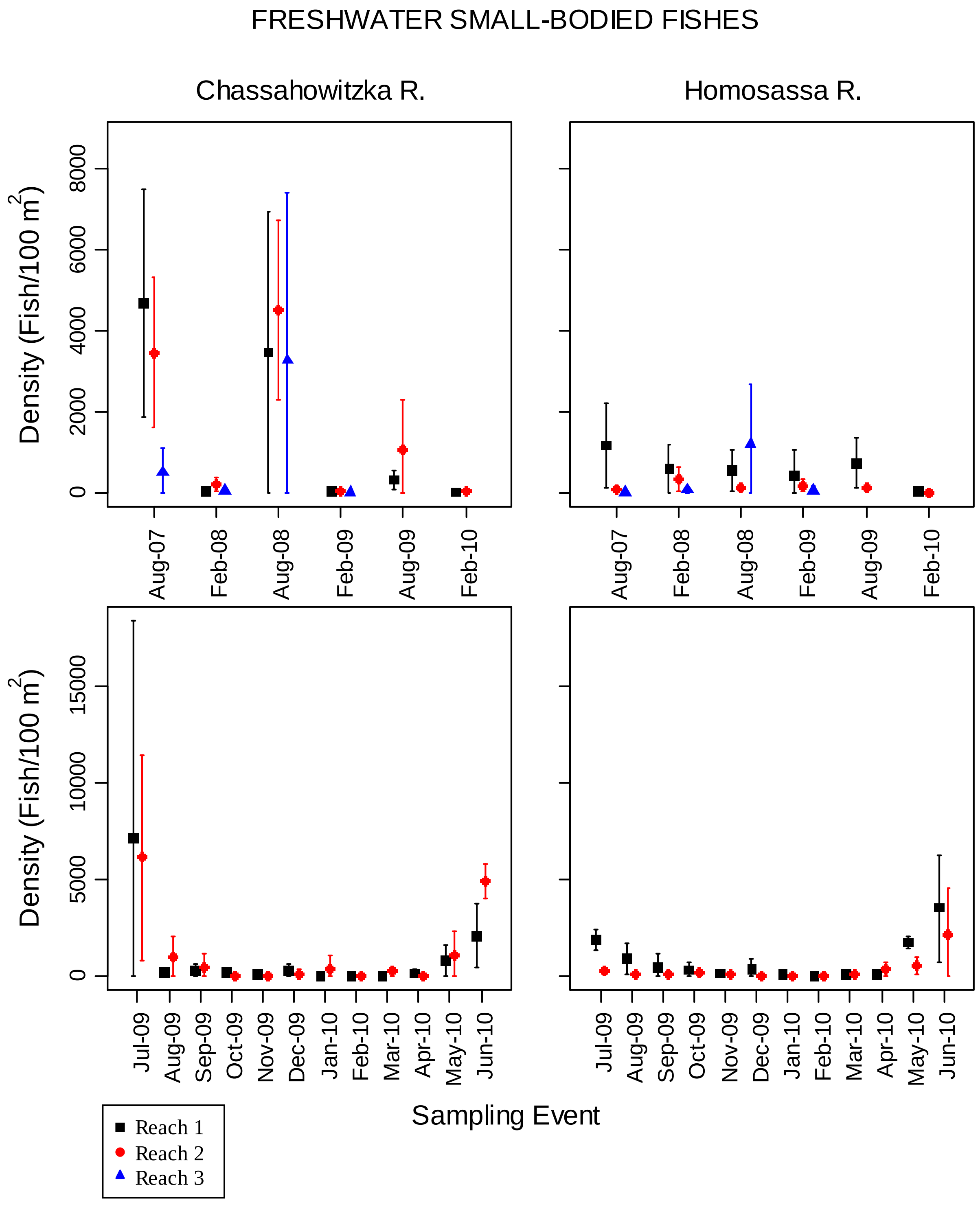


Figure 7. Average density of freshwater small-bodied fishes collected at seine depletion sites within the Homosassa and Chassahowitzka rivers. Error bars represent one standard deviation.

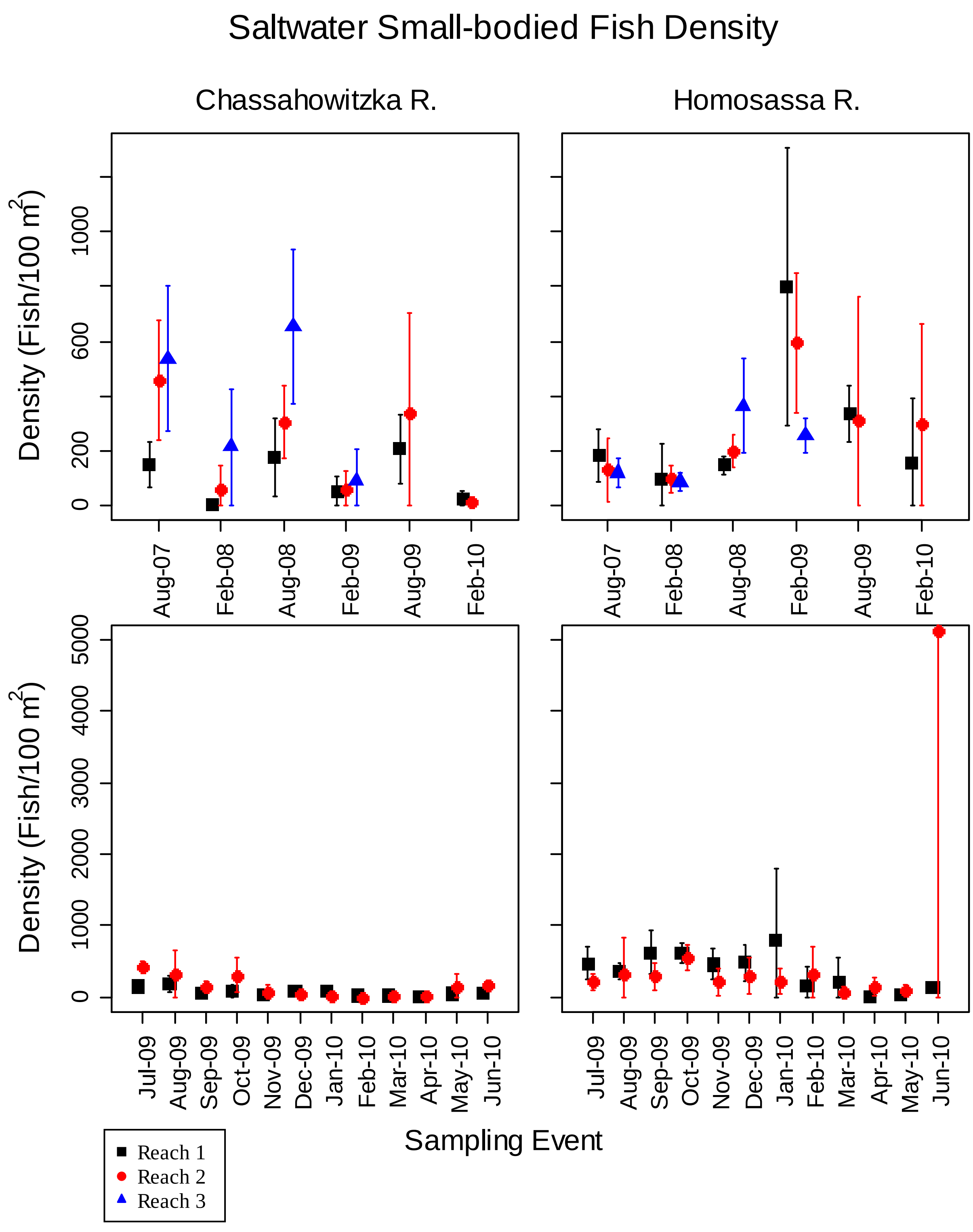


Figure 8. Average density of saltwater small-bodied fishes collected at seine depletion sites within the Homosassa and Chassahowitzka rivers. Error bars represent one standard deviation (upper limit for June 2010 in the Homosassa River = 10,395).

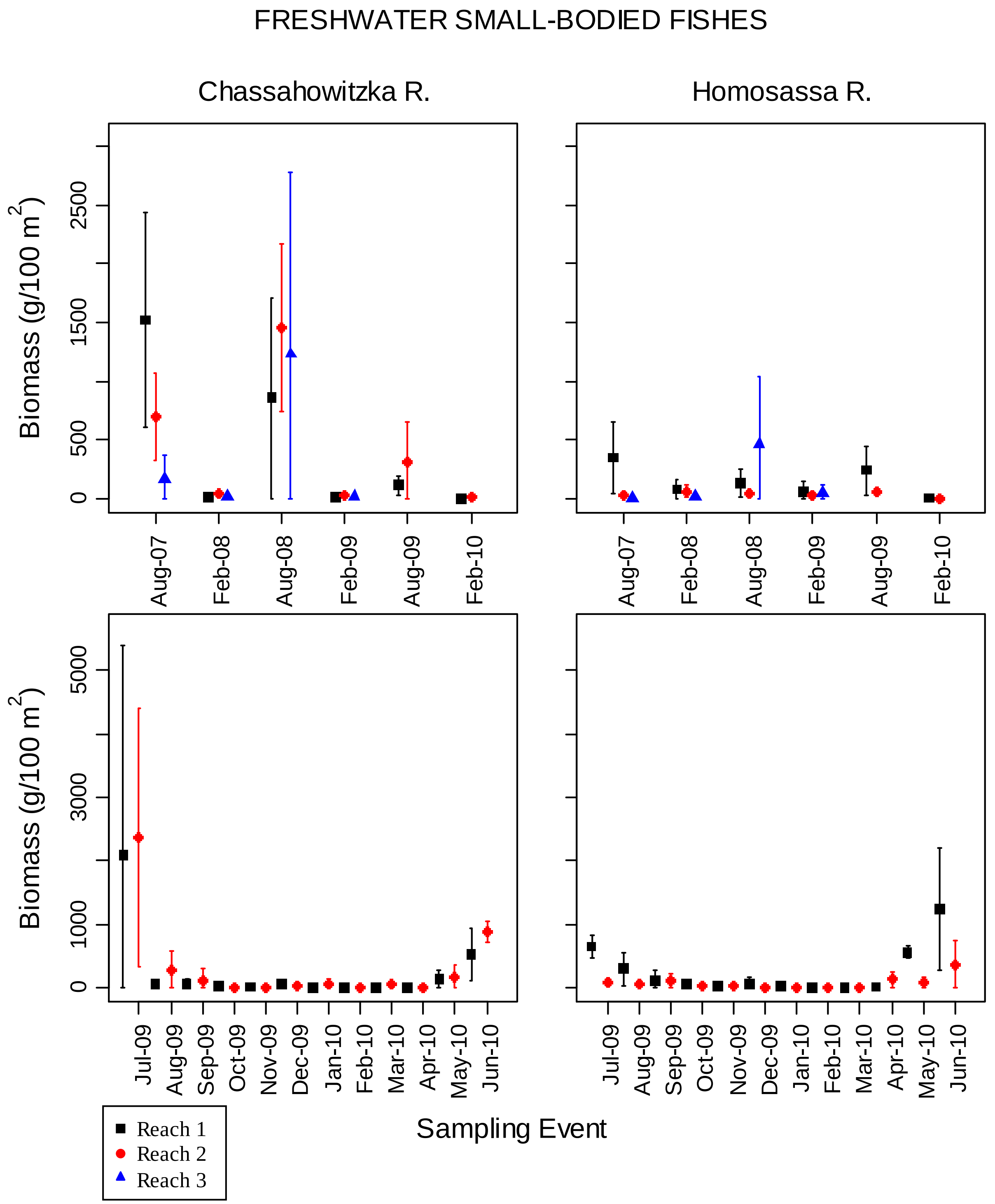


Figure 9. Average biomass of freshwater small-bodied fishes collected at seine depletion sites within the Homosassa and Chassahowitzka rivers. Error bars represent one standard deviation.

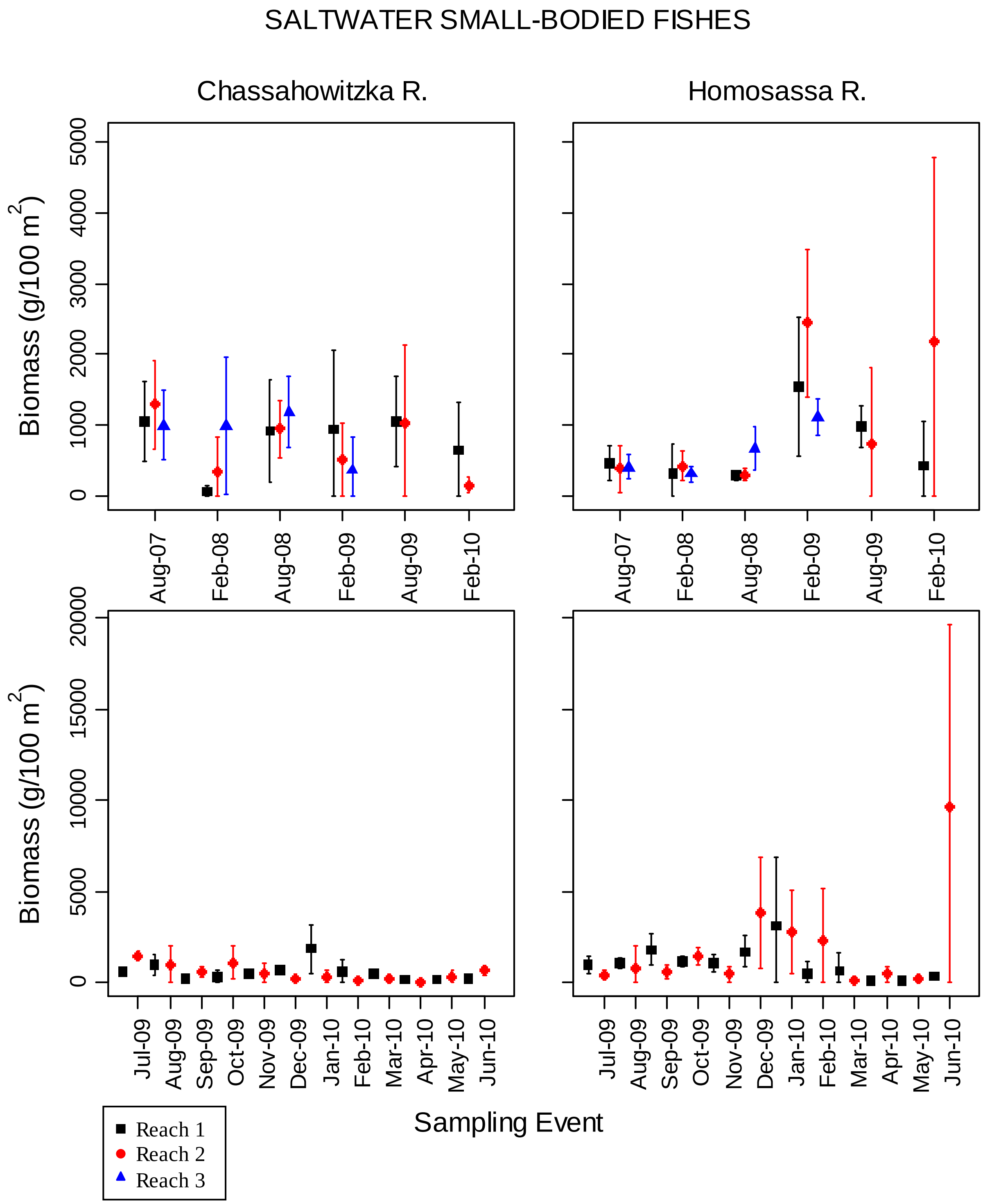


Figure 10. Average biomass of saltwater small-bodied fishes collected at seine depletion sites within the Homosassa and Chassahowitzka rivers. Error bars represent one standard deviation.

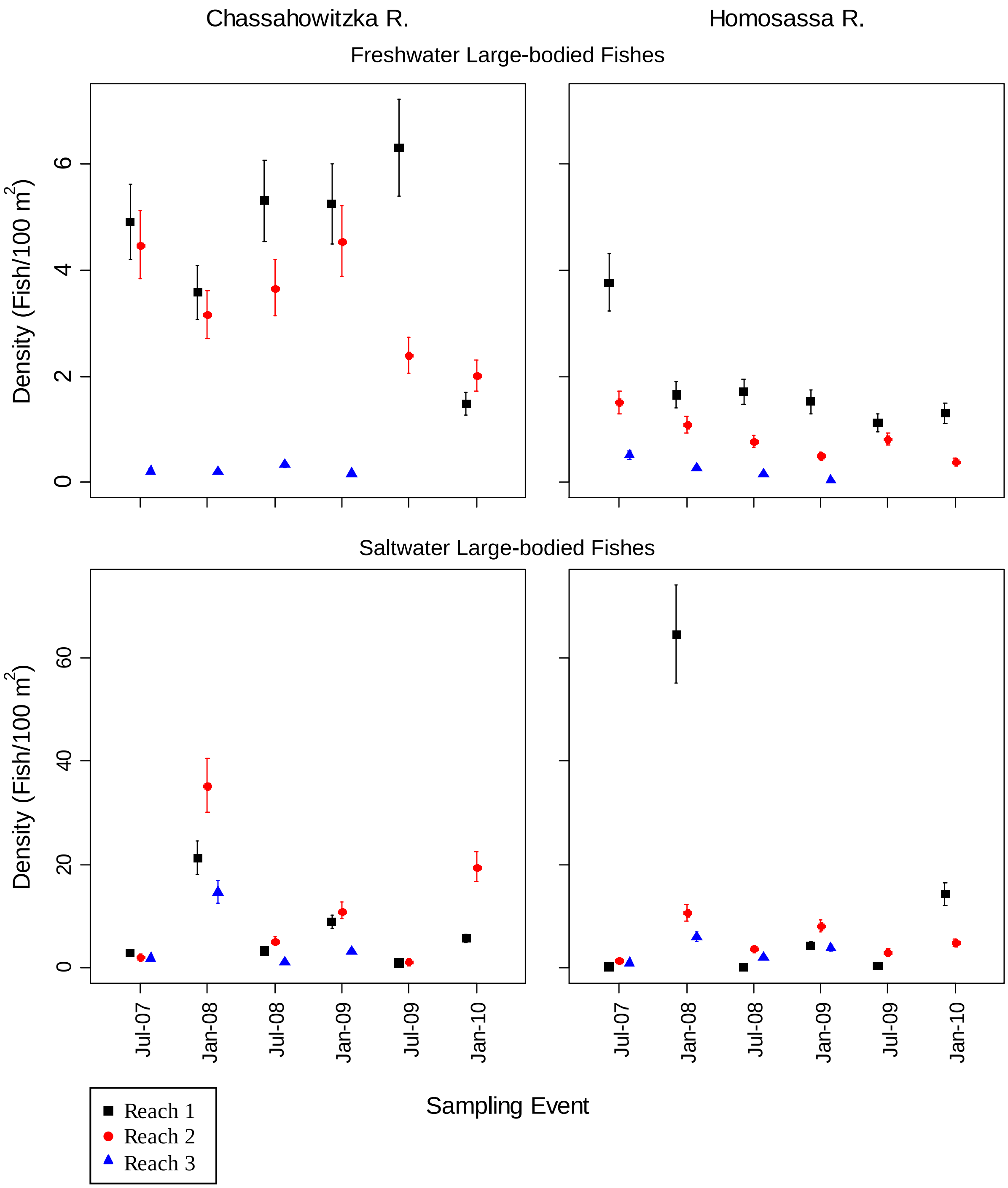


Figure 11. Estimated density of freshwater (upper panels) and saltwater (lower panels) large-bodied fishes captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean.

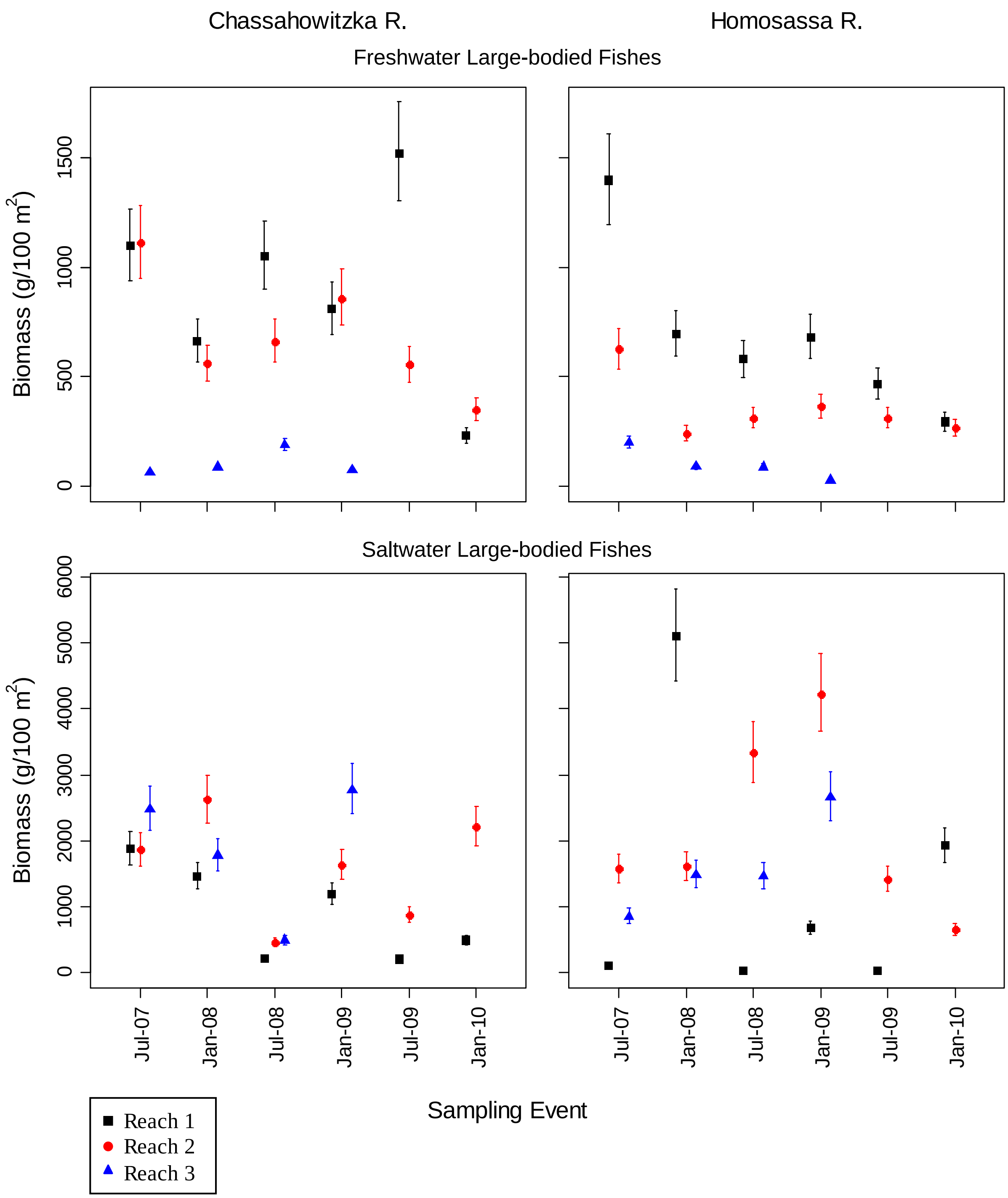


Figure 12. Estimated biomass of freshwater (upper panels) and saltwater (lower panels) large-bodied fishes captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean.

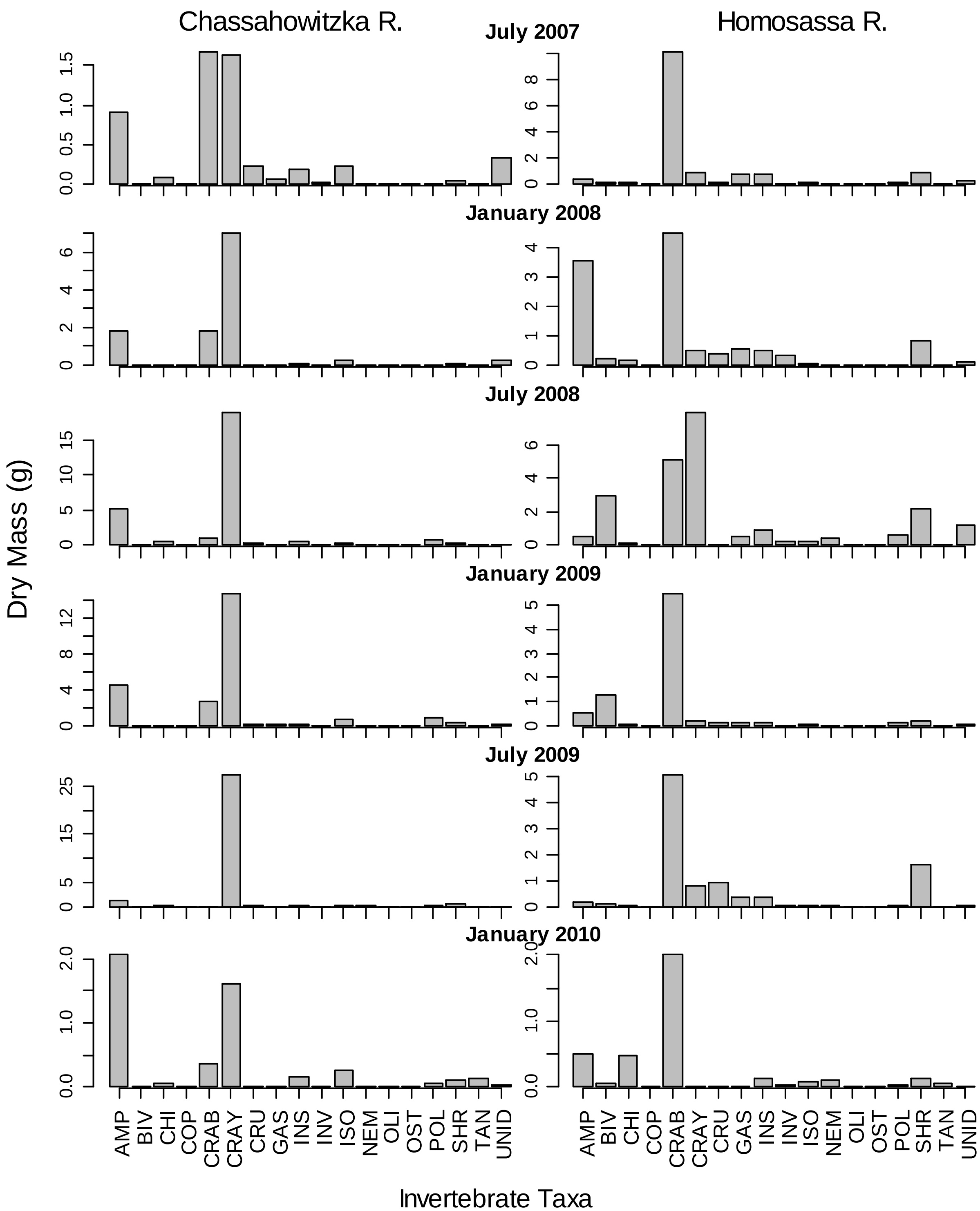


Figure 13. Composition of invertebrates (calculated as the sum of the dry masses) in fish diets collected from the Homosassa and Chassahowitzka rivers. AMP=Amphipods, BIV=Bivalve, CHI=Chironomid Larvae, COP=Copepod, CRAB=Crabs, CRAY=Crayfish, CRU=Unidentified Crustacean, GAS=Gastropod, INS=Other Insect Larvae, INV=Other Invertebrate, ISO=Isopod, NEM=Nematode, OLI=Oligochaete, OST=Ostracod, POL=Polychaete, SHR=Shrimp, TAN=Tanaid, UNID=Unidentified Invertebrate.

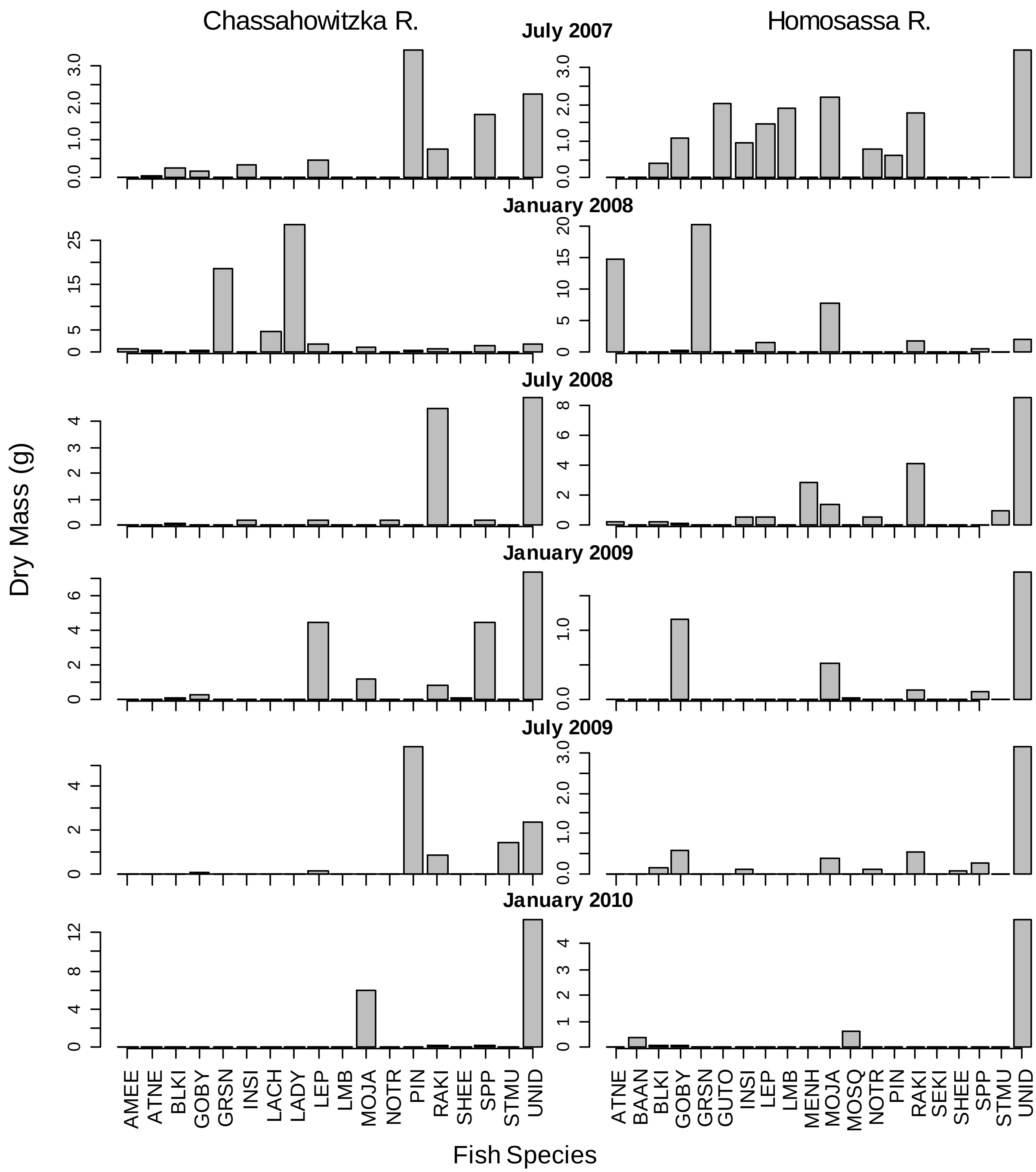


FIGURE 14. Composition of fishes (calculated as the sum of the dry masses) in fish diets collected from the Homosassa and Chassahowitzka rivers. AMEE=American eel, ATNE=Atlantic needlefish, BLKI=Bluefin killifish, GOBY=Clown goby and naked goby, GRSN=Gray snapper, INSI=Inland silverside, LACH=Lake chubsucker, LADY=Ladyfish, LEP=*Lepomis* spp., LMB=Largemouth bass, MOJA=Mojarra, NOTR=*Notropis* spp., PIN=Pinfish, RAKI=Rainwater killifish, SHEE=Sheepshead, SPP=Other fish species, STMU=Striped mullet, UNID=Unidentified fish.

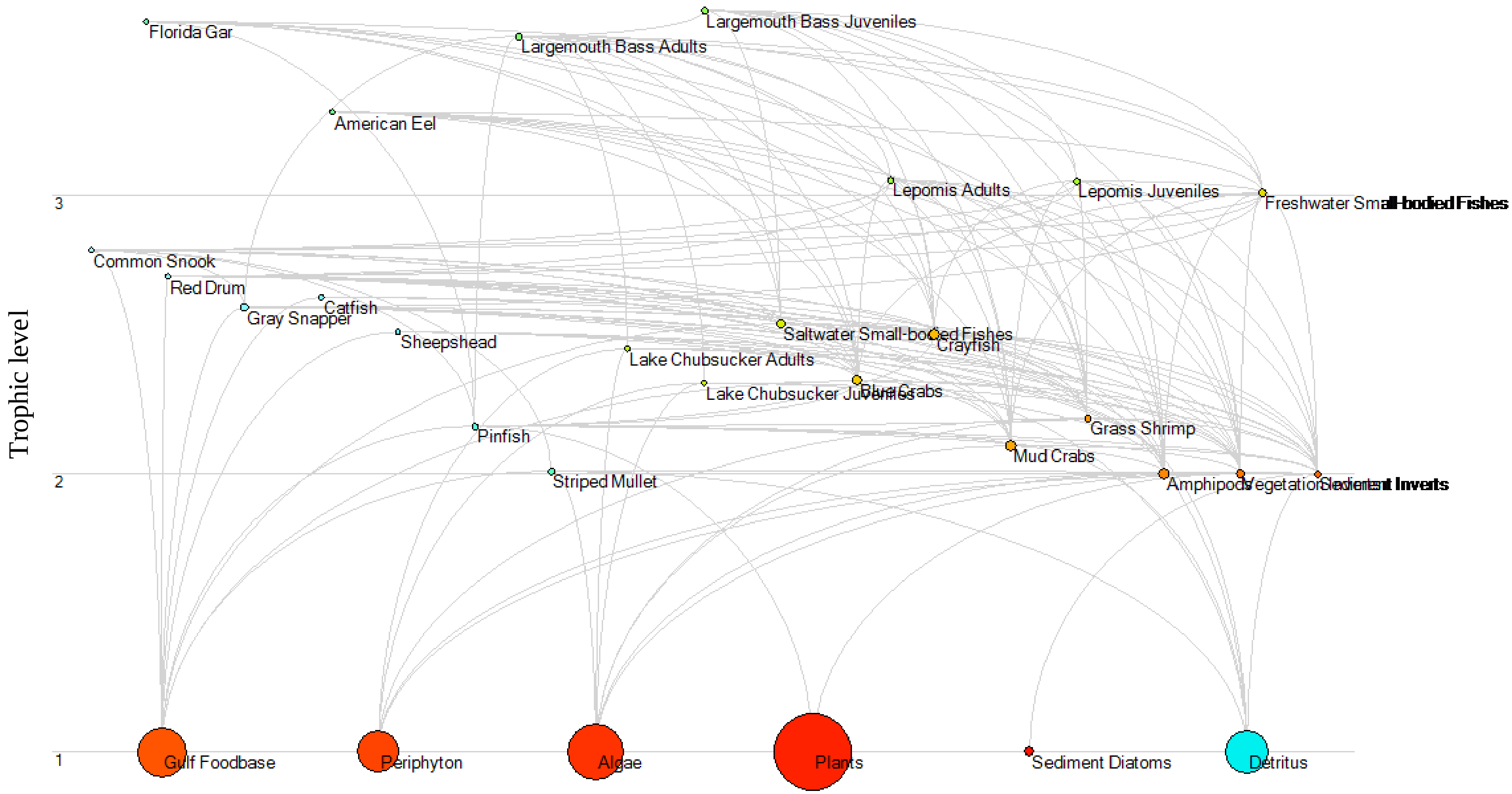


Figure 15. Ecopath trophic flow diagram of the Chassahowitzka River. The size of the circle is relative to the biomass of the trophic group.

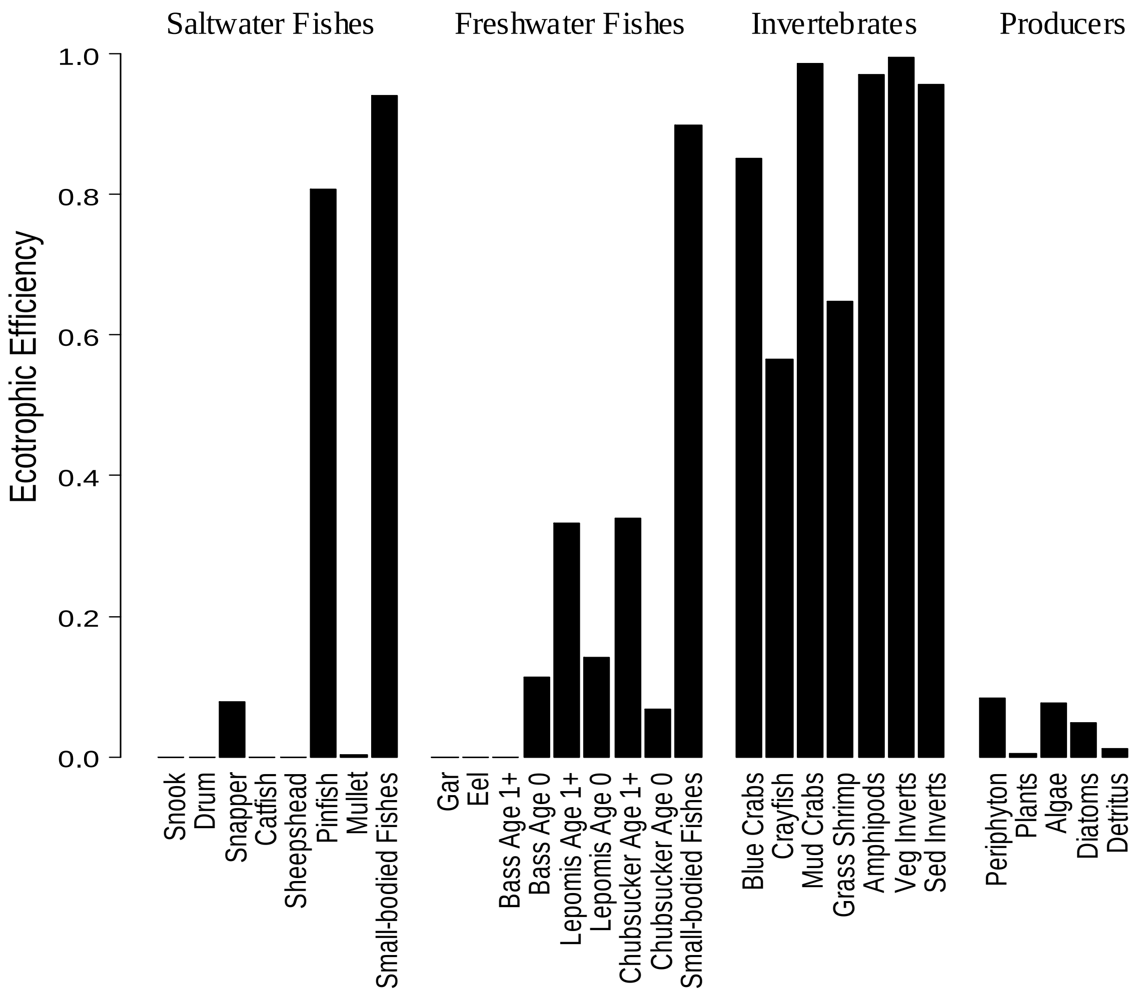


Figure 16. Estimated ecotrophic efficiency (proportion of production consumed by predators) of plants, algae, invertebrates and fishes within the Chassahowitzka River.

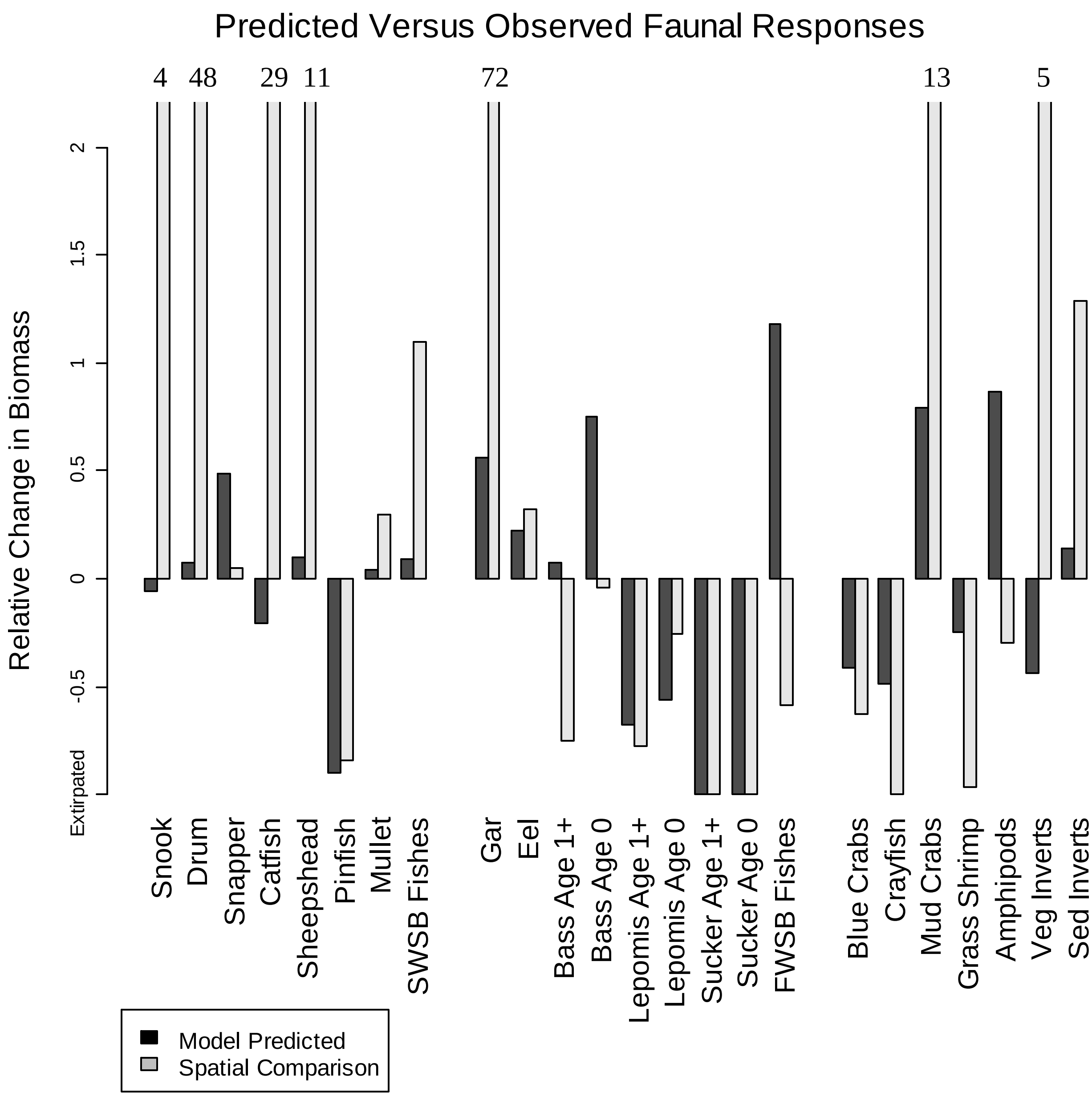


Figure 17. Comparison of time dynamic ecosystem model predicted changes in mean annual biomass of faunal organisms with observed spatial differences between the Chassahowitzka and Homosassa rivers.

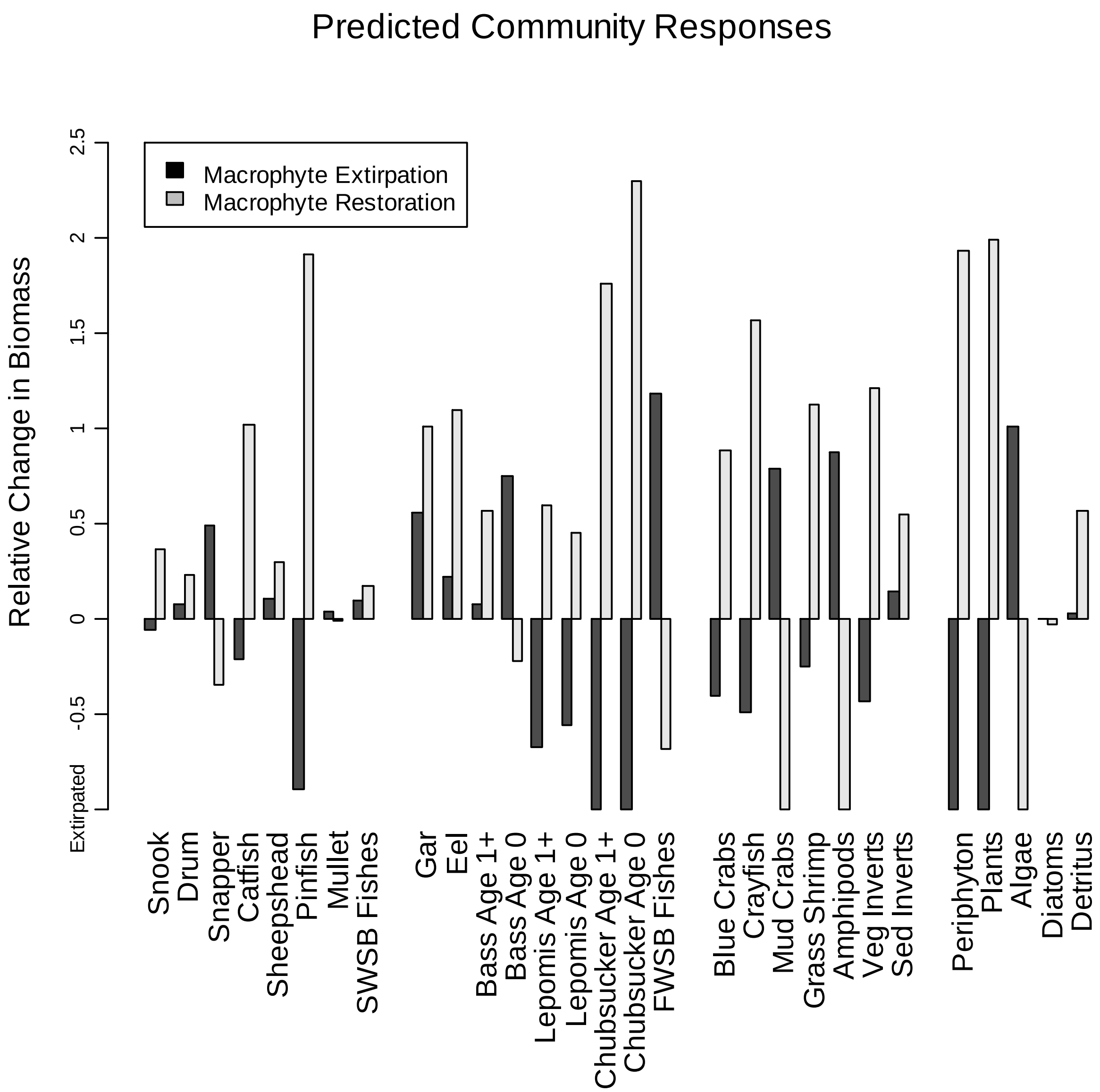


Figure 18. Comparison of time dynamic ecosysetm model predicted community responses to the extirpation and restoration of macrophytes in the Chassahowitzka River.

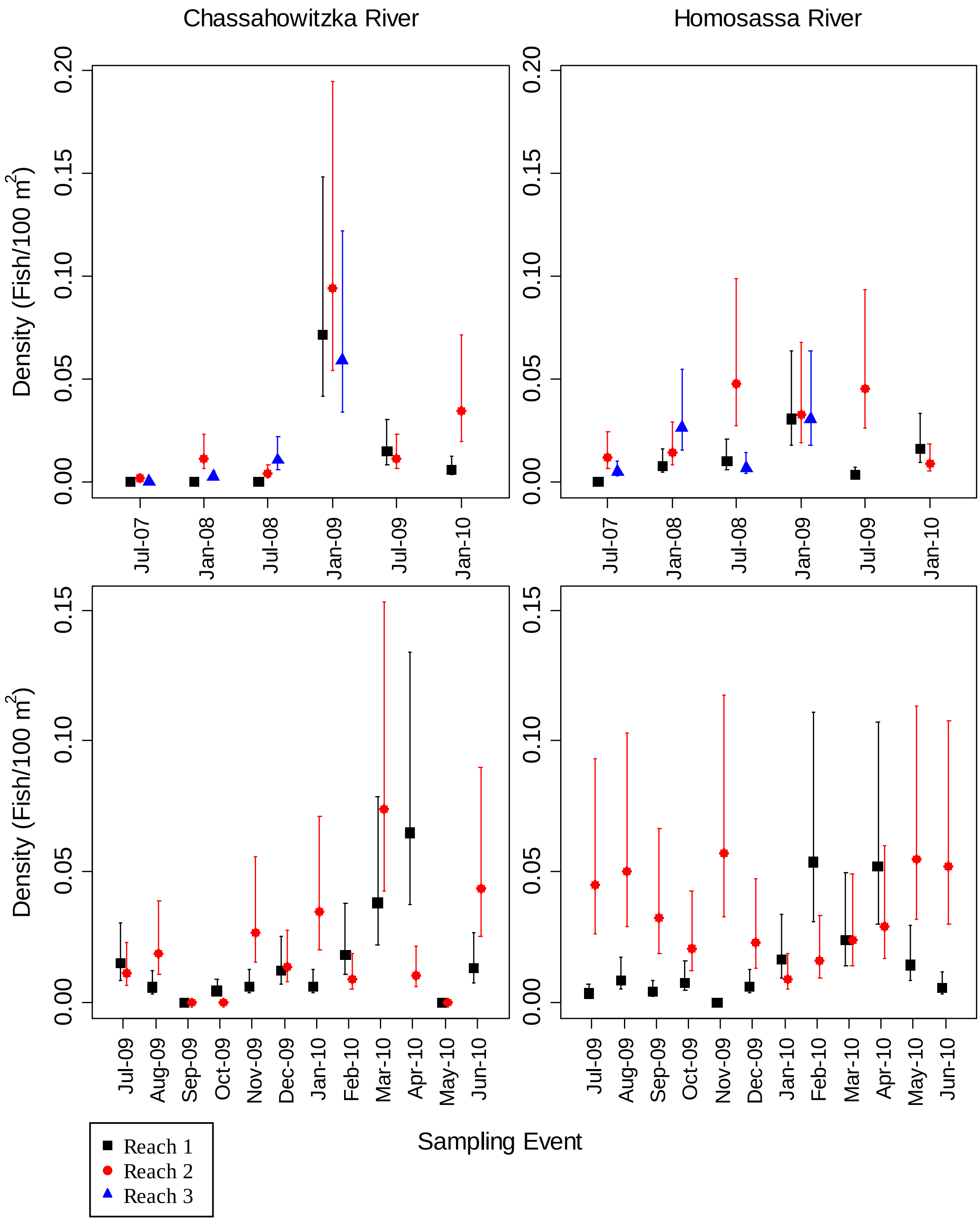


Figure 19. Estimated mean density of sheepshead captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

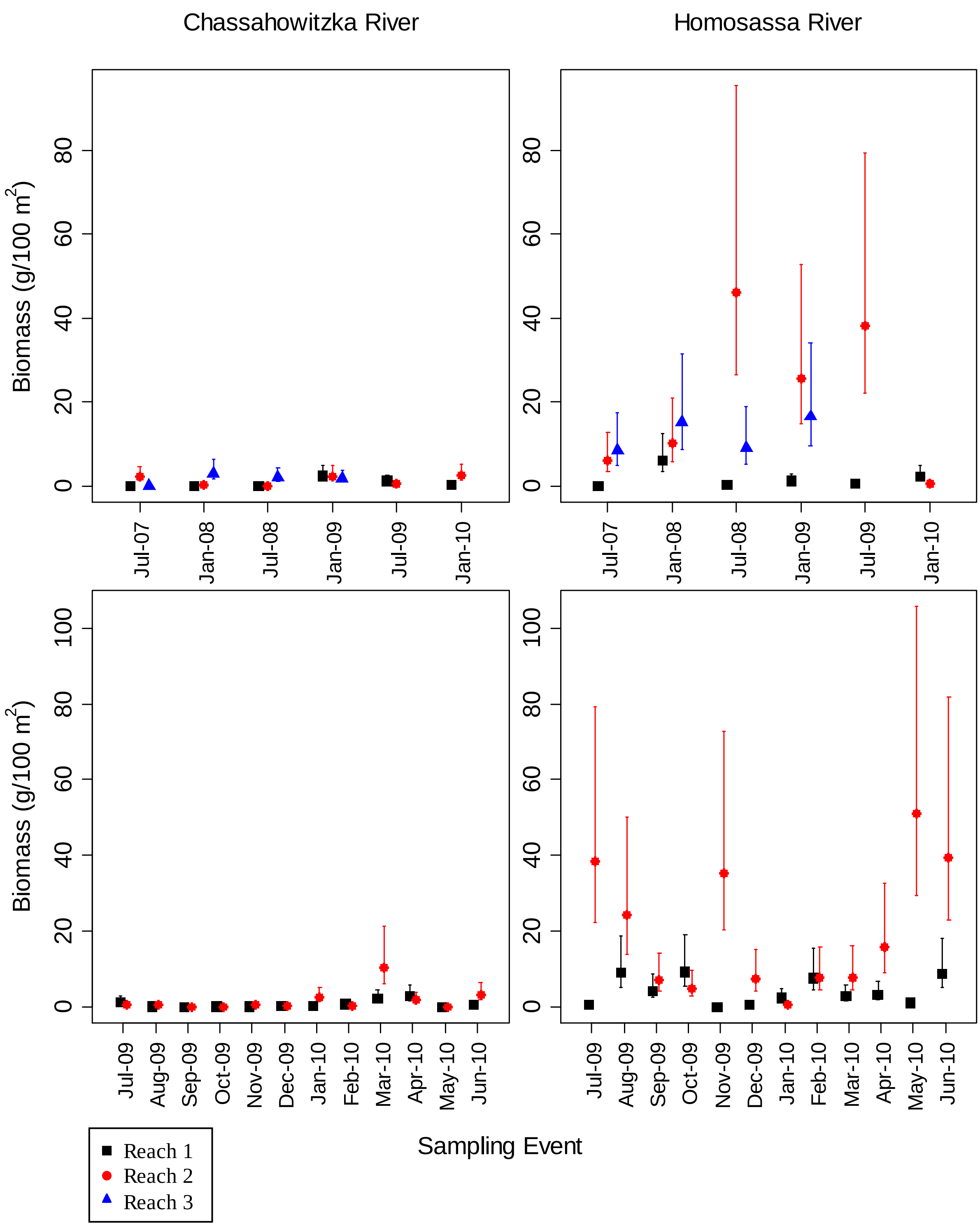


Figure 20. Estimated mean biomass of sheepshead captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

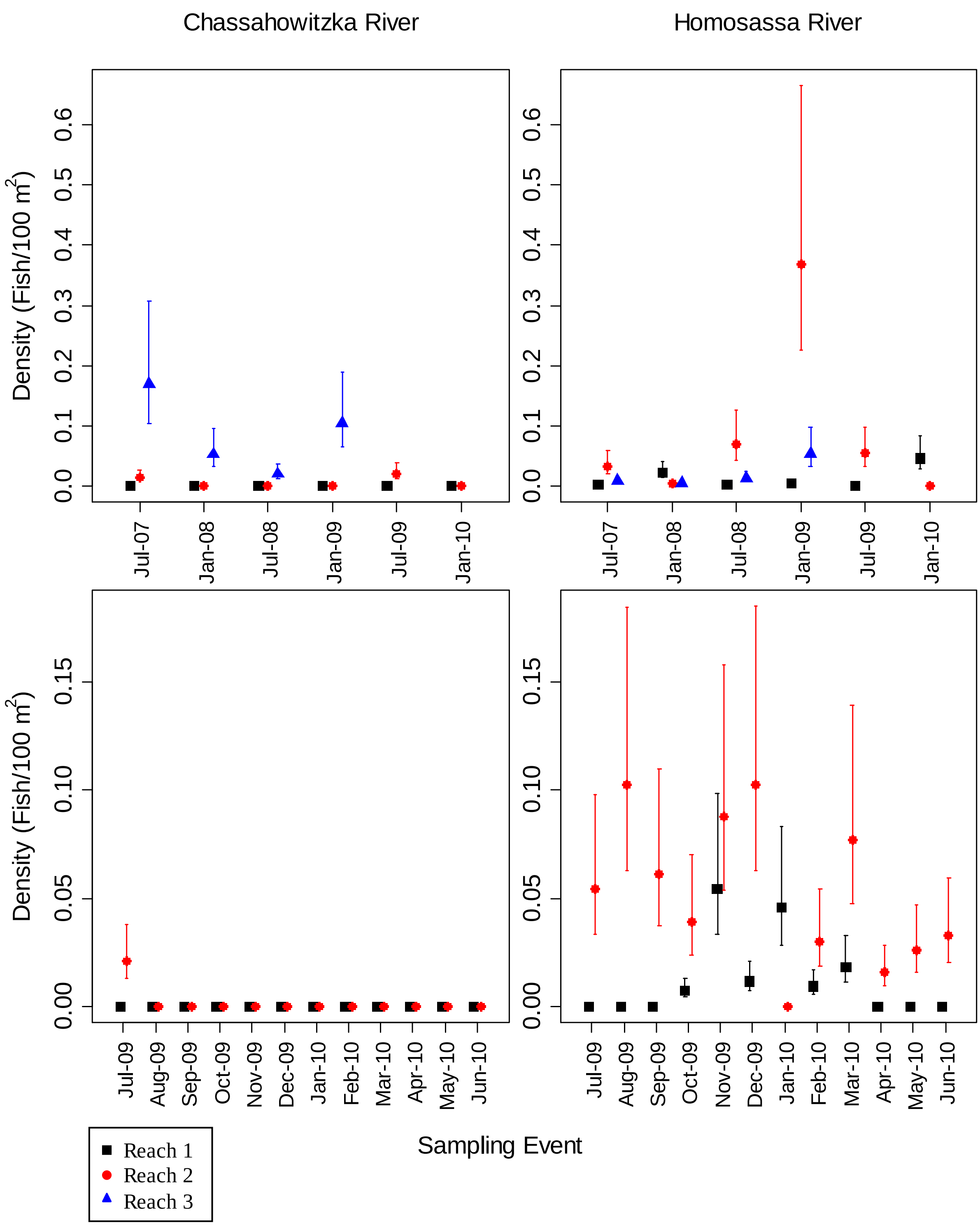


Figure 21. Estimated mean density of common snook captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

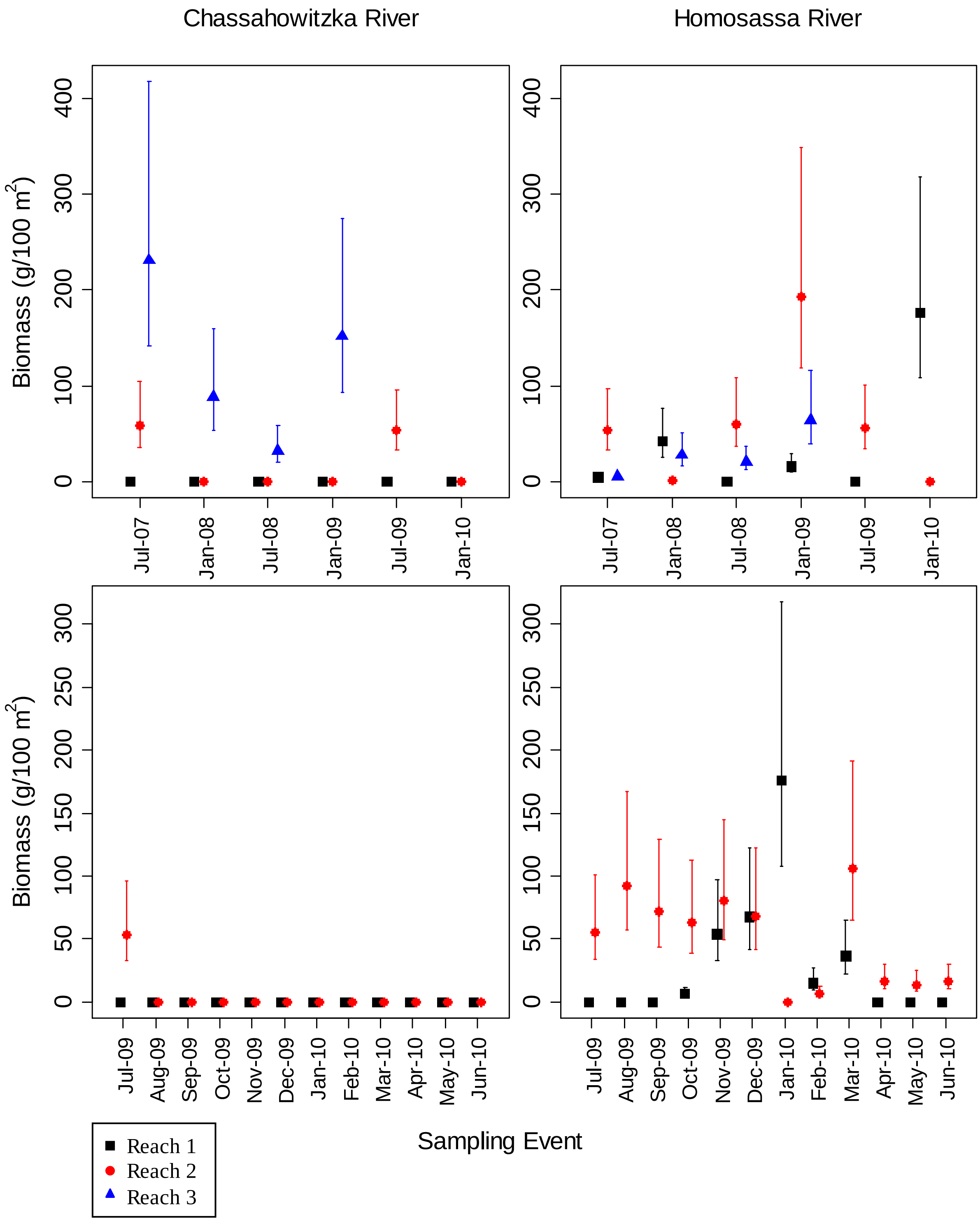


Figure 22. Estimated mean biomass of common snook captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

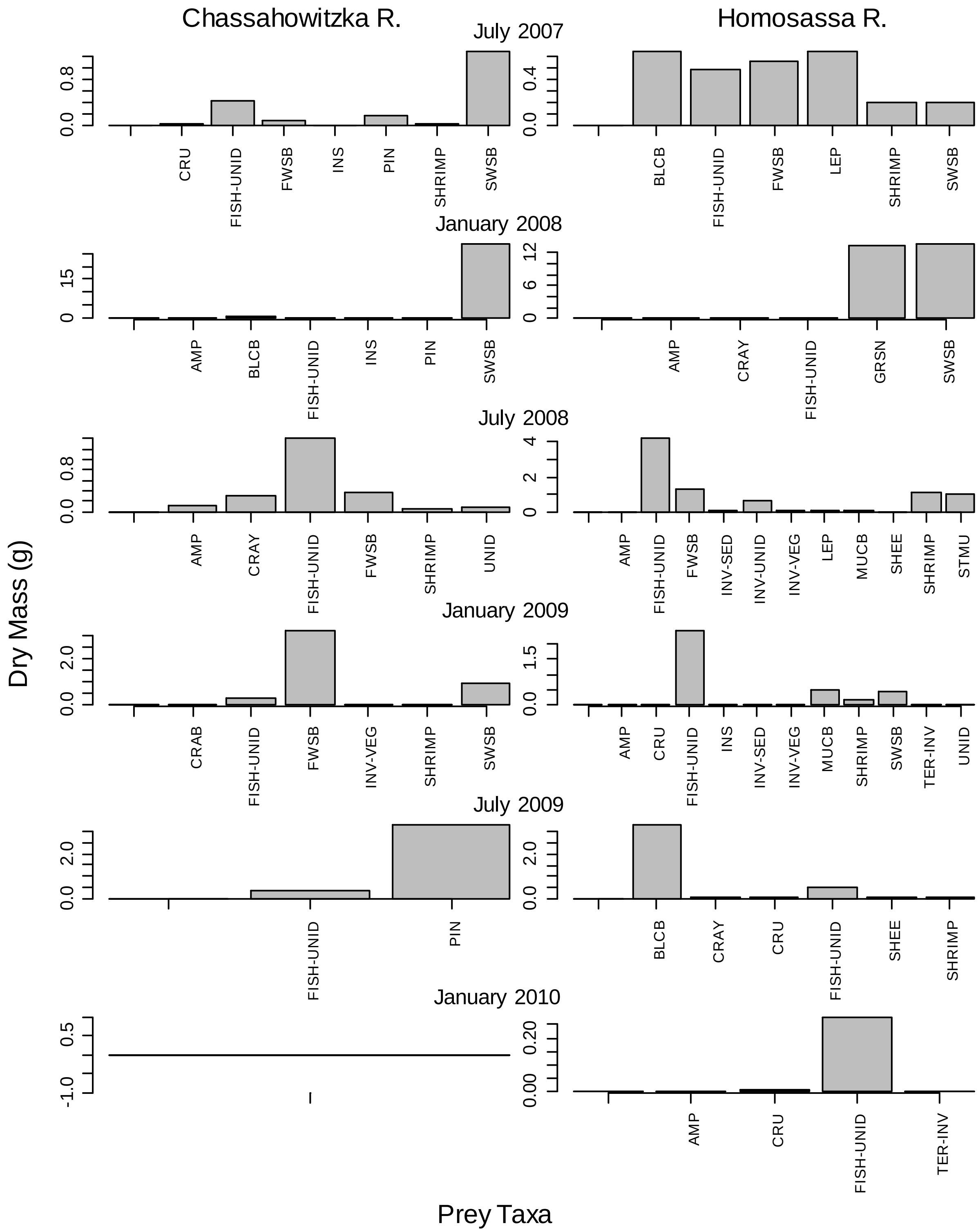


Figure 23. Diet composition (by dry mass) of common snook in the Chassahowitzka and Homosassa rivers. AMP=amphipod, BLCB=blue crab, CRAB=unidentified crab, CRAY=crayfish, CRU=unidentified crustacean, FISH-UNID=unidentified fish, FWSB=freshwater small-bodied fishes, GRSN=gray snapper, INS=inland silverside, INV-SED=sediment inverts, INV-VEG=vegetative inverts, LEP=*Lepomis*, MUCB=mud crab, PIN=pinfish, SWSB=saltwater small-bodied fishes, SHEE=sheepshead.

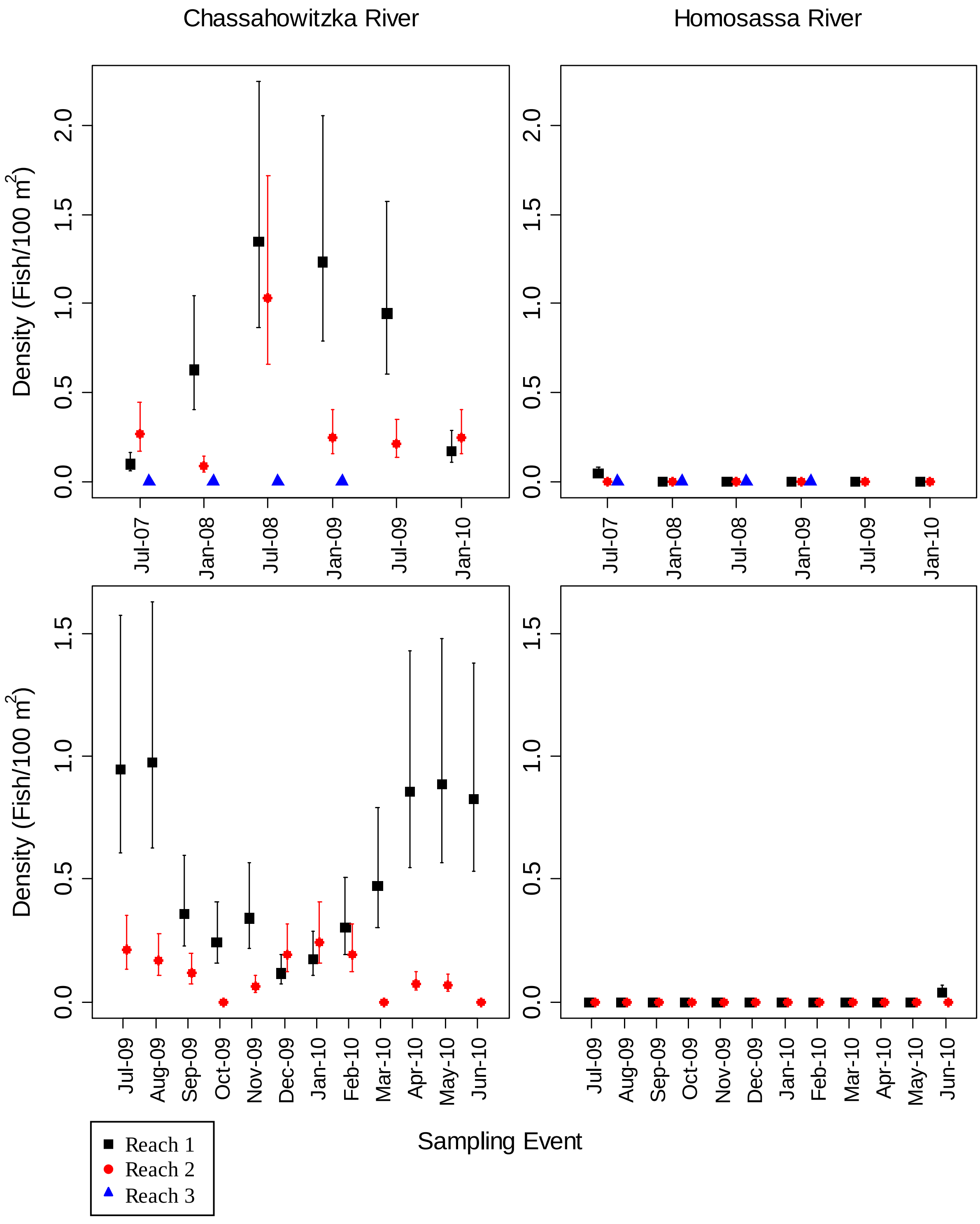


Figure 24. Estimated mean density of lake chubsucker captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

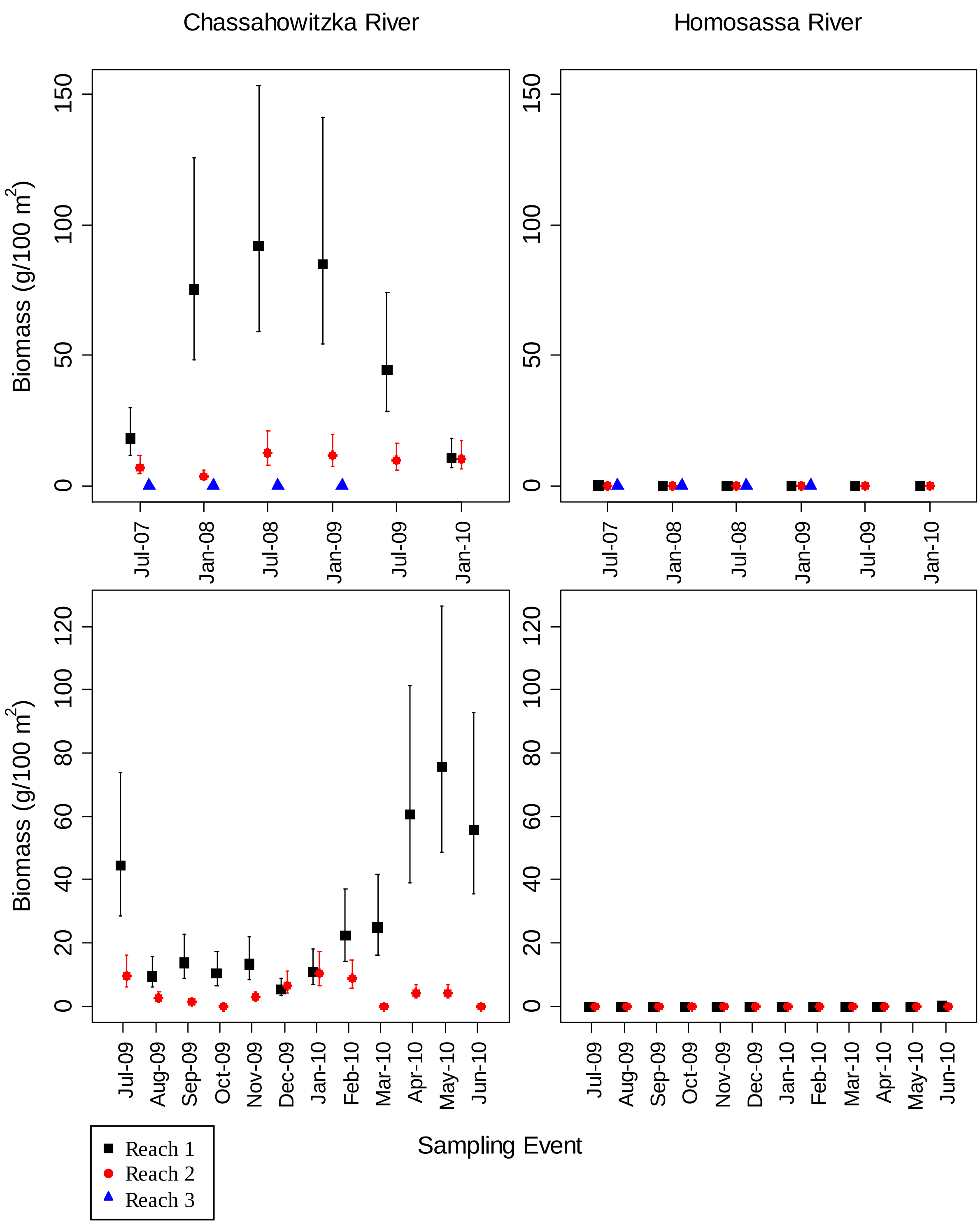


Figure 25. Estimated mean biomass of lake chubsucker captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

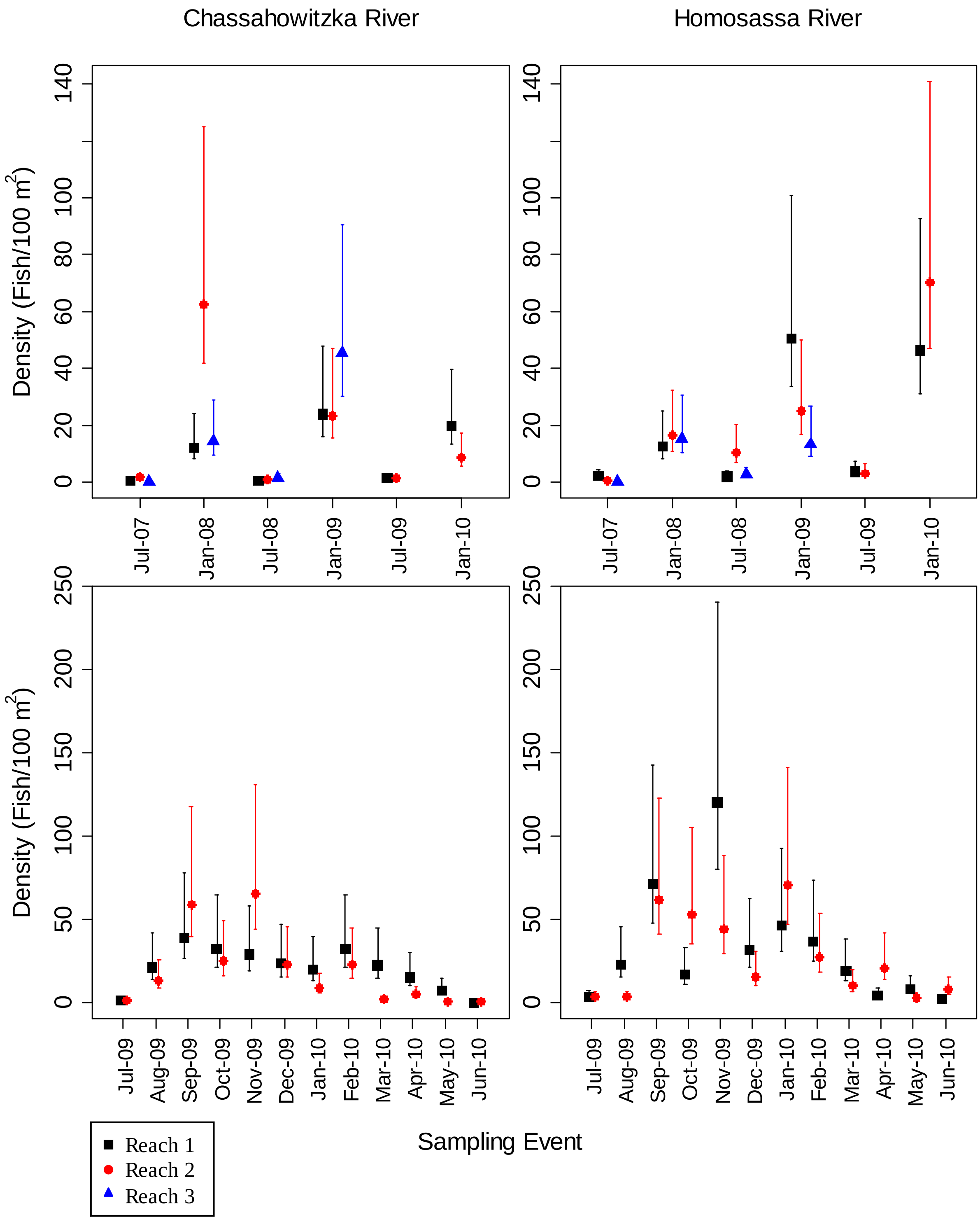


Figure 26. Estimated mean density of tidewater mojarra captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

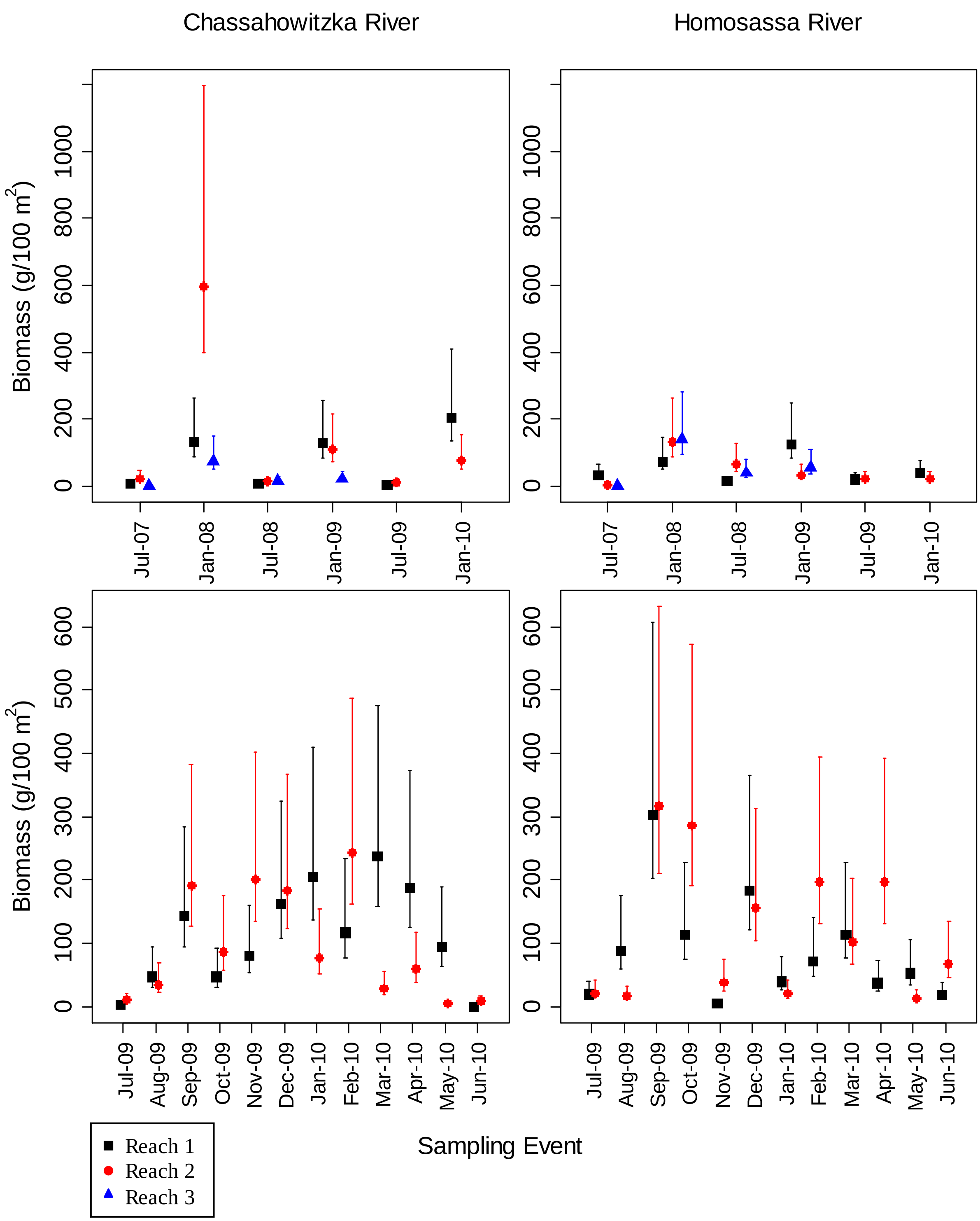


Figure 27. Estimated mean biomass of tidewater mojarra captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

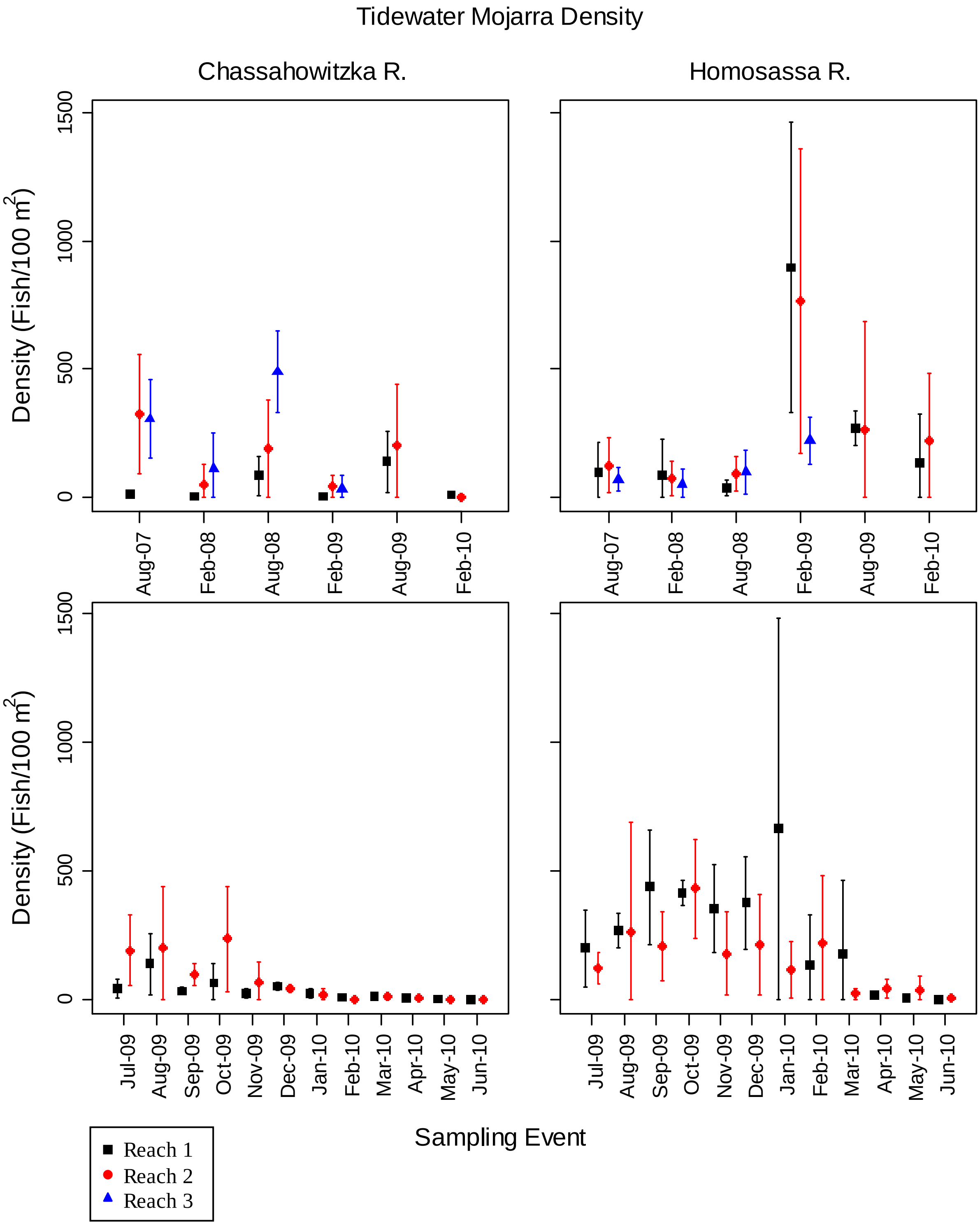


Figure 28. Estimated mean density of tidewater mojarra captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

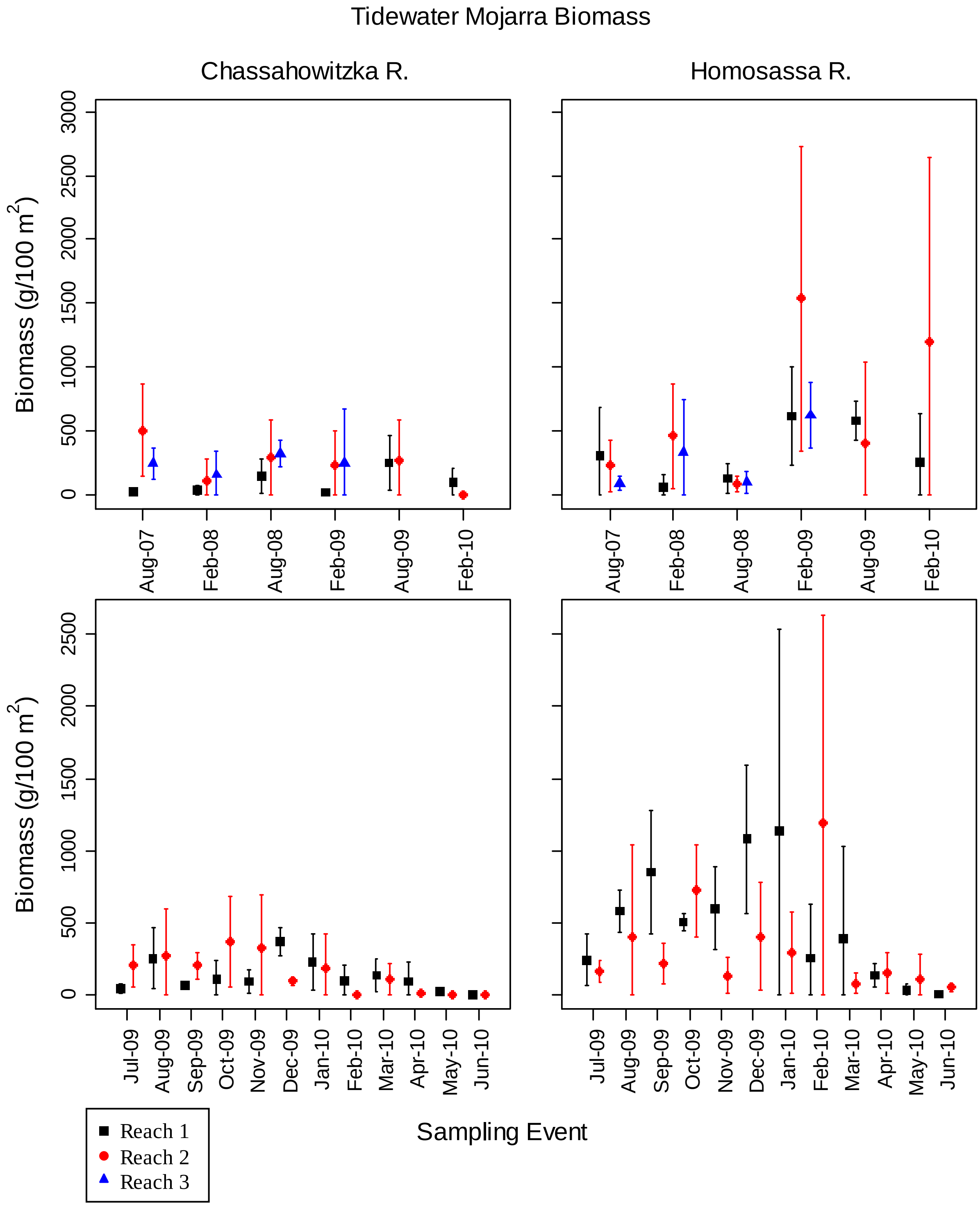


Figure 29. Estimated mean biomass of tidewater mojarra captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

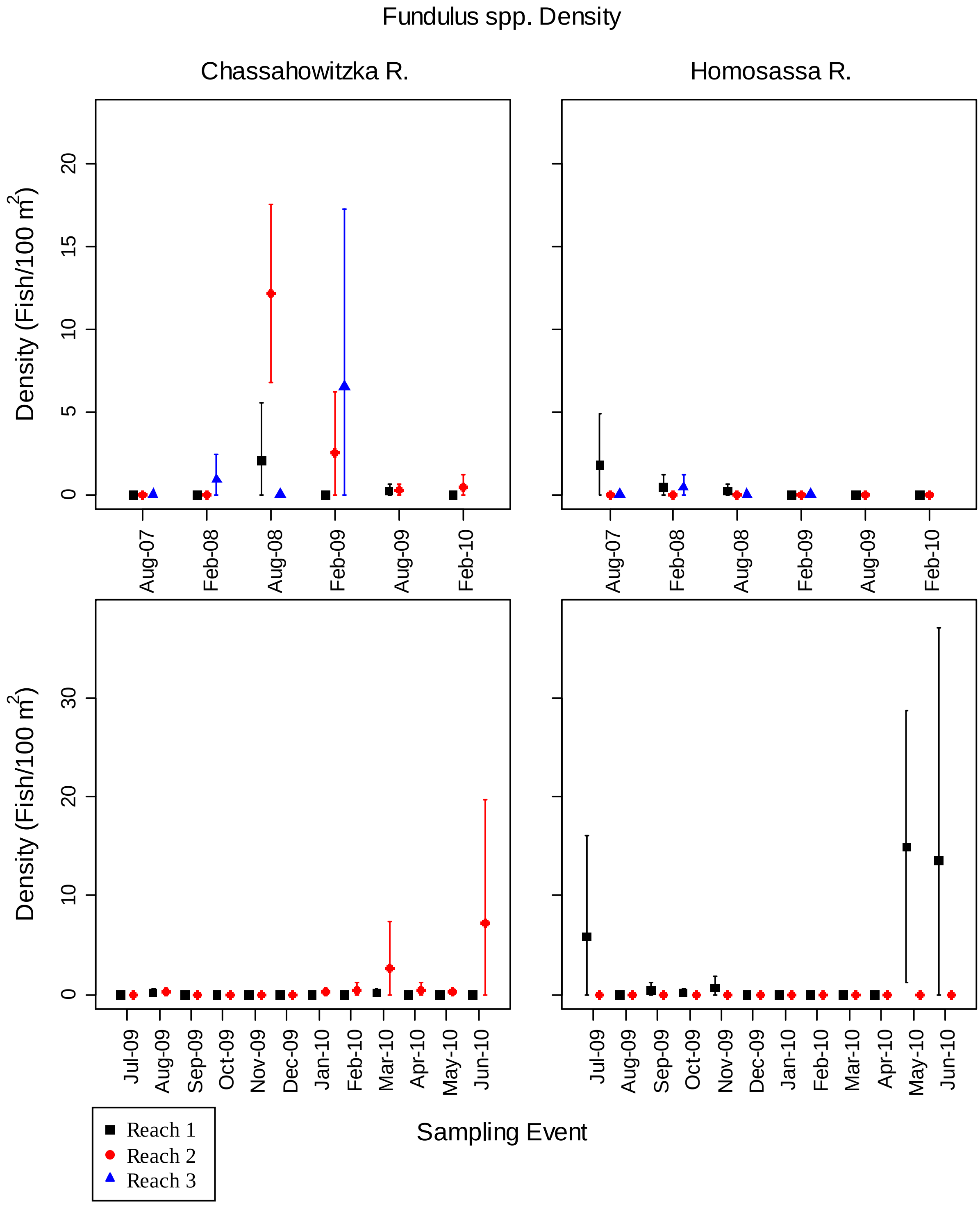


Figure 30. Estimated mean density of *Fundulus* spp. (*F. seminolis* and *F. grandis*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

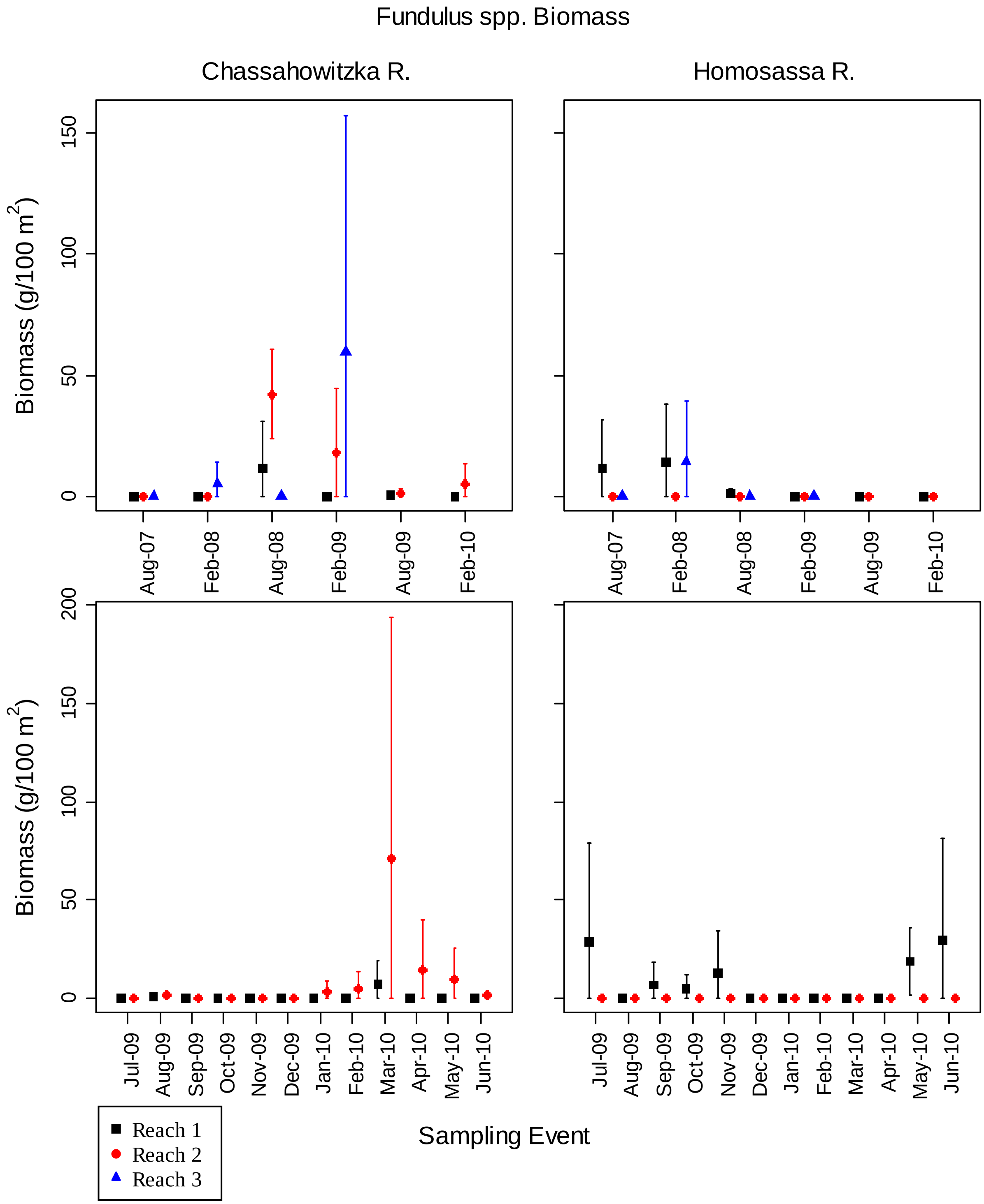


Figure 31. Estimated mean biomass of *Fundulus* spp. (*F. seminolis* and *F. grandis*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

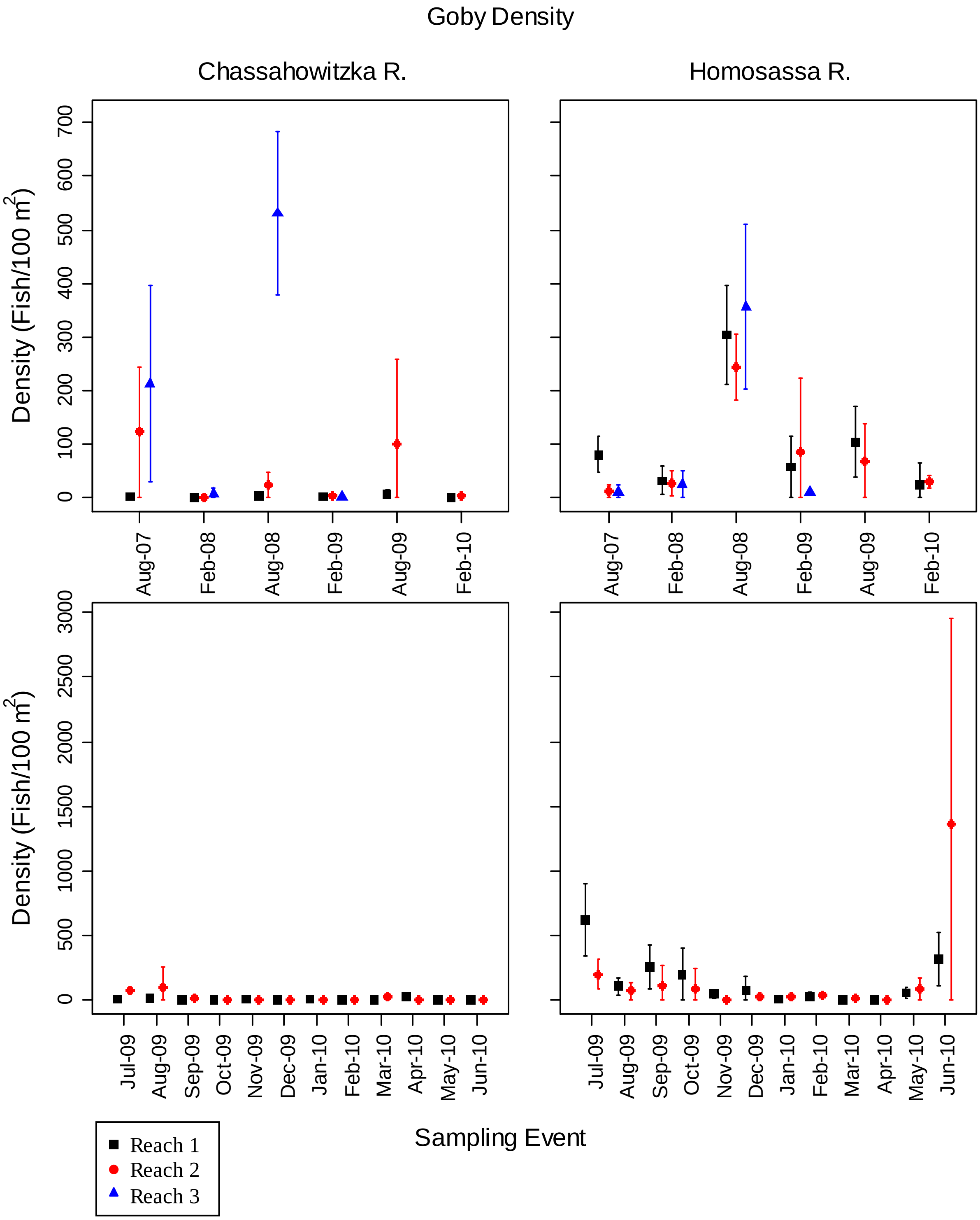


Figure 32. Estimated mean density of gobies (*Gobiosoma bosc* and *Microgobius gulosus*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

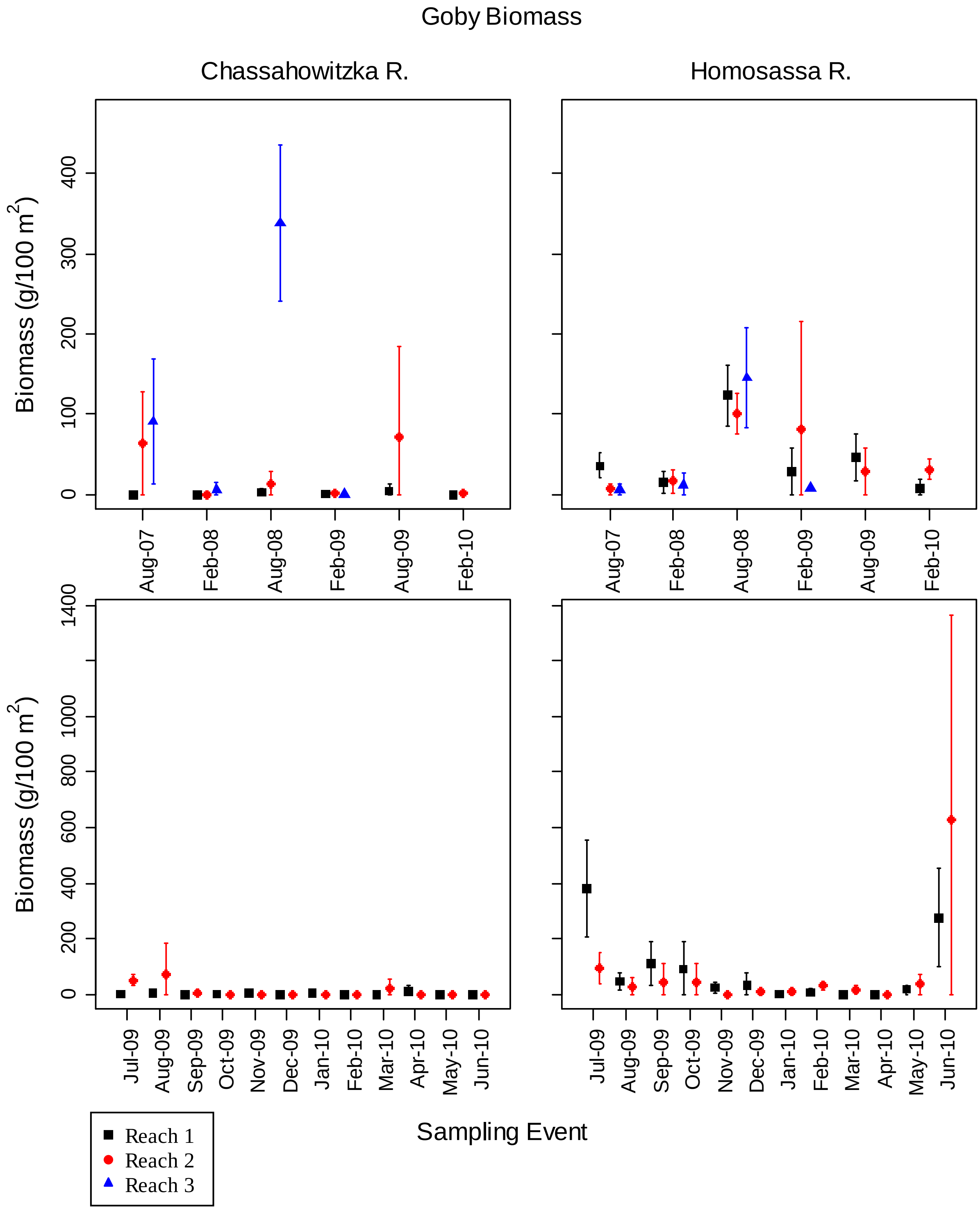


Figure 33. Estimated mean biomass of gobies (*Gobiosoma bosc* and *Microgobius gulosus*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

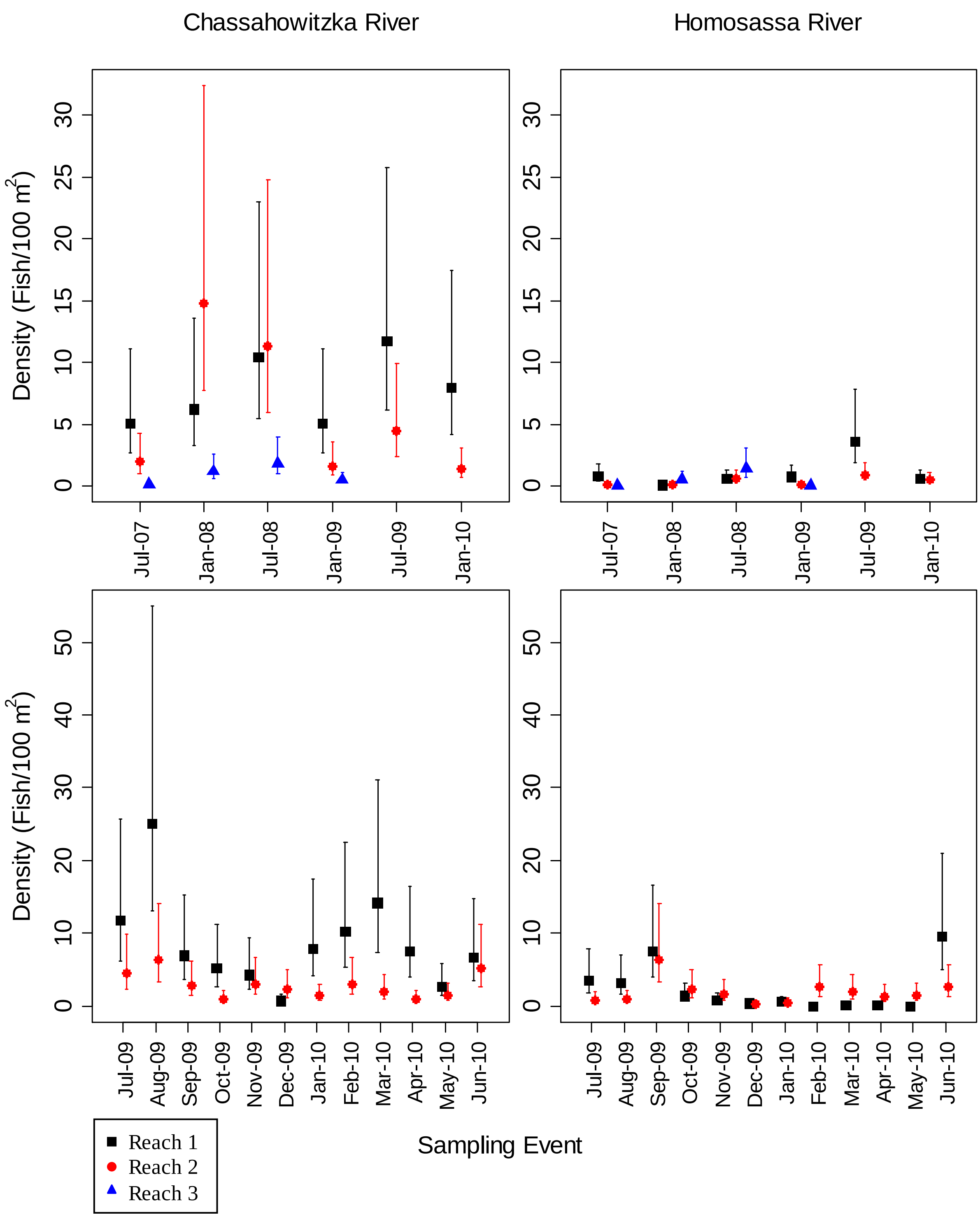


Figure 34. Estimated mean density of pinfish captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

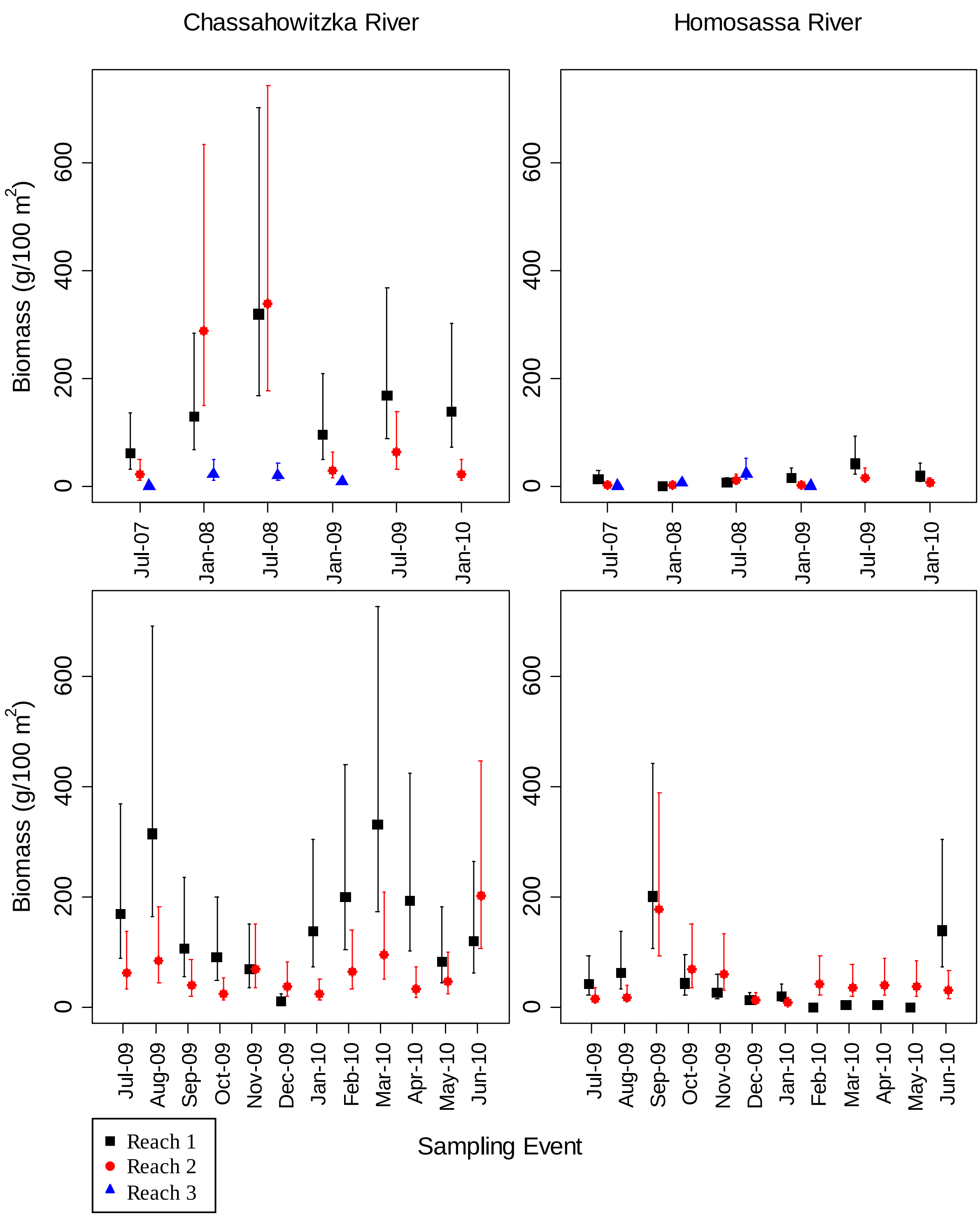


Figure 35. Estimated mean biomass of pinfish captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

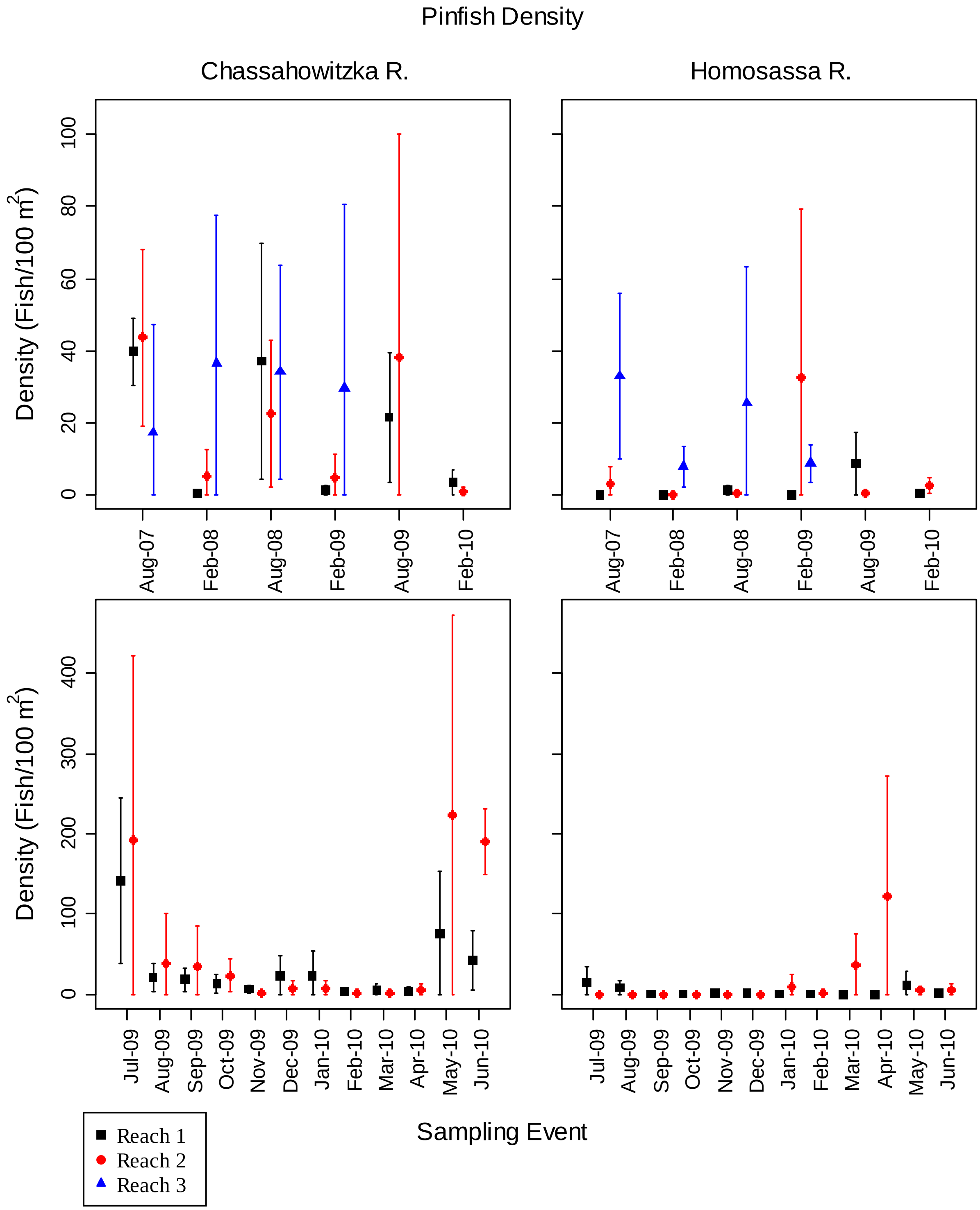


Figure 36. Estimated mean density of pinfish captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

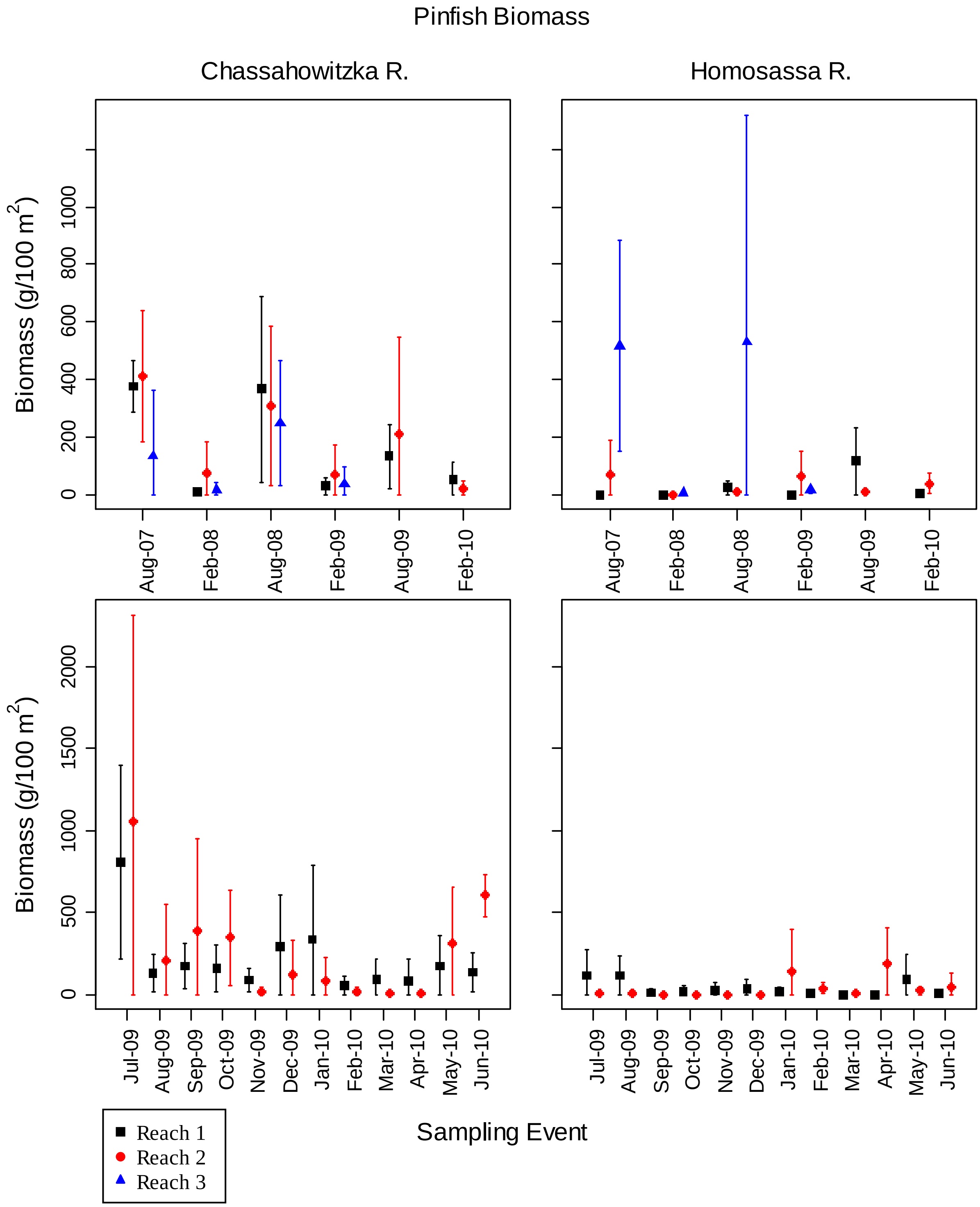


Figure 37. Estimated mean biomass of pinfish captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

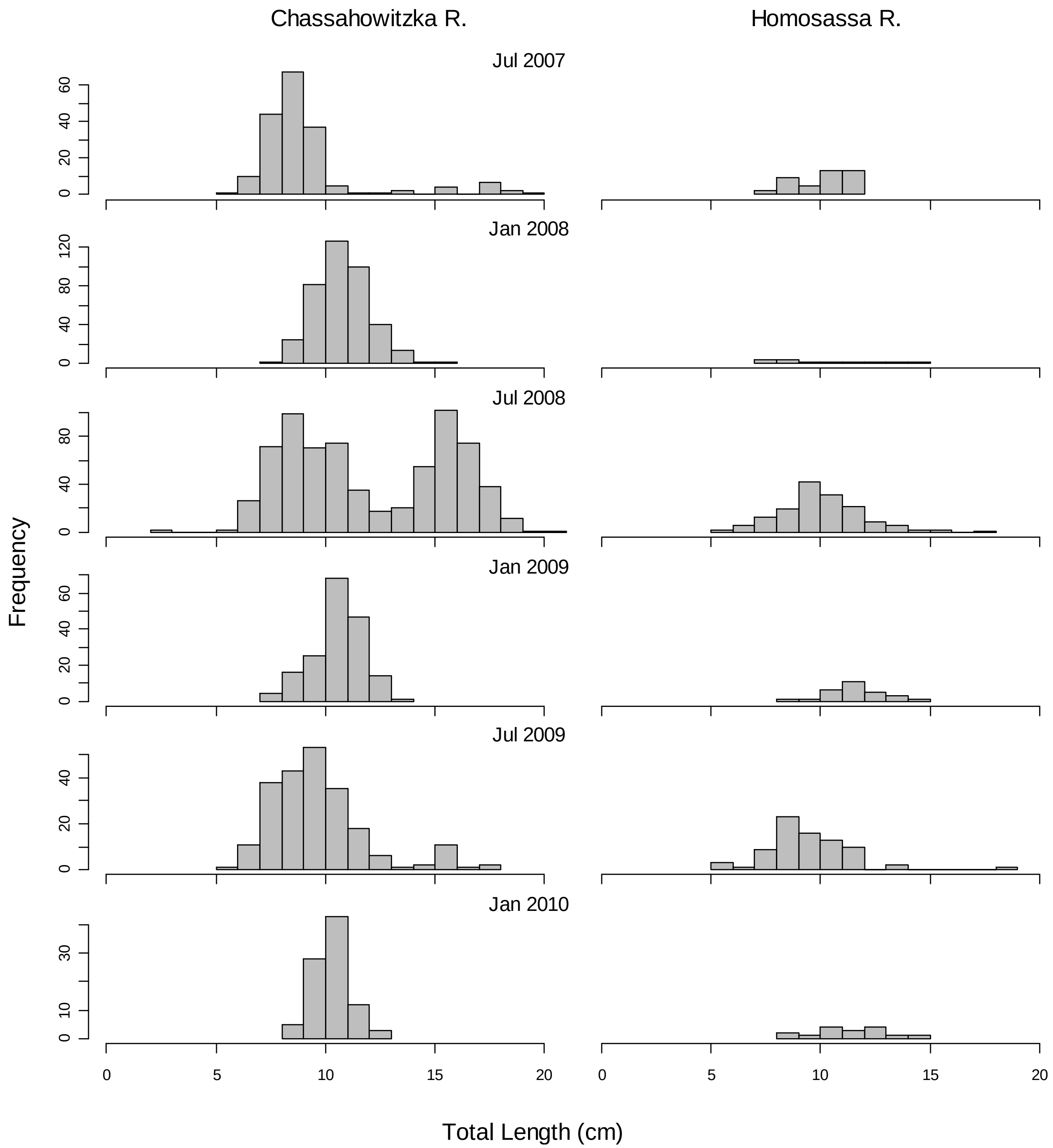


Figure 38. Biannual length frequency distributions of pinfish captured by electrofishing within the Chassahowitzka and Homosassa rivers.

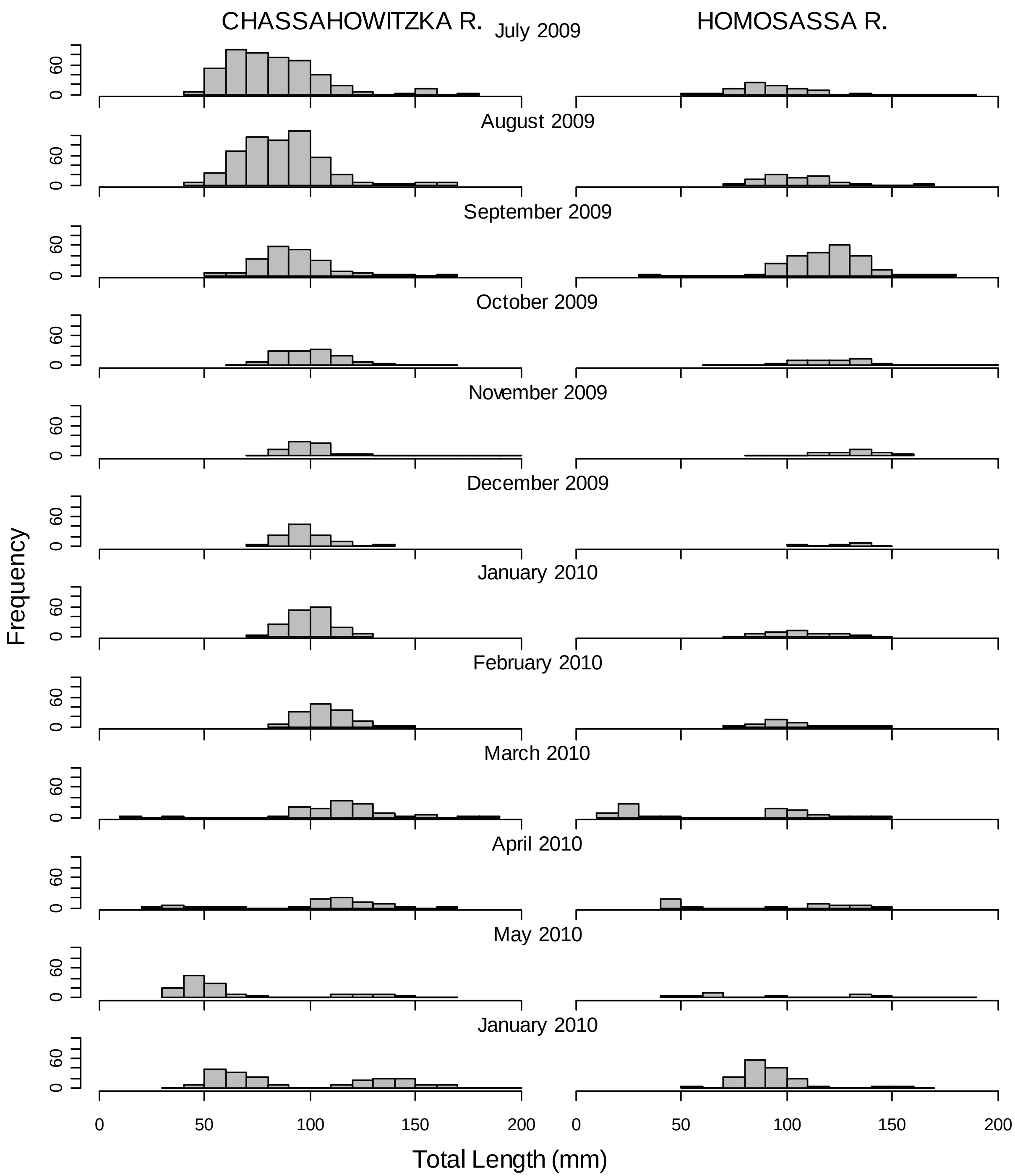


Figure 39. Monthly length frequency distributions of pinfish captured by electrofishing and seining within the Chassahowitzka and Homosassa rivers.

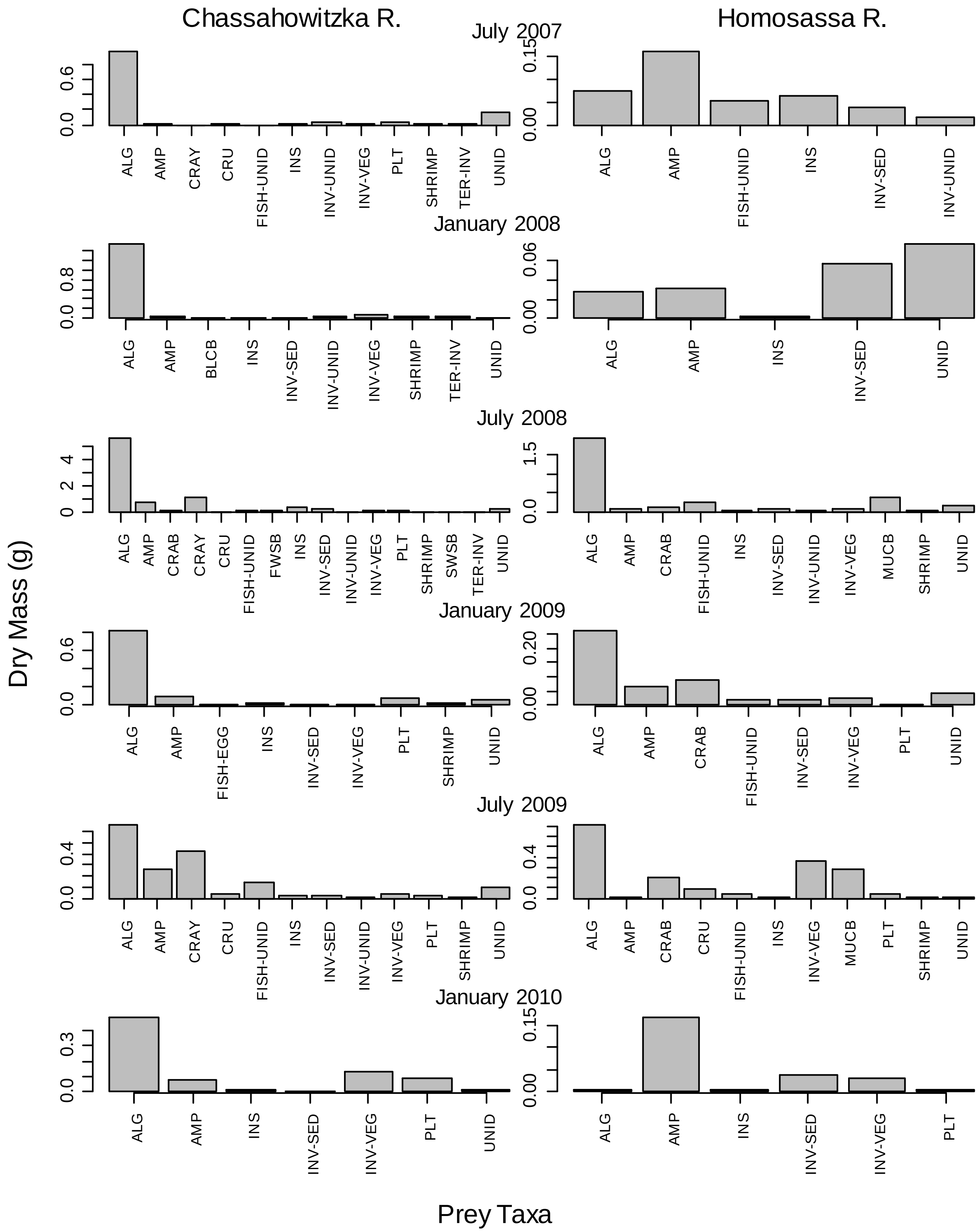


Figure 40. Diet composition (by dry mass) of pinfish in the Chassahowitzka and Homosassa rivers.

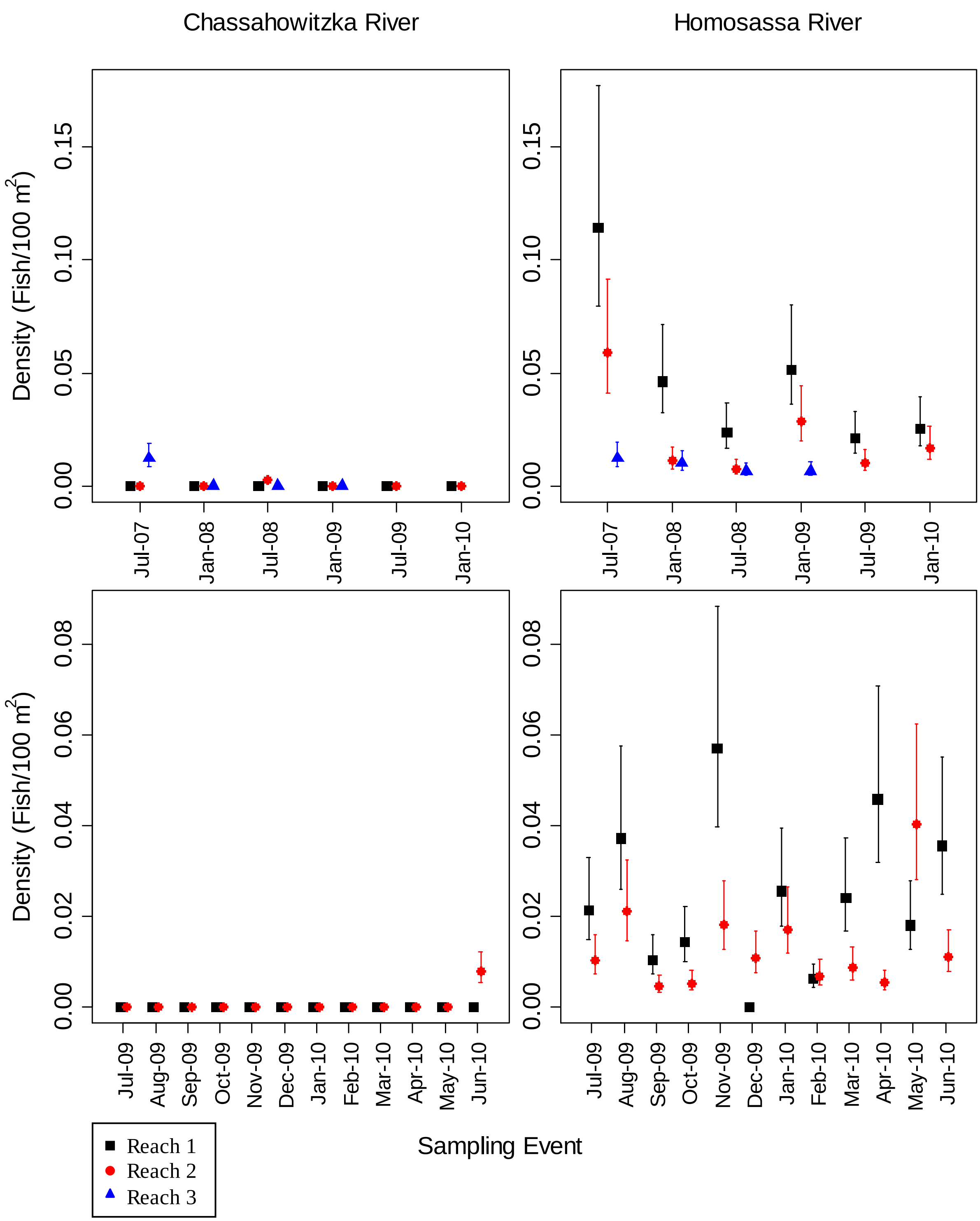


Figure 41. Estimated mean density of Florida gar captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

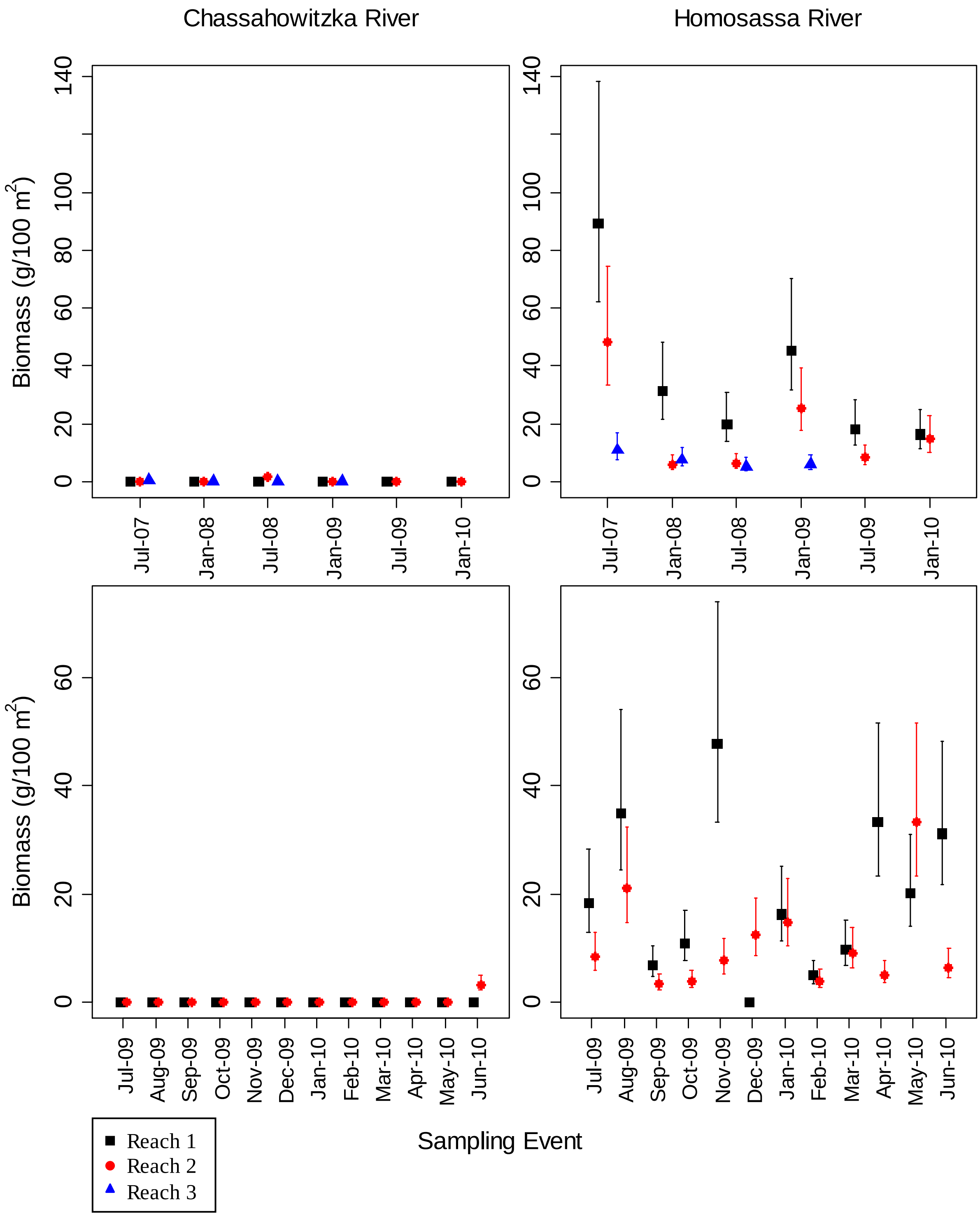


Figure 42. Estimated mean biomass of Florida gar captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

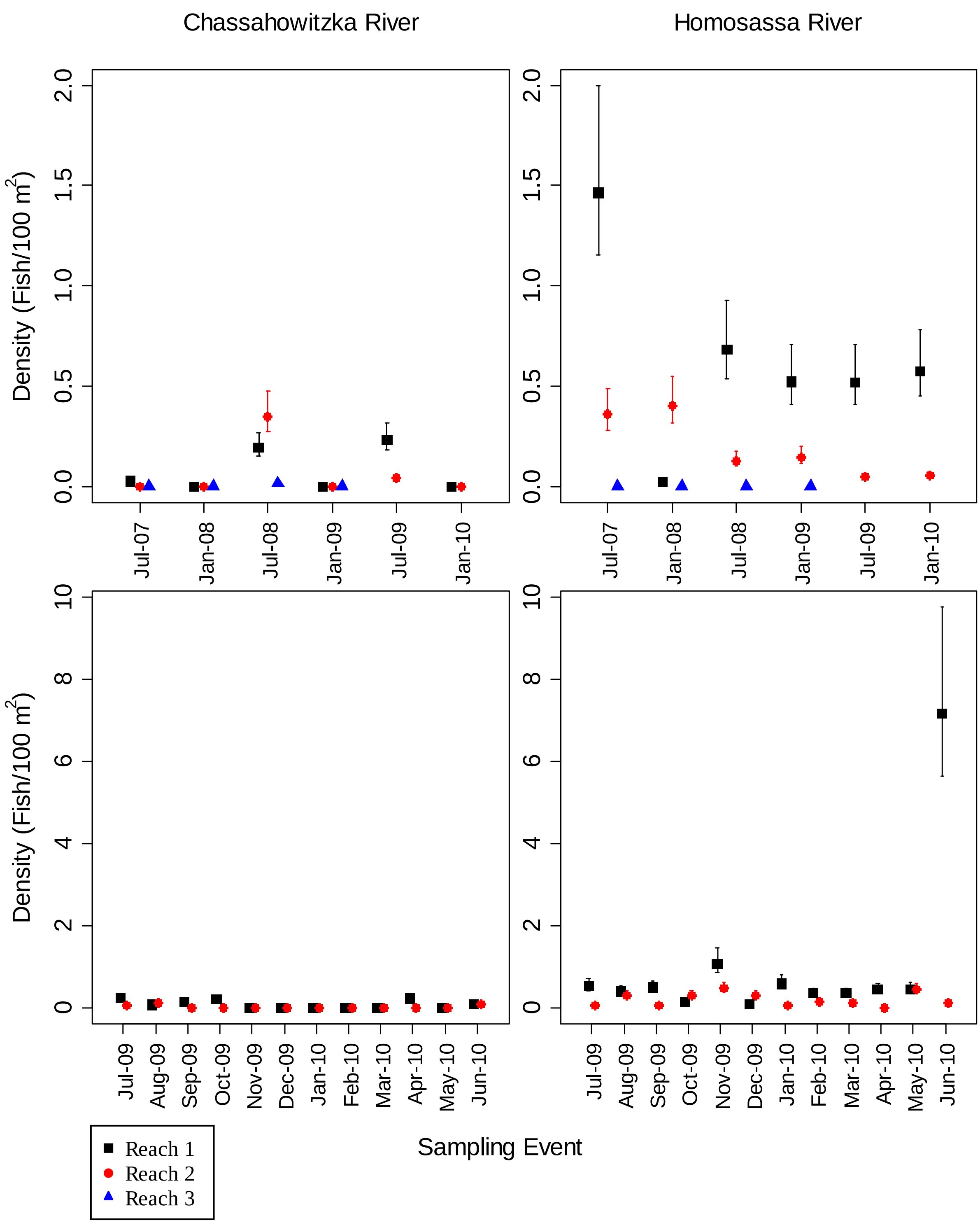


Figure 43. Estimated mean density of bluegill captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

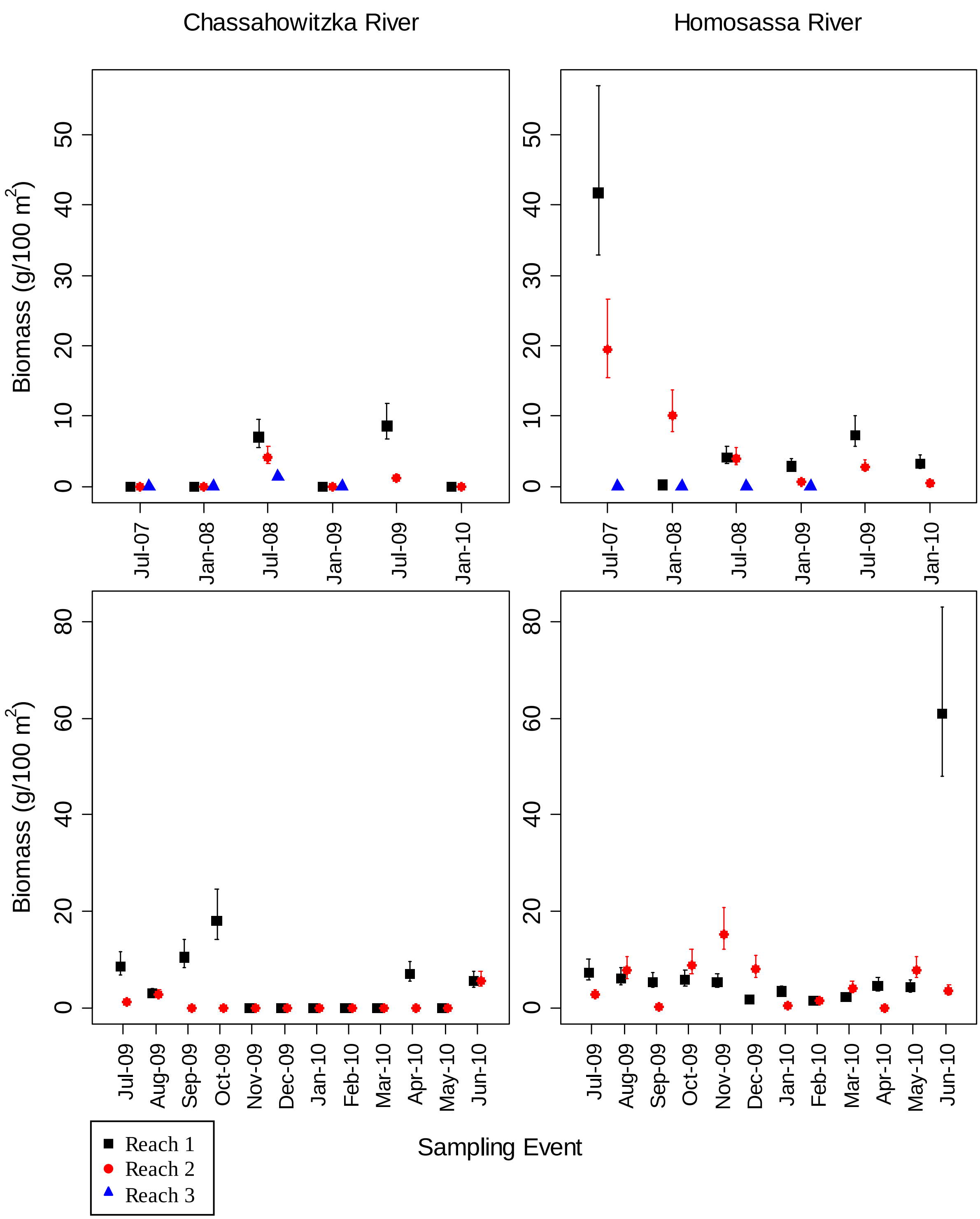


Figure 44. Estimated mean biomass of bluegill captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

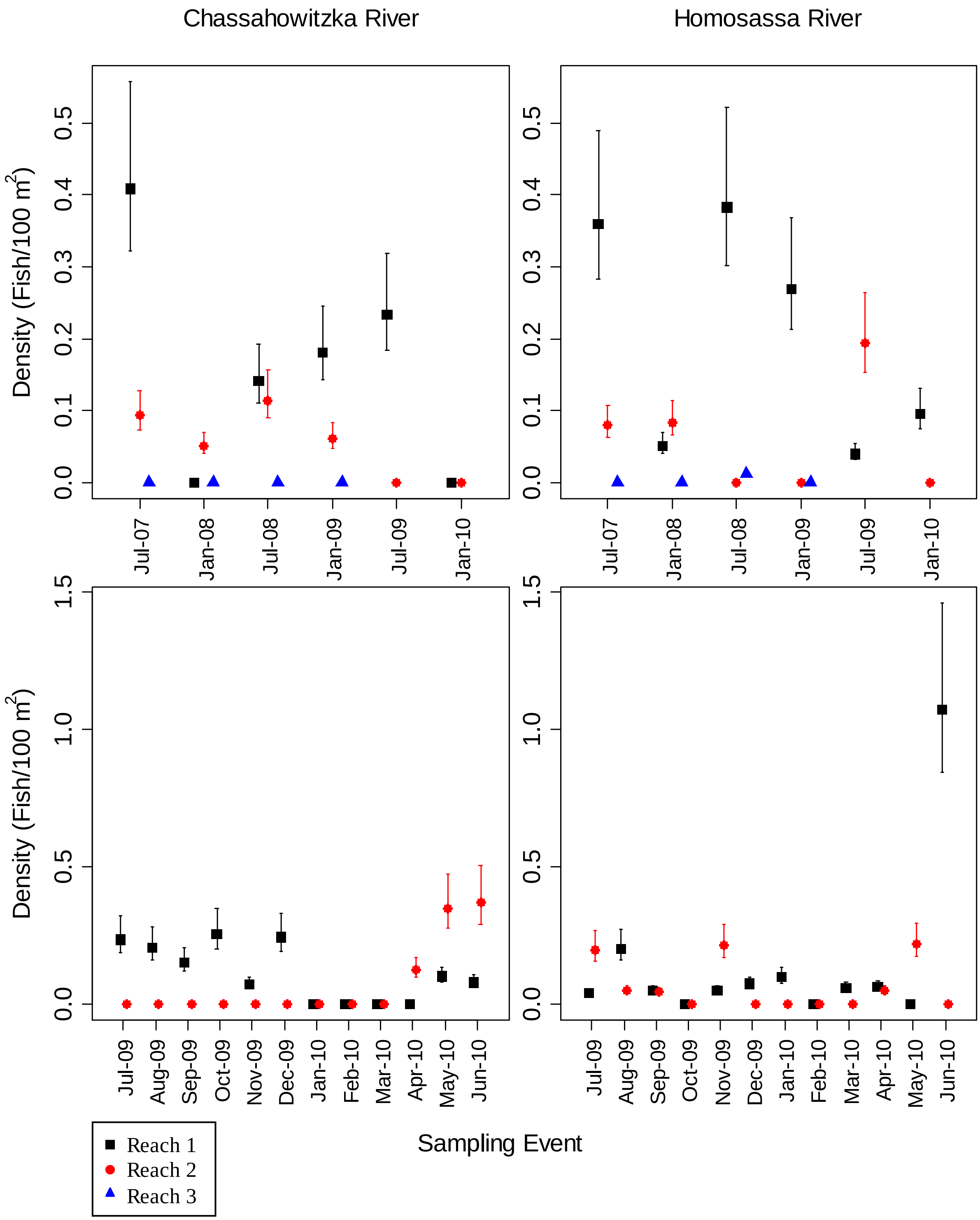


Figure 45. Estimated mean density of redear sunfish captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

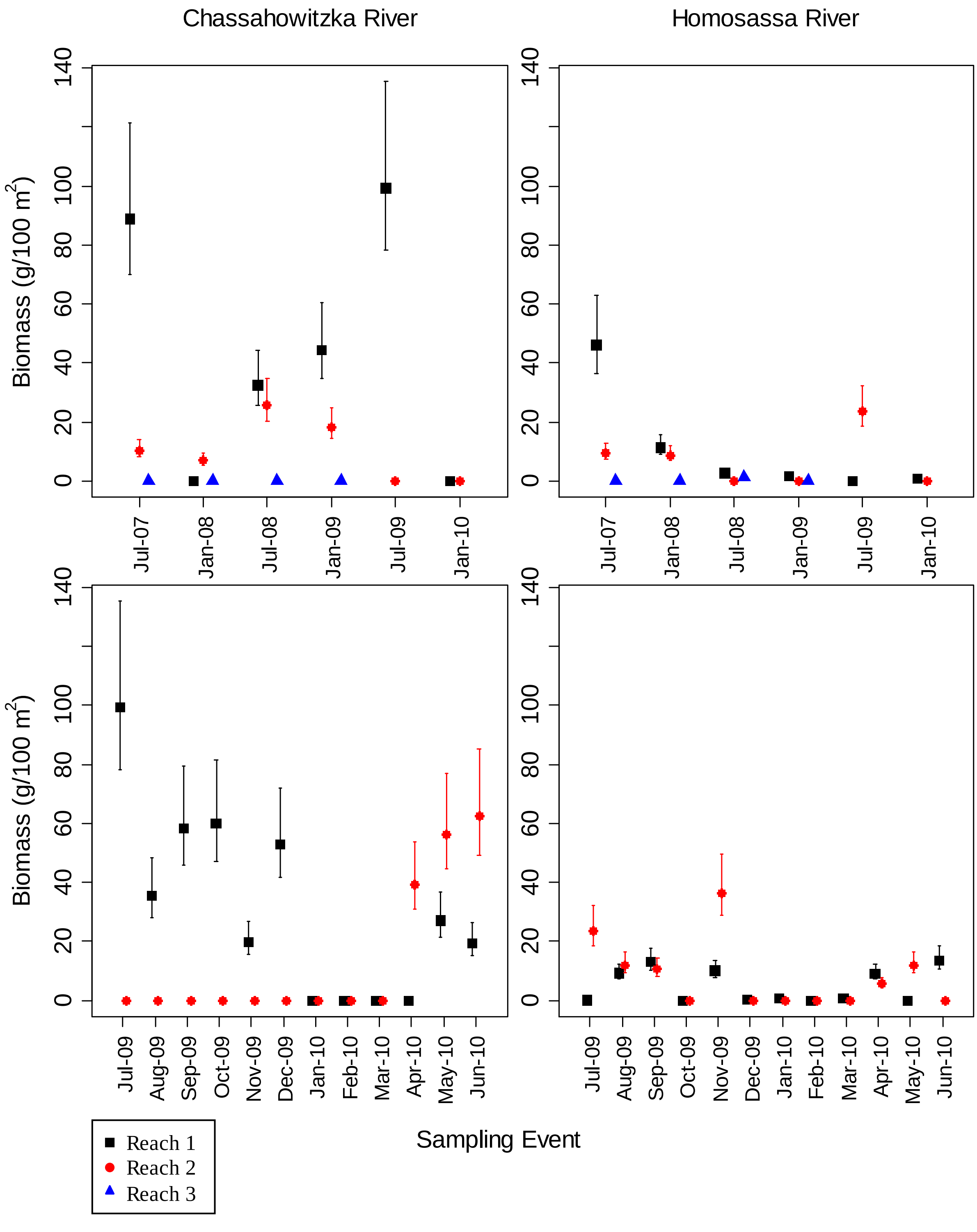


Figure 46. Estimated mean biomass of redear sunfish captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

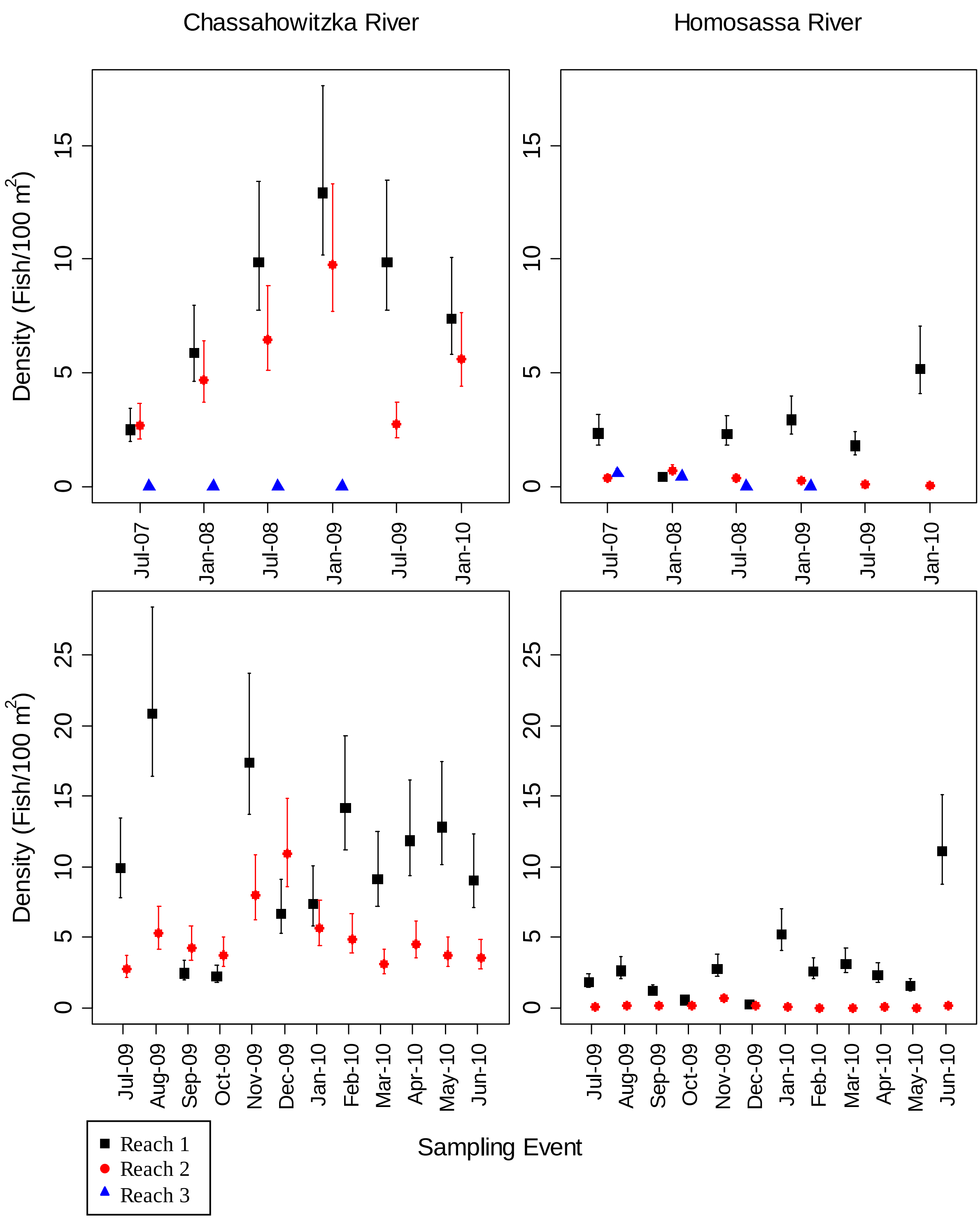


Figure 47. Estimated mean density of spotted sunfish captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

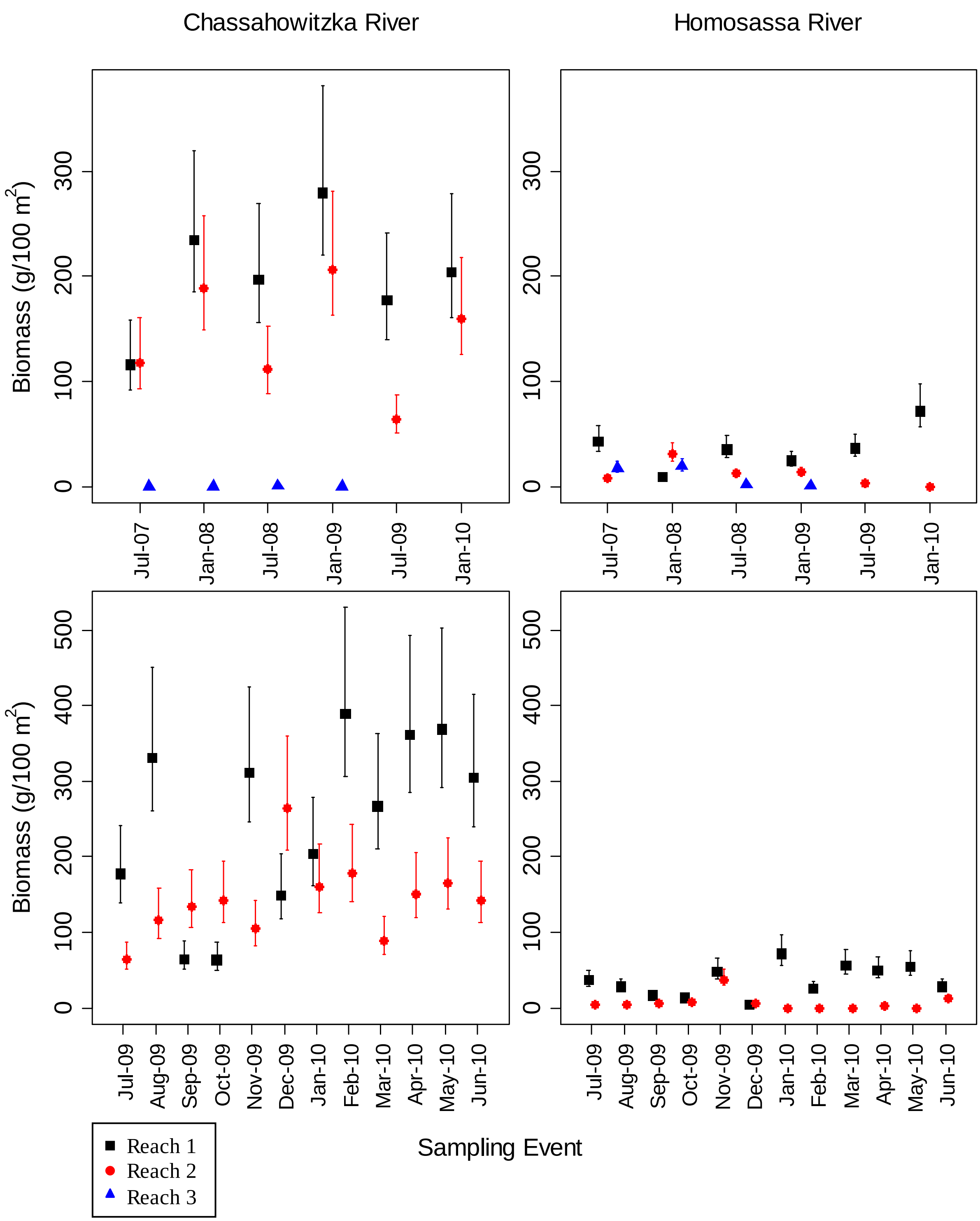


Figure 48. Estimated mean biomass of spotted sunfish captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

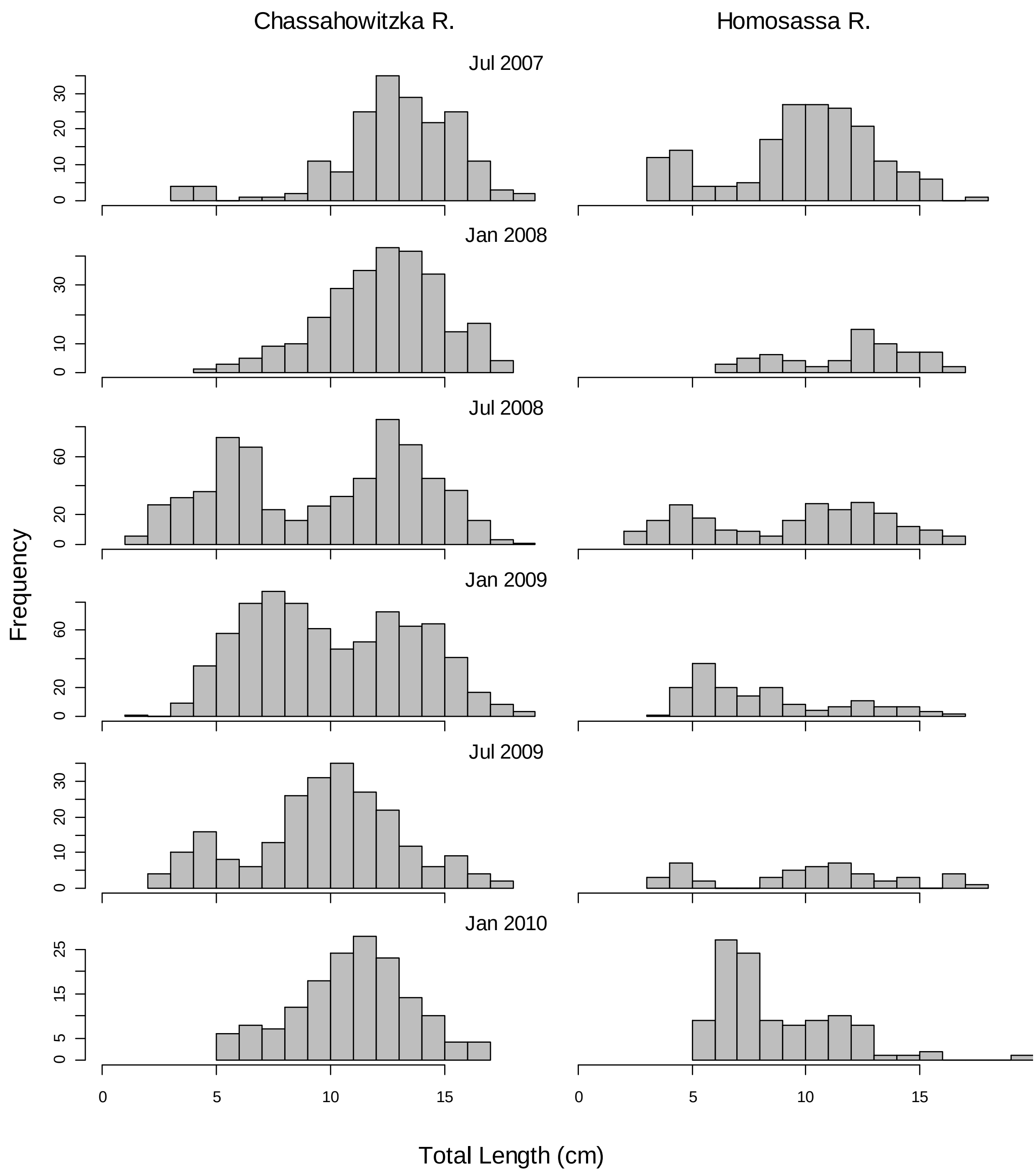


Figure 49. Biannual length frequency distributions of spotted sunfish captured by electrofishing within the Chassahowitzka and Homosassa rivers.

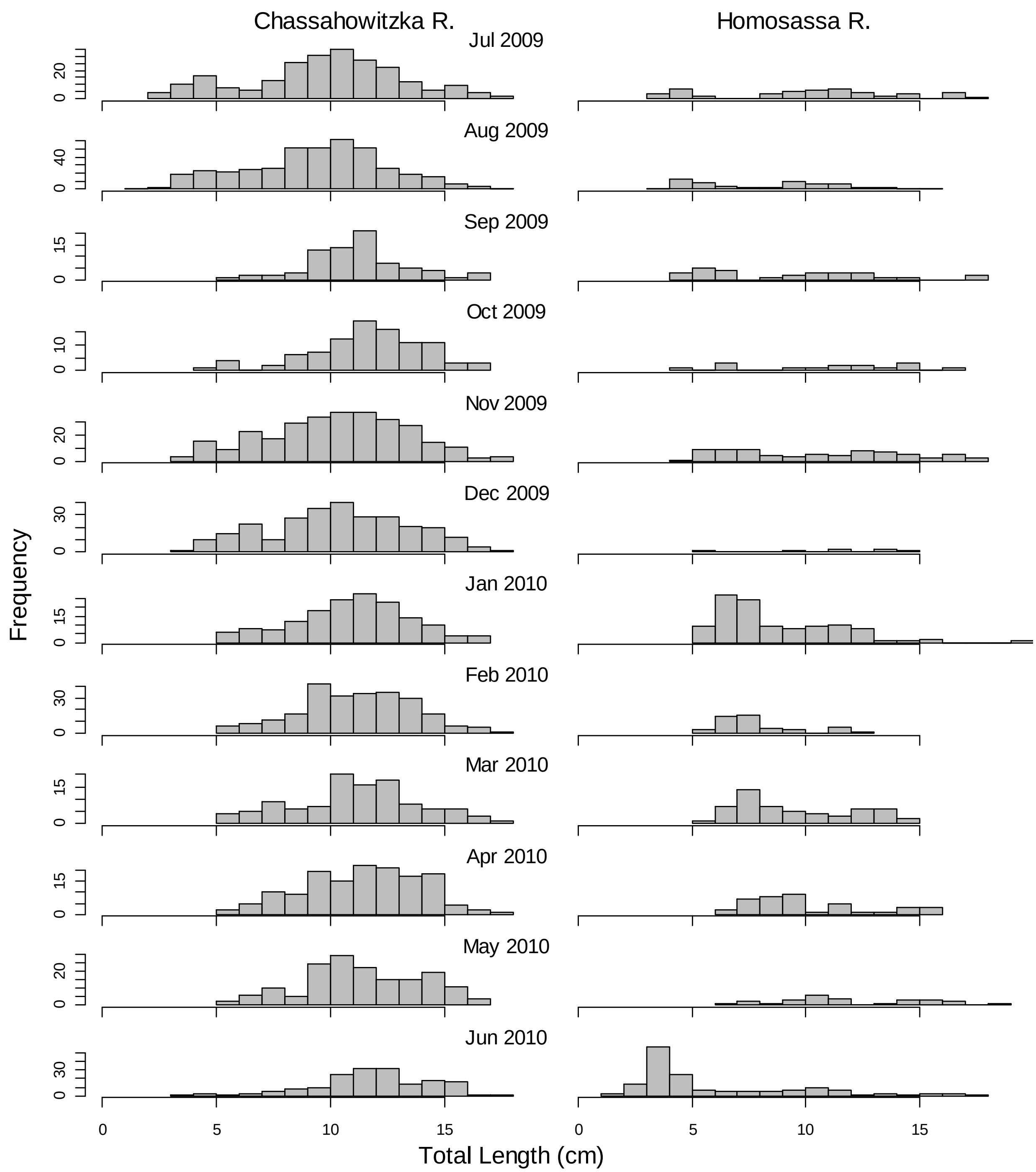


Figure 50. Monthly length frequency distributions of spotted sunfish captured by electrofishing within the Chassahowitzka and Homosassa rivers.

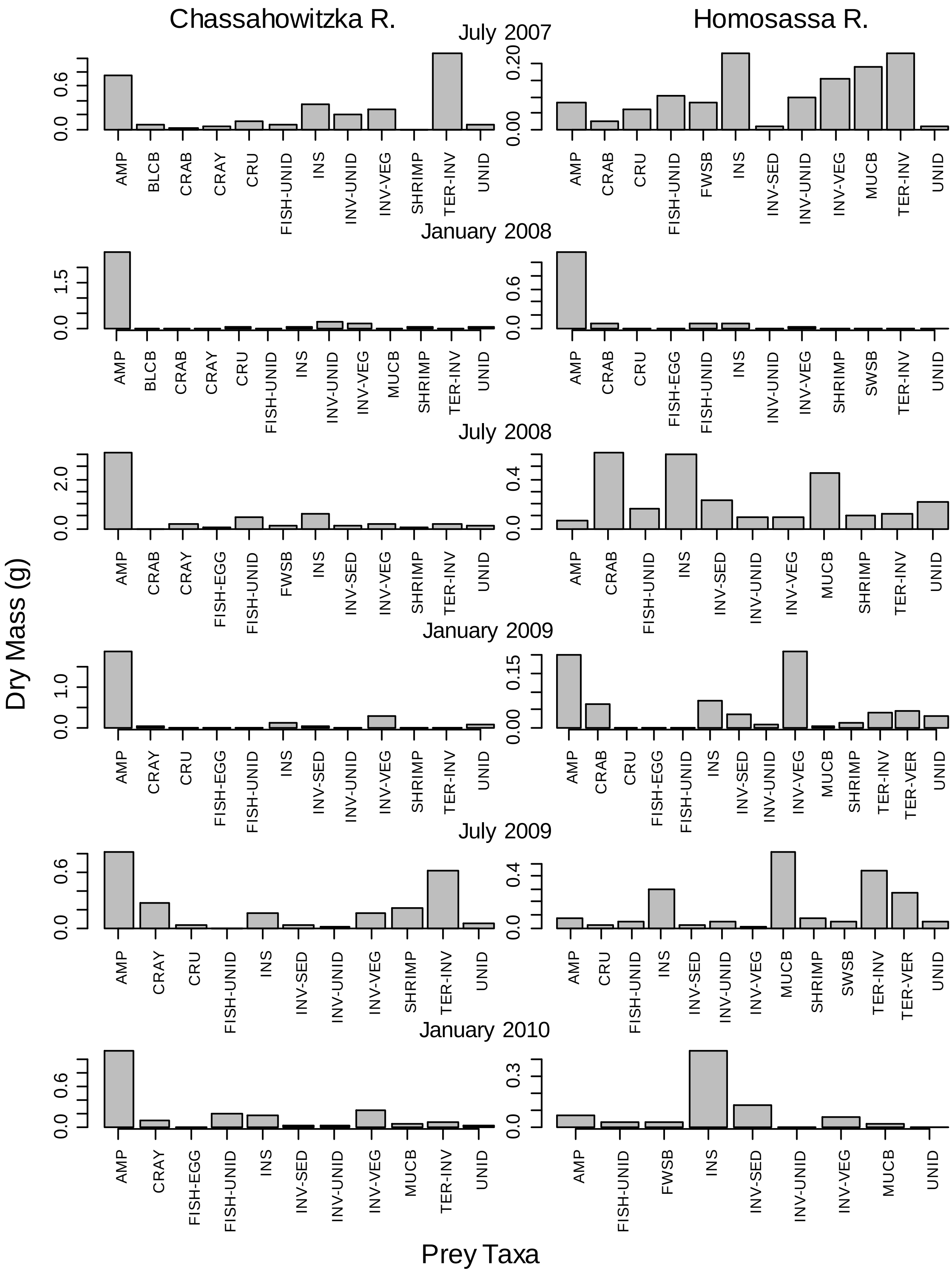


Figure 51. Diet composition (by dry mass) of spotted sunfish in the Chassahowitzka and Homosassa rivers.

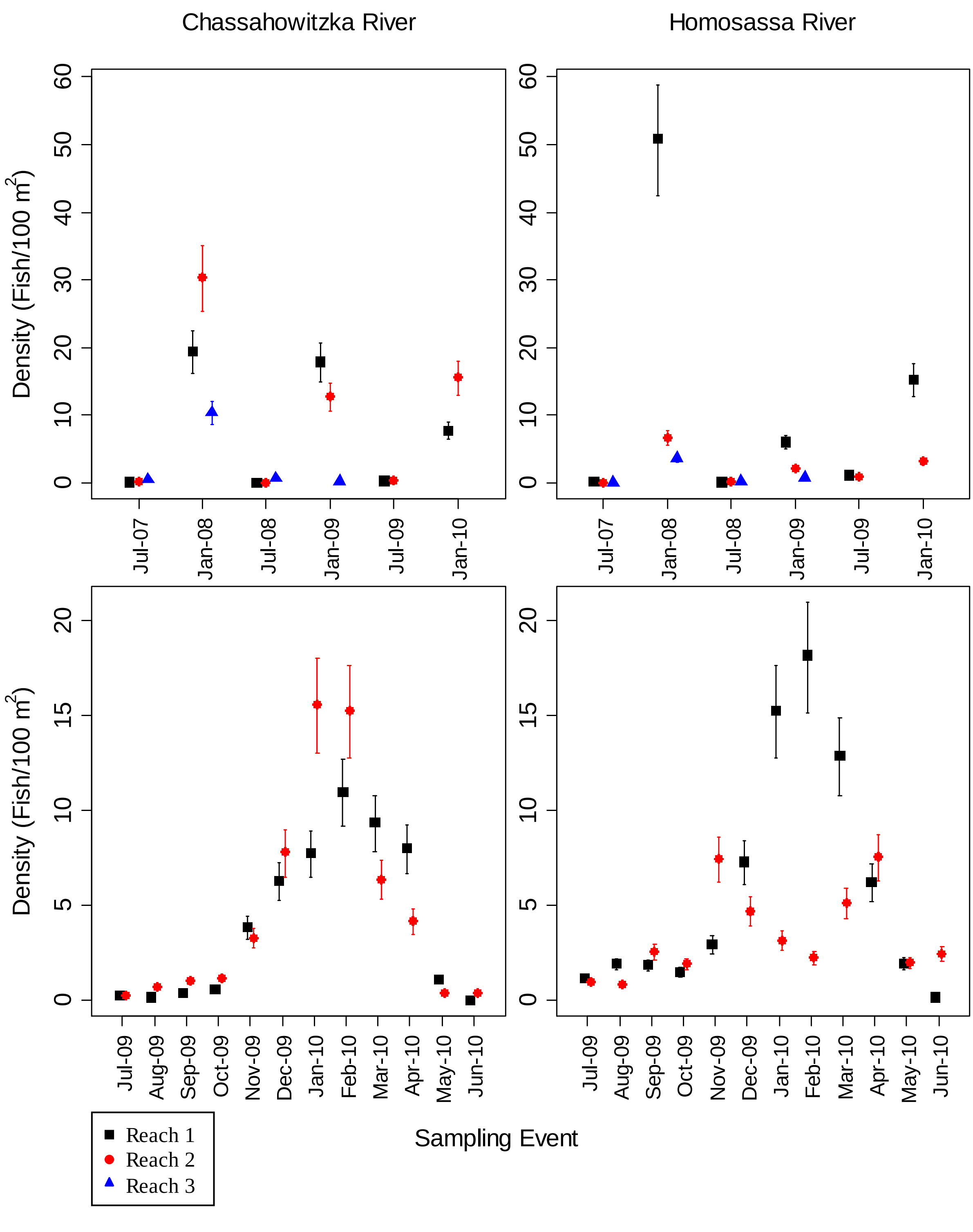


Figure 52. Estimated mean density of gray snapper captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

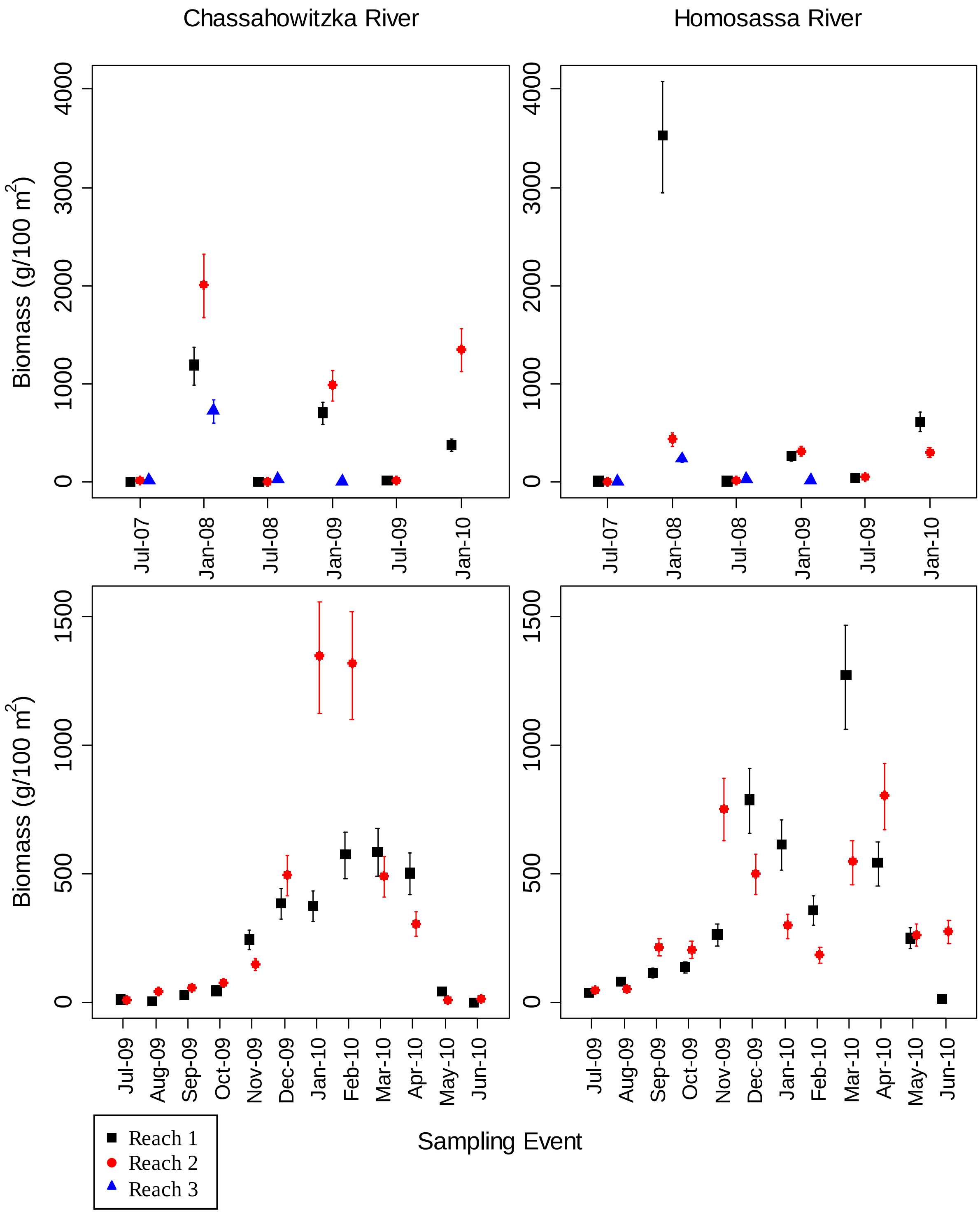


Figure 53. Estimated mean biomass of gray snapper captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

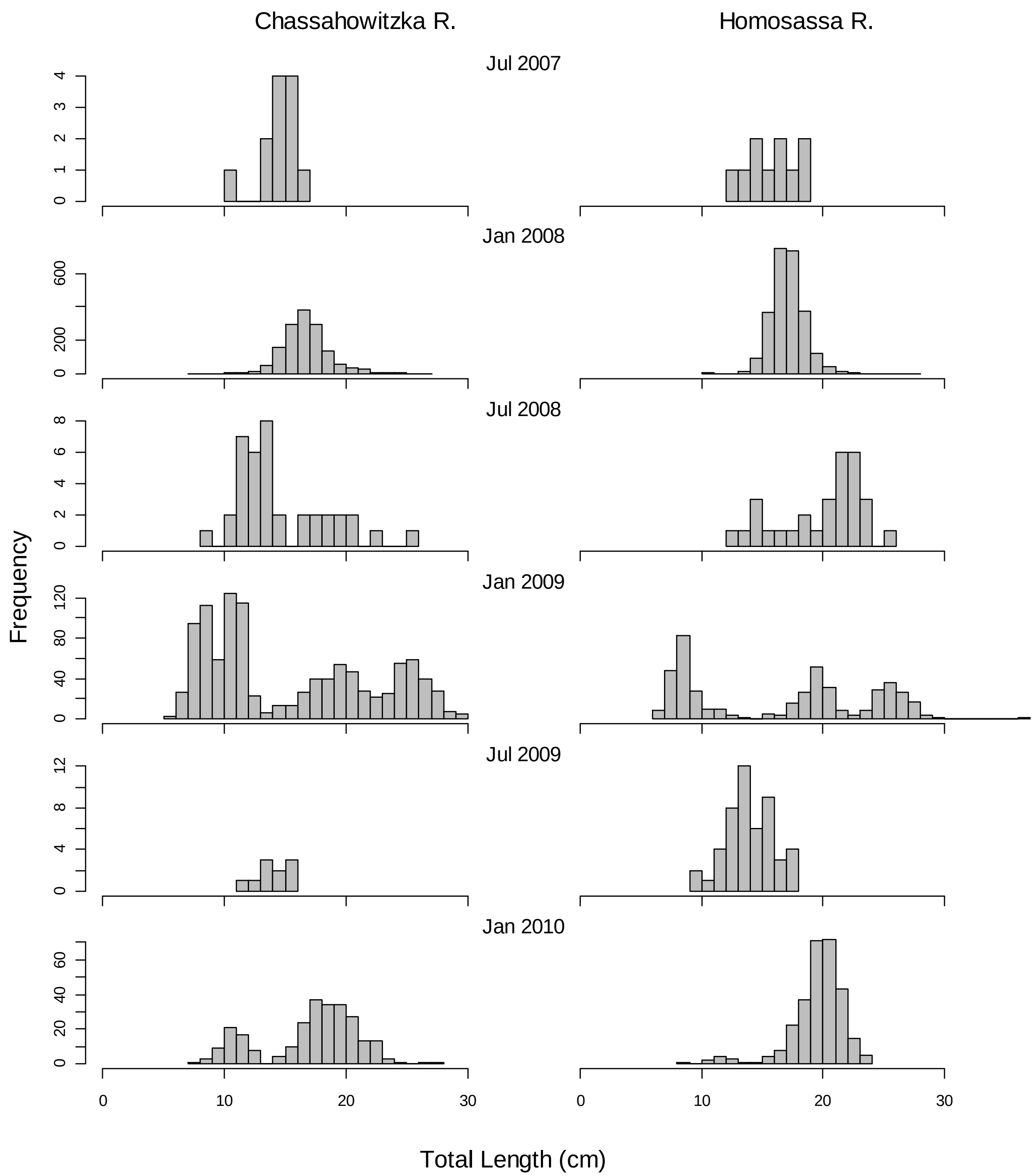


Figure 54. Biannual length frequency distributions of gray snapper captured by electrofishing within the Chassahowitzka and Homosassa rivers.

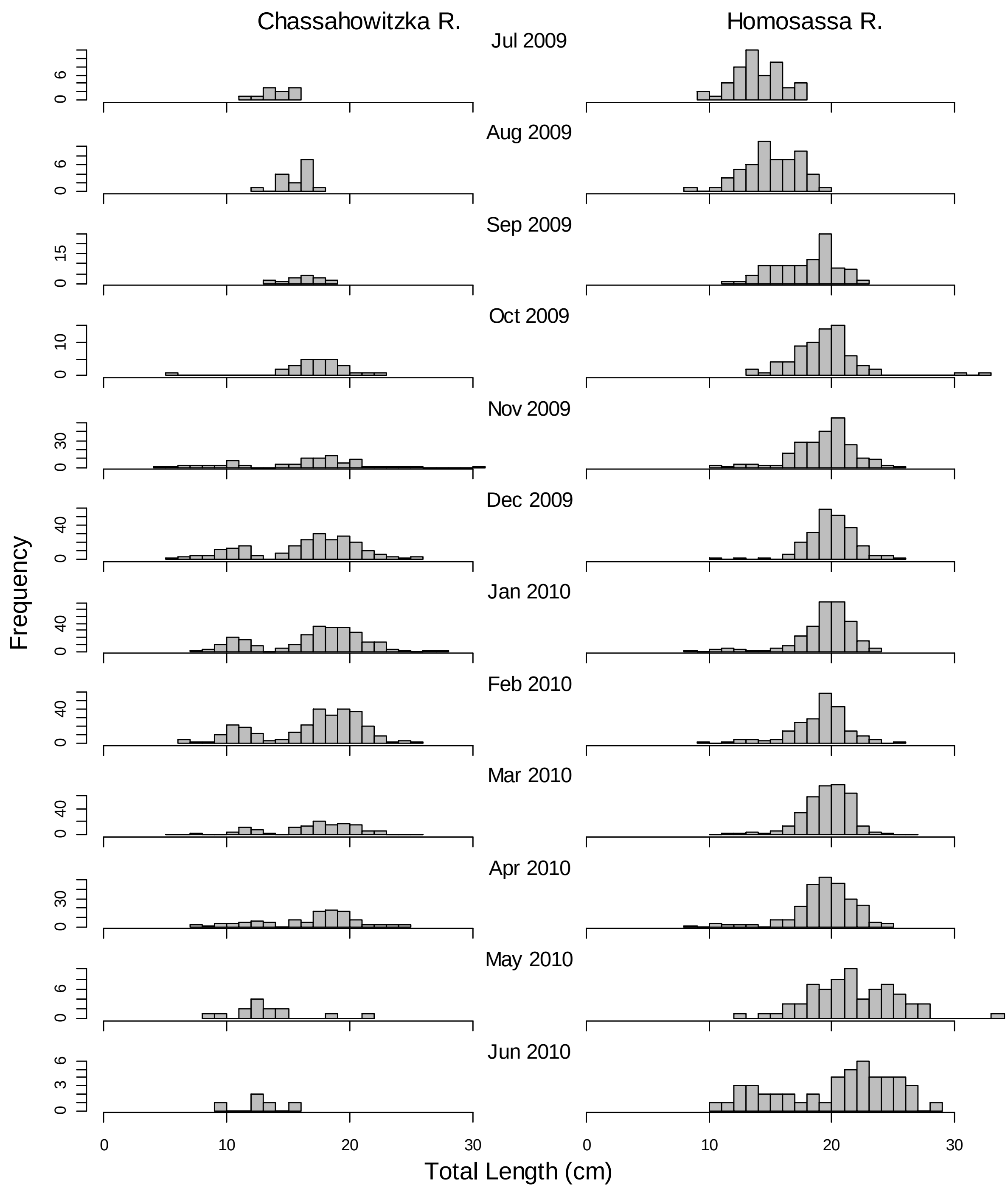


Figure 55. Monthly length frequency distributions of gray snapper captured by electrofishing within the Chassahowitzka and Homosassa rivers.

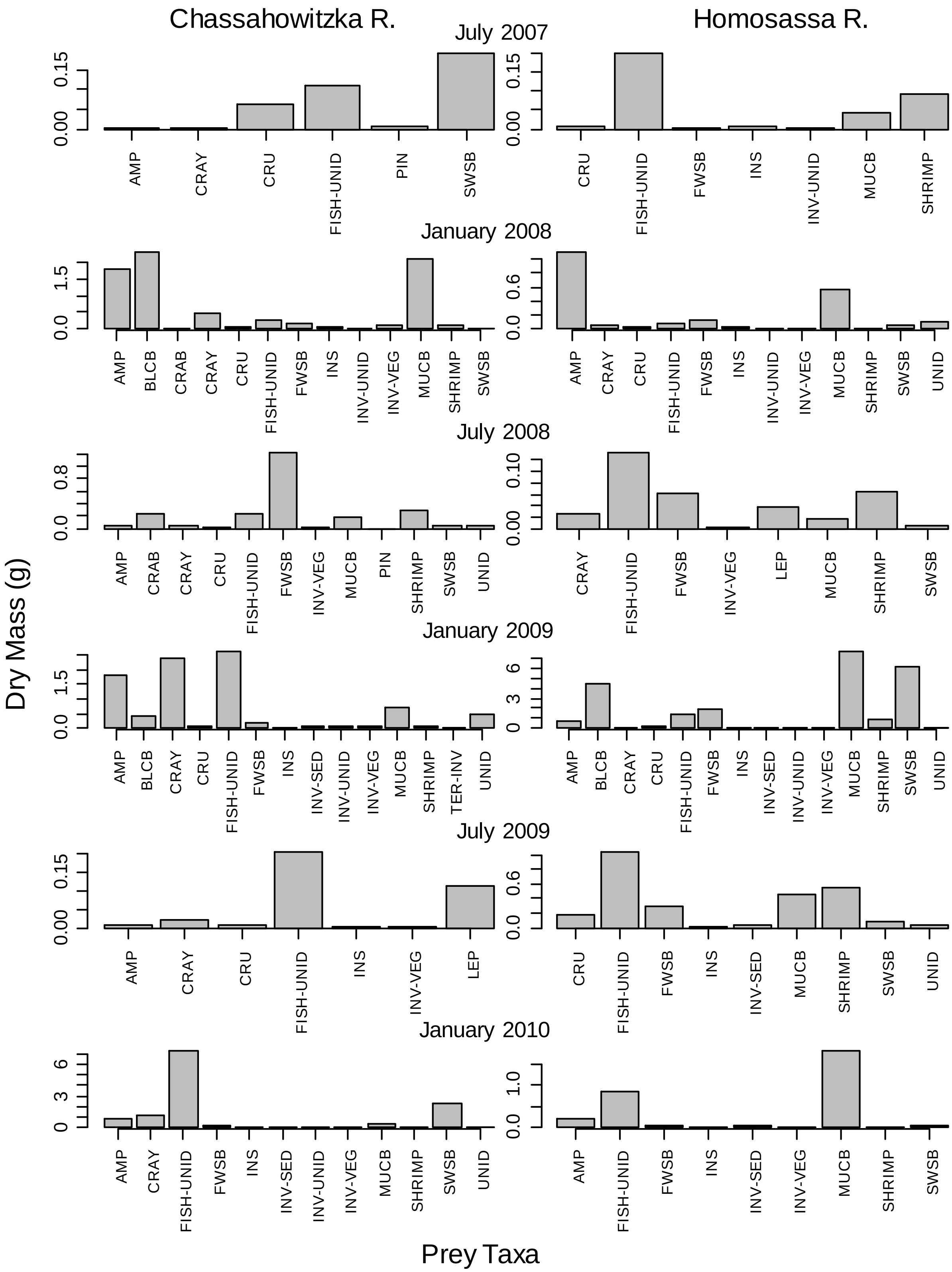


Figure 56. Diet composition (by dry mass) of gray snapper in the Chassahowitzka and Homosassa rivers.

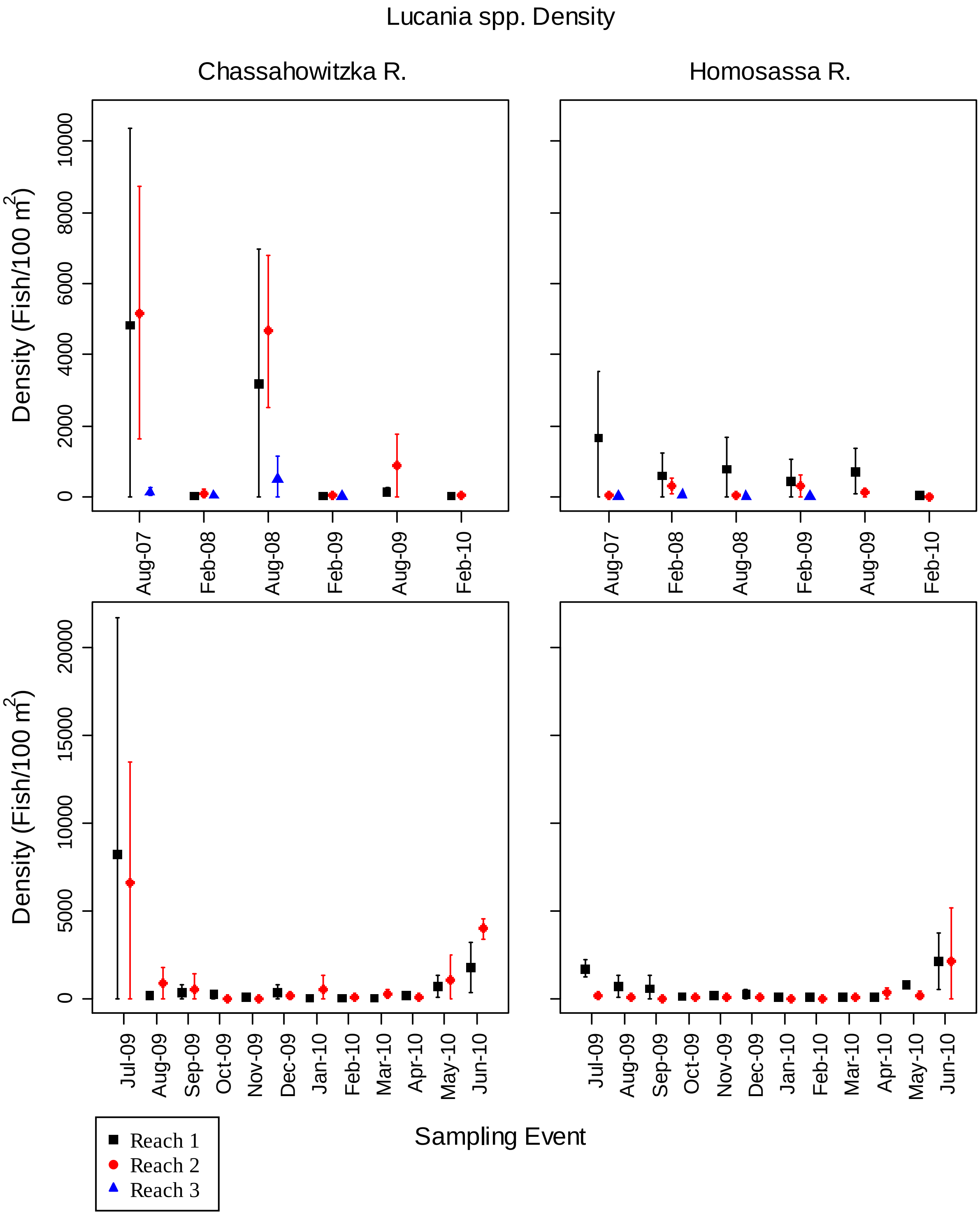


Figure 57. Estimated mean density of *Lucania* spp. (*L. parva* and *L. goodei*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

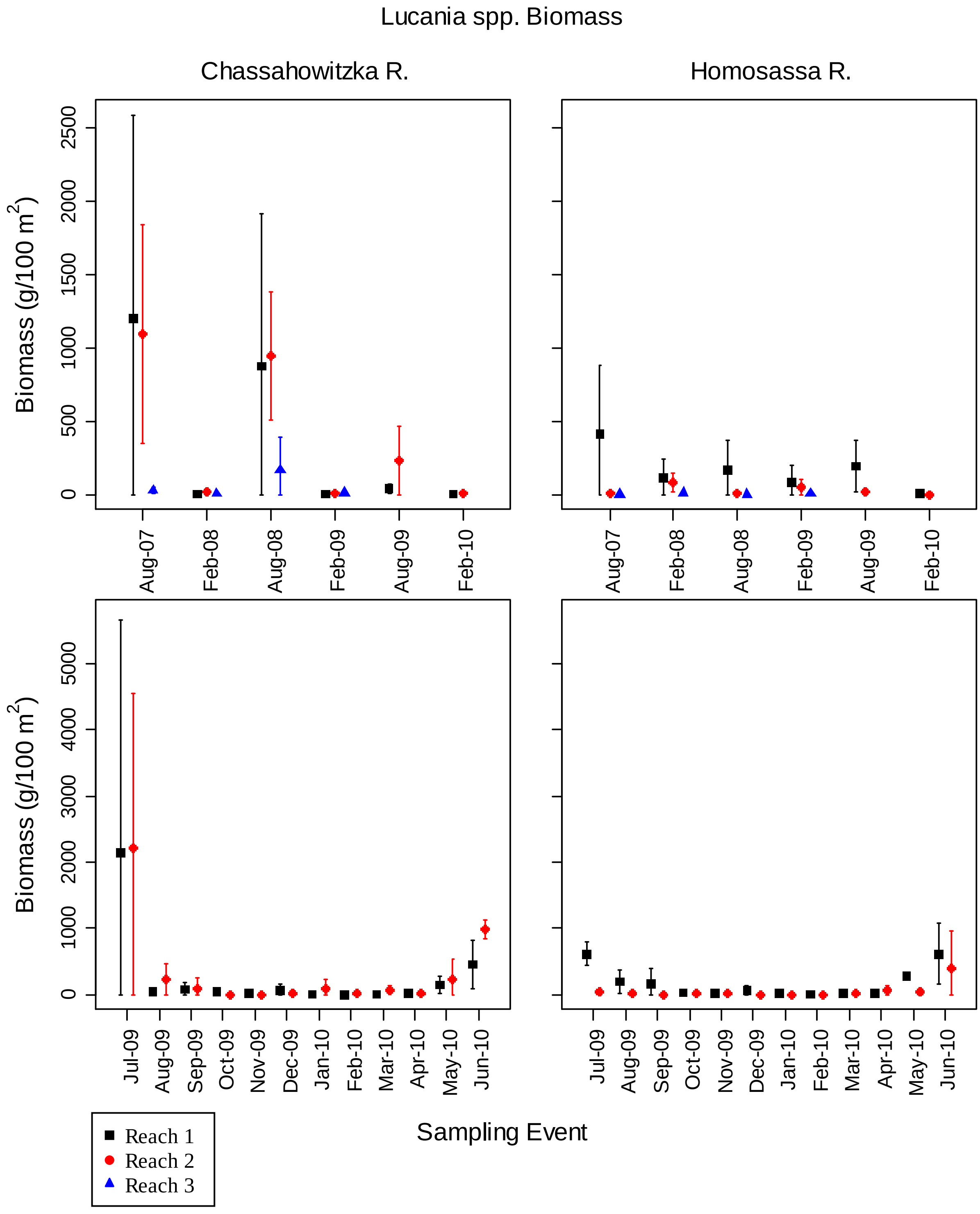


Figure 58. Estimated mean biomass of *Lucania* spp. (*L. parva* and *L. goodei*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

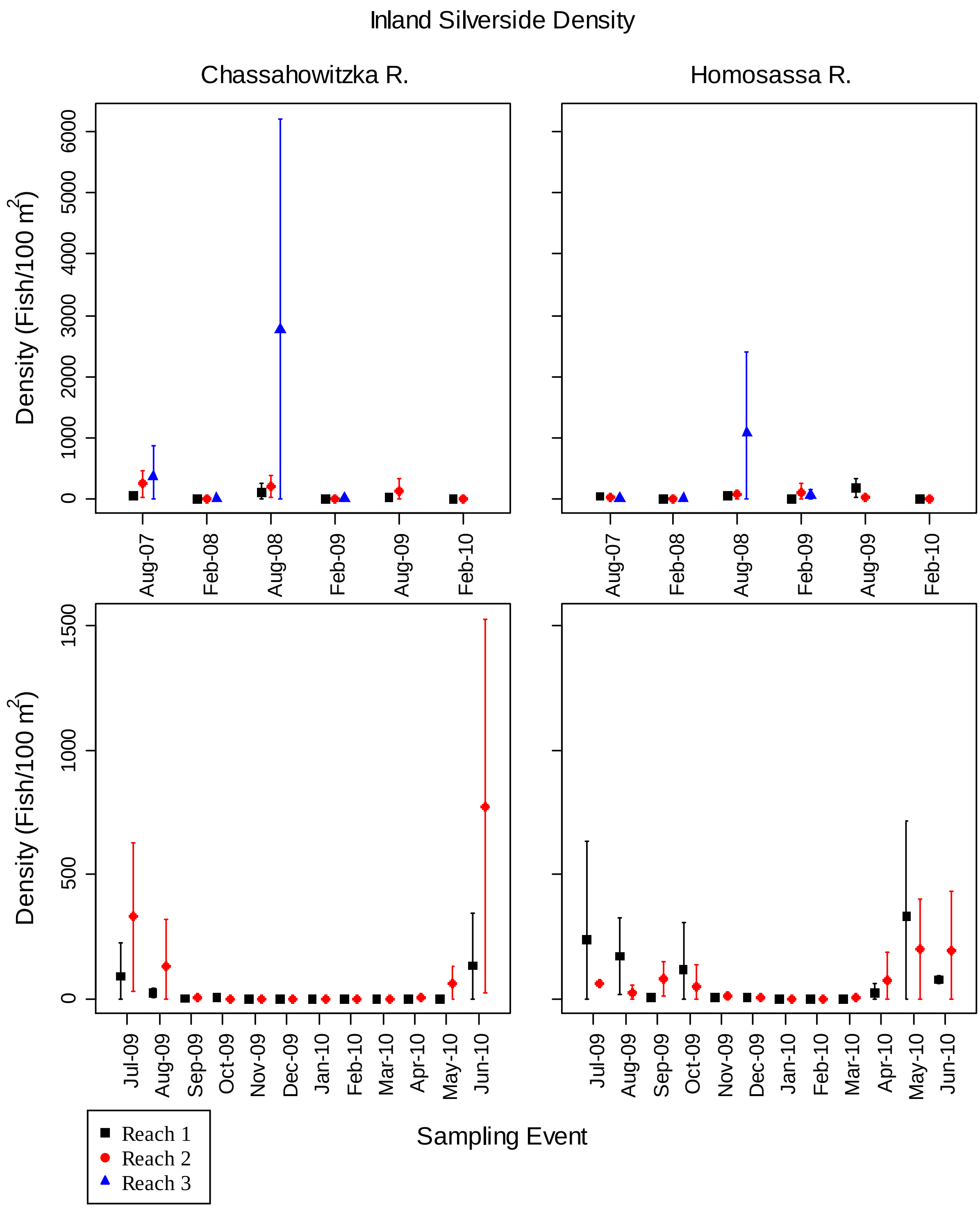


Figure 59. Estimated mean density of inland silverside captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

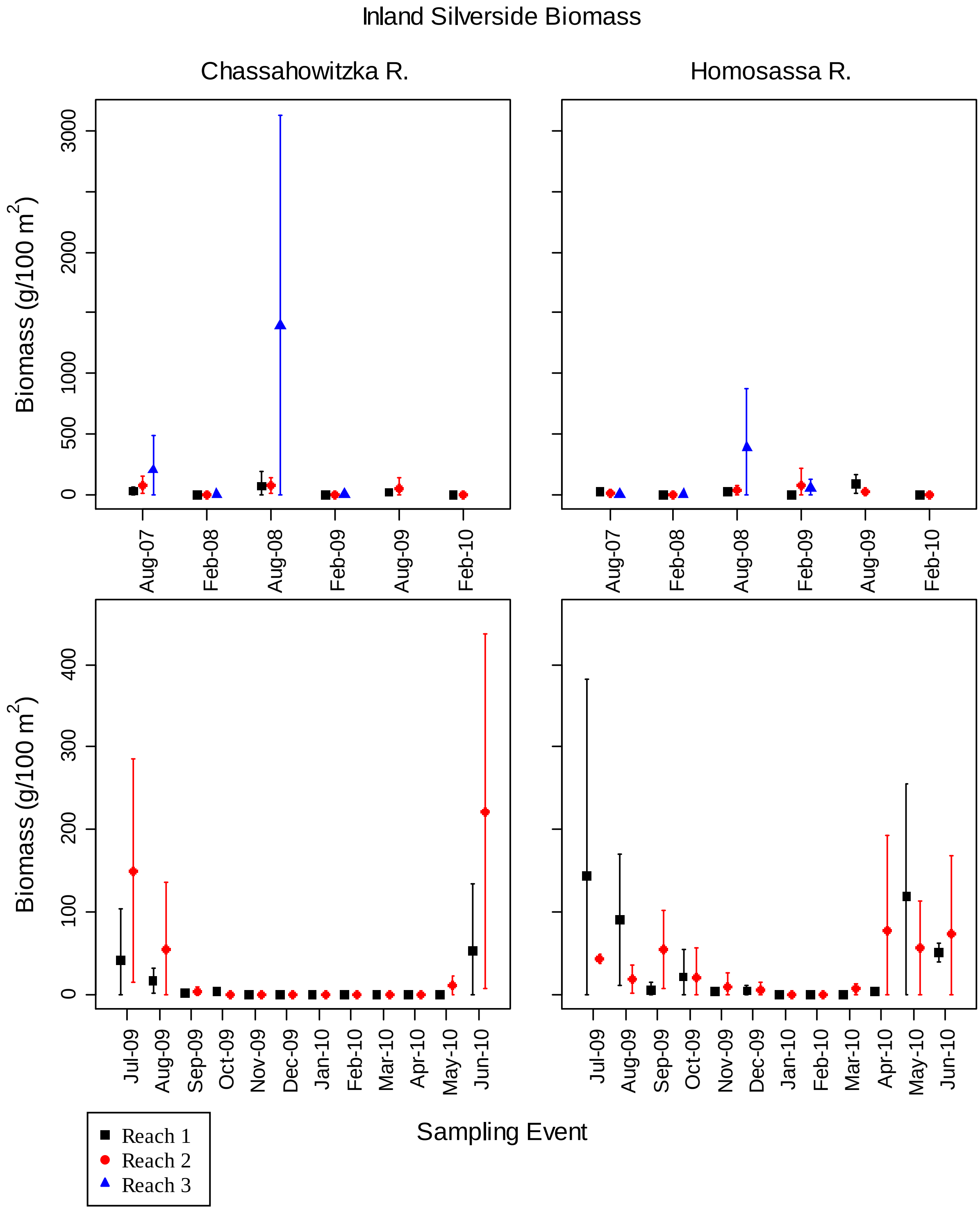


Figure 60. Estimated mean biomass of inland silverside captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

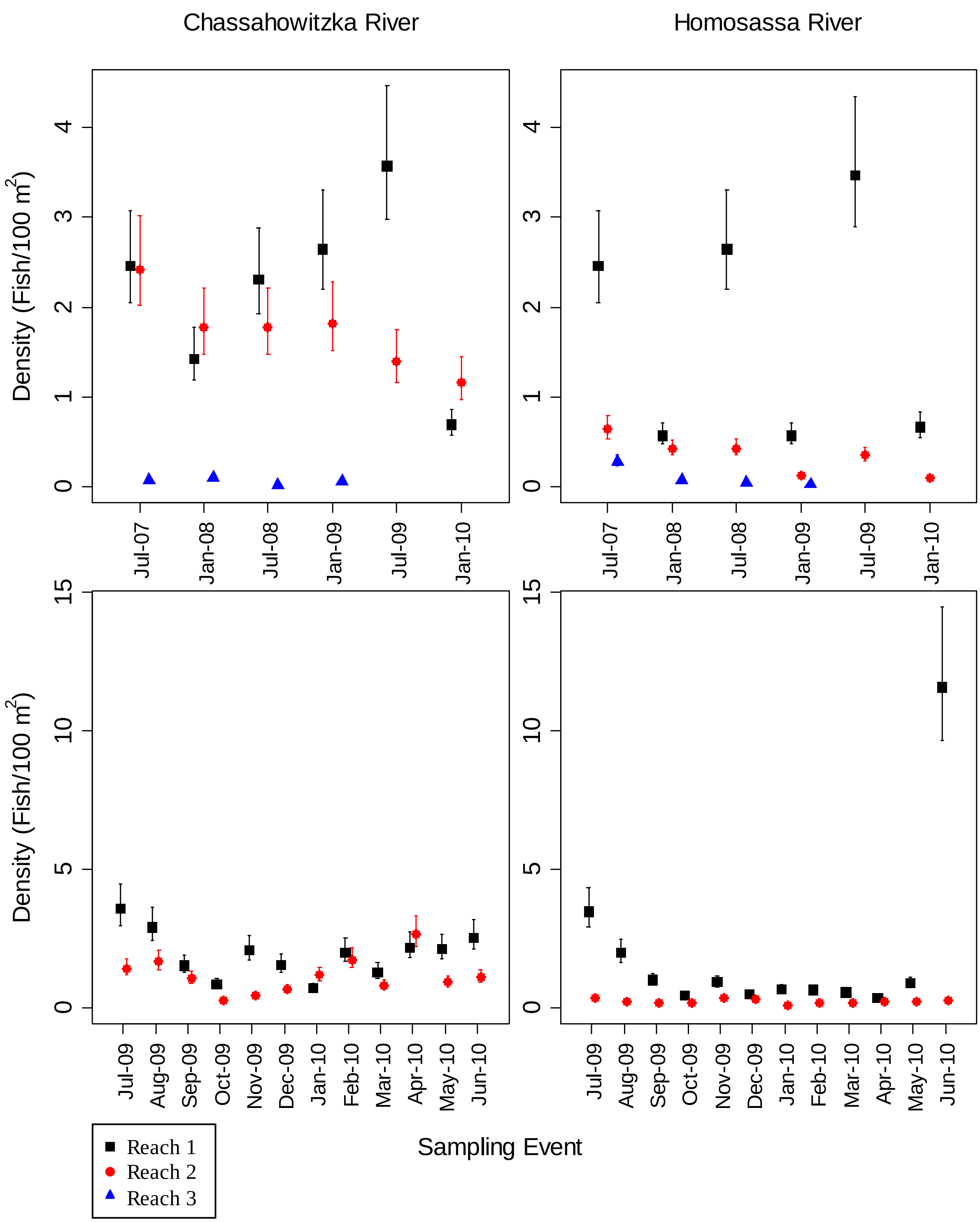


Figure 61. Estimated mean density of largemouth bass captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

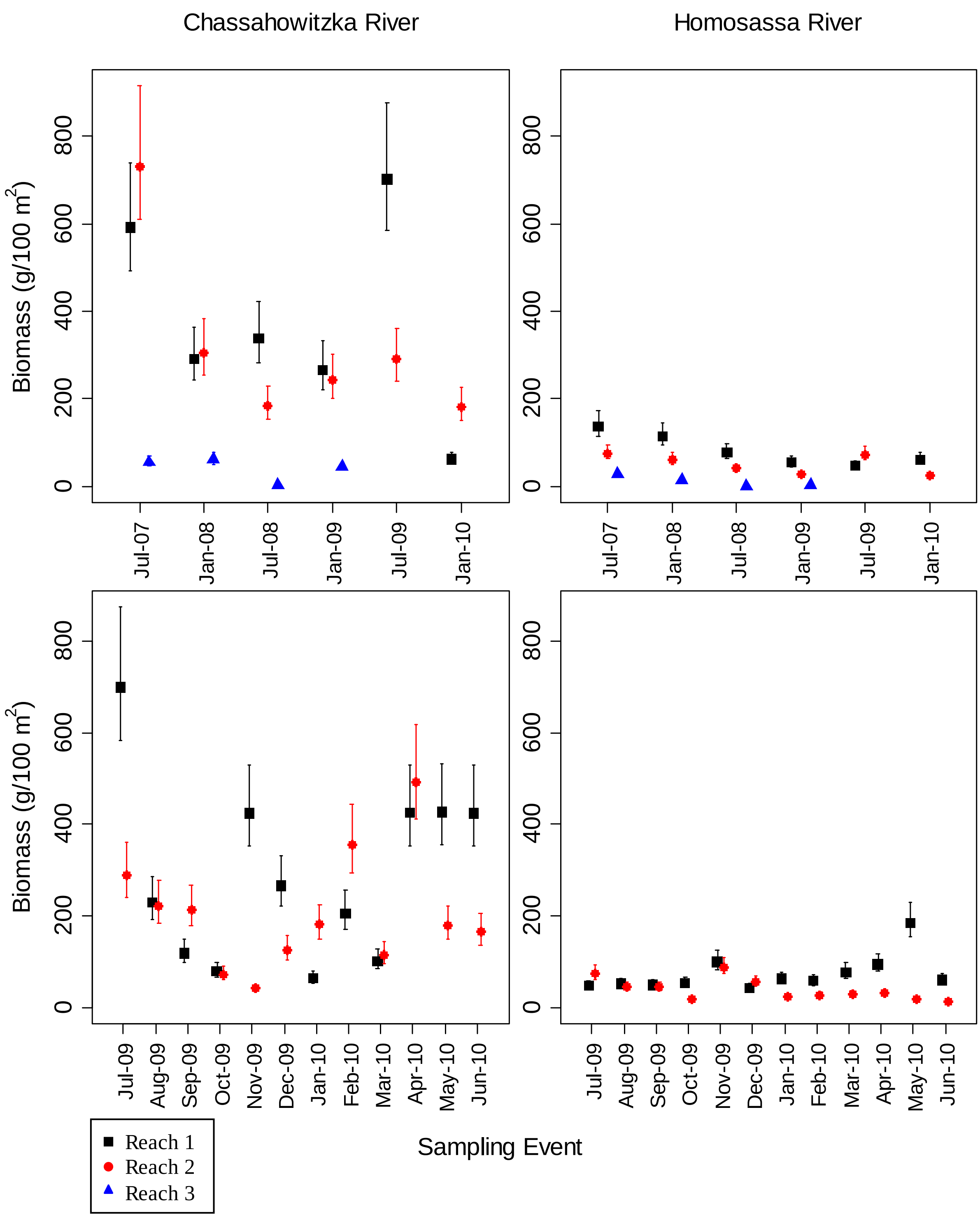


Figure 62. Estimated mean biomass of largemouth bass captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

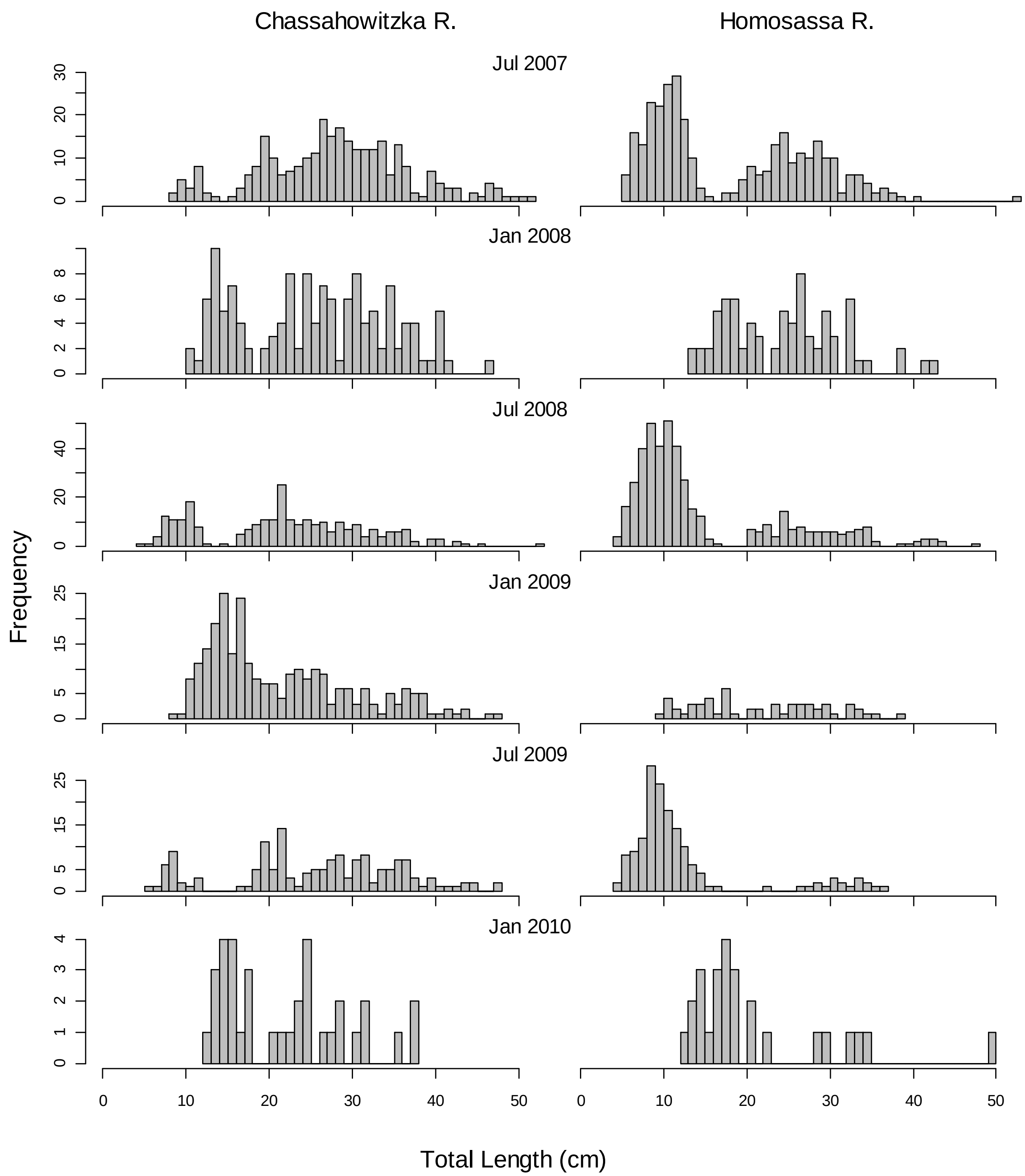


Figure 63. Biannual length frequency distributions of largemouth bass captured by electrofishing within the Chassahowitzka and Homosassa rivers.

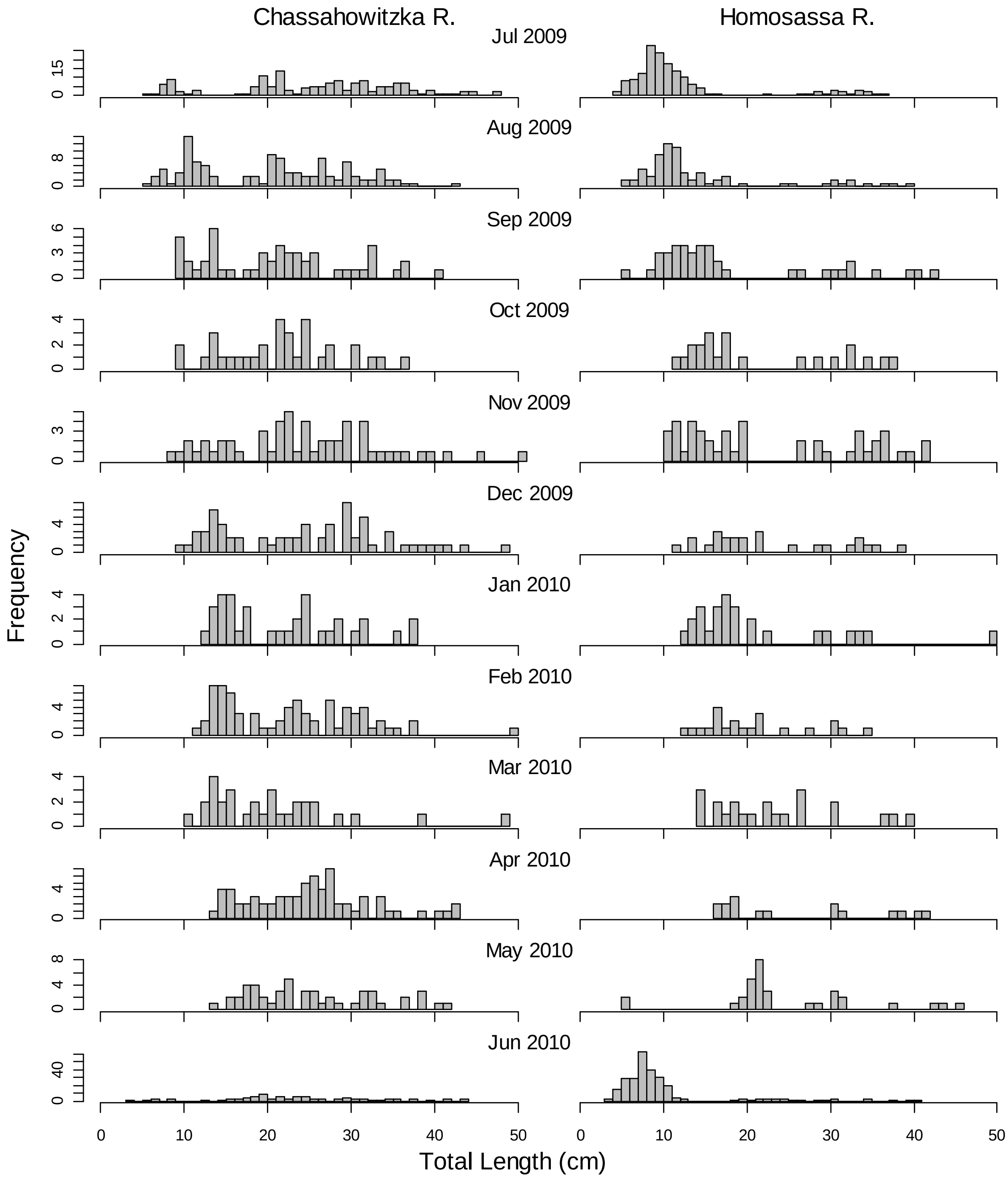


Figure 64. Monthly length frequency distributions of largemouth bass captured by electrofishing within the Chassahowitzka and Homosassa rivers.

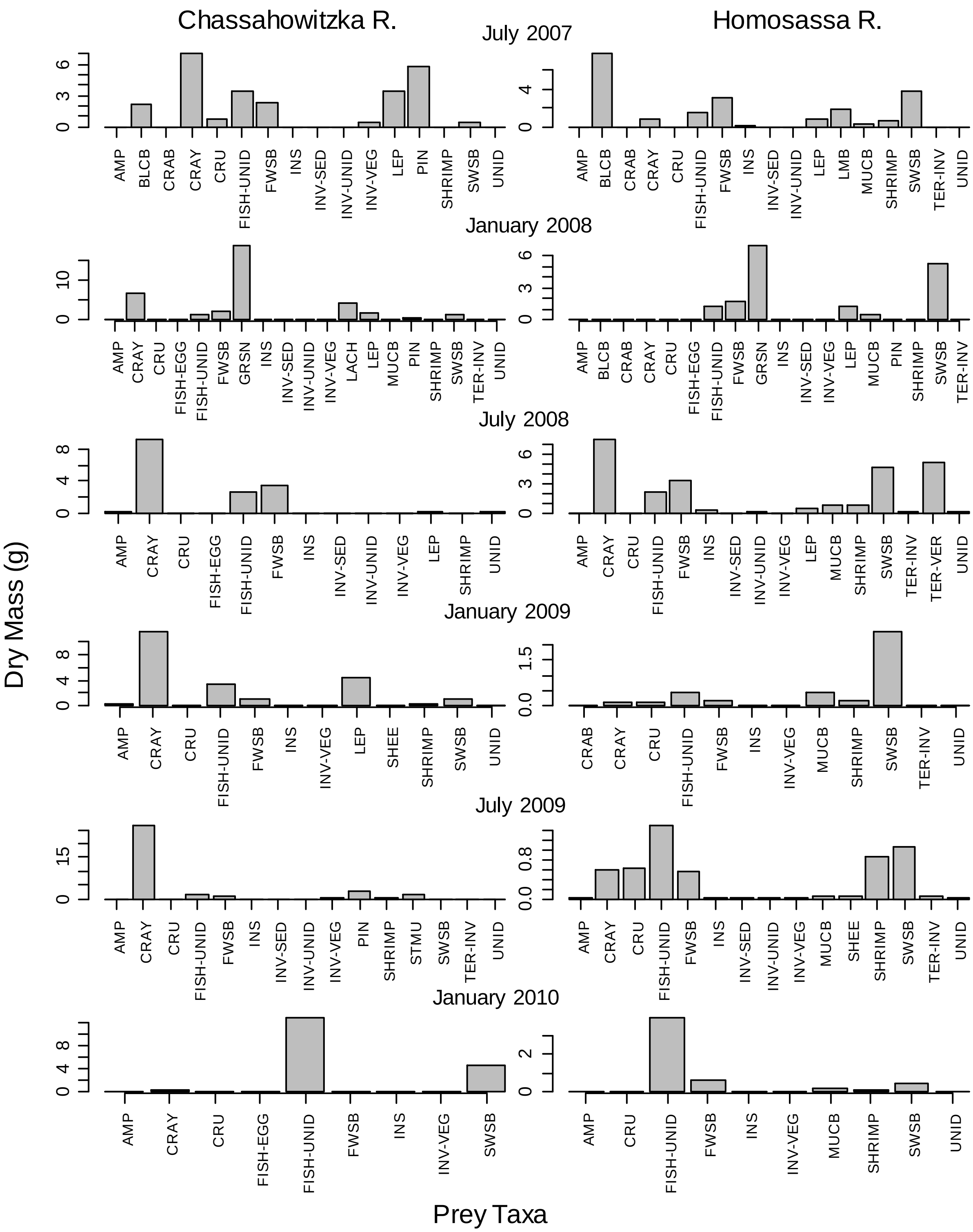


Figure 65. Diet composition (by dry mass) of largemouth bass in the Chassahowitzka and Homosassa rivers.

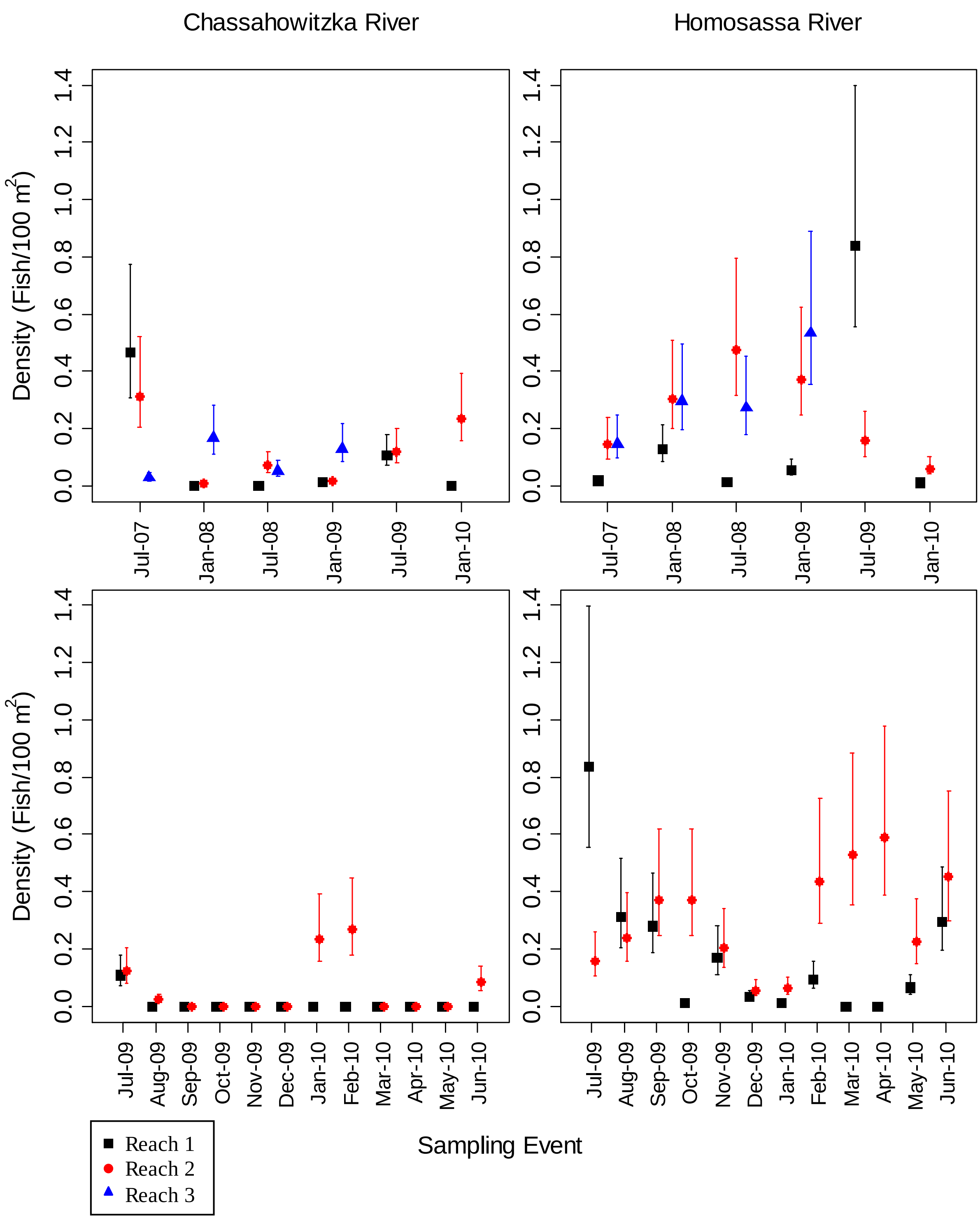


Figure 66. Estimated mean density of striped mullet captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

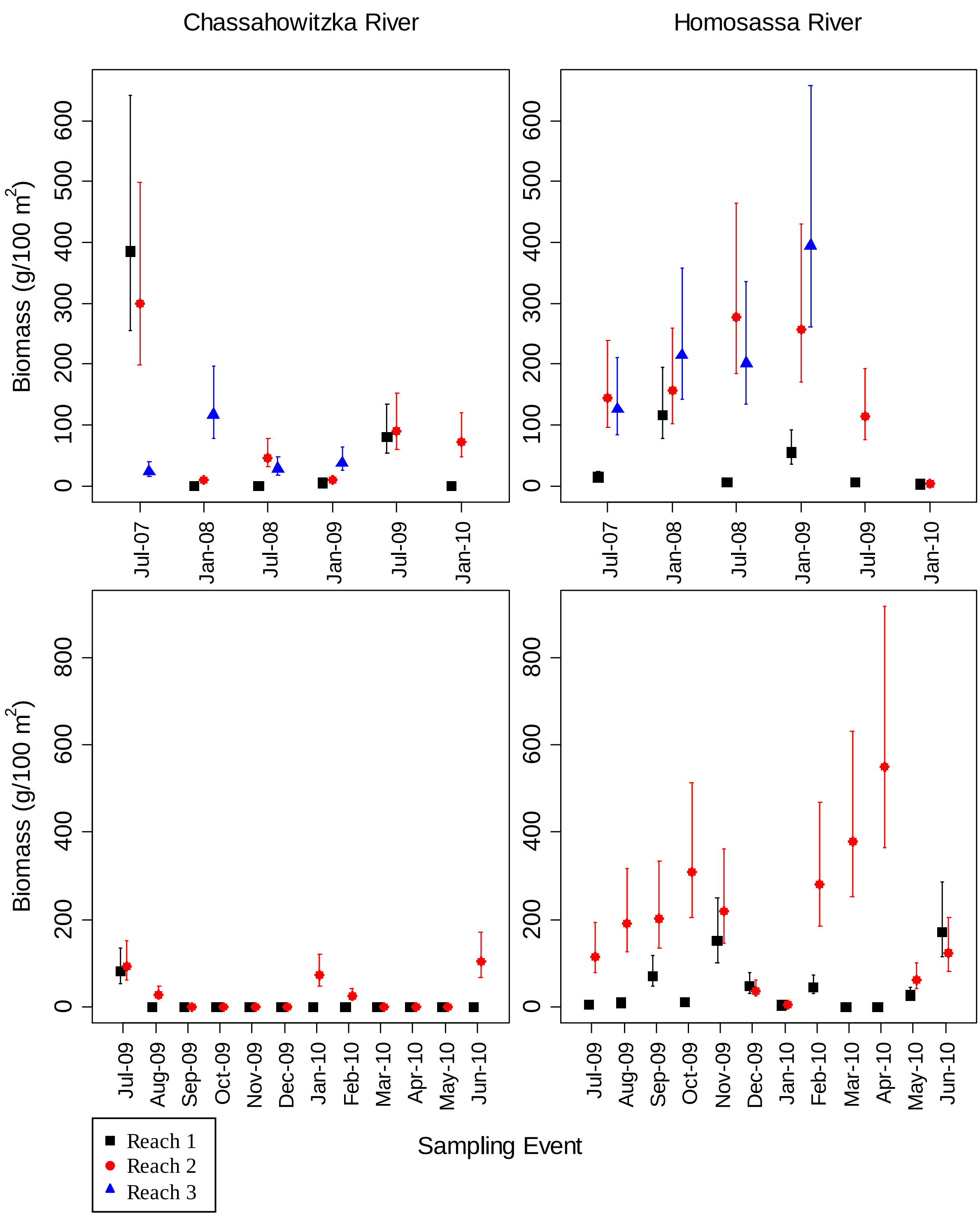


Figure 67. Estimated mean biomass of striped mullet captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

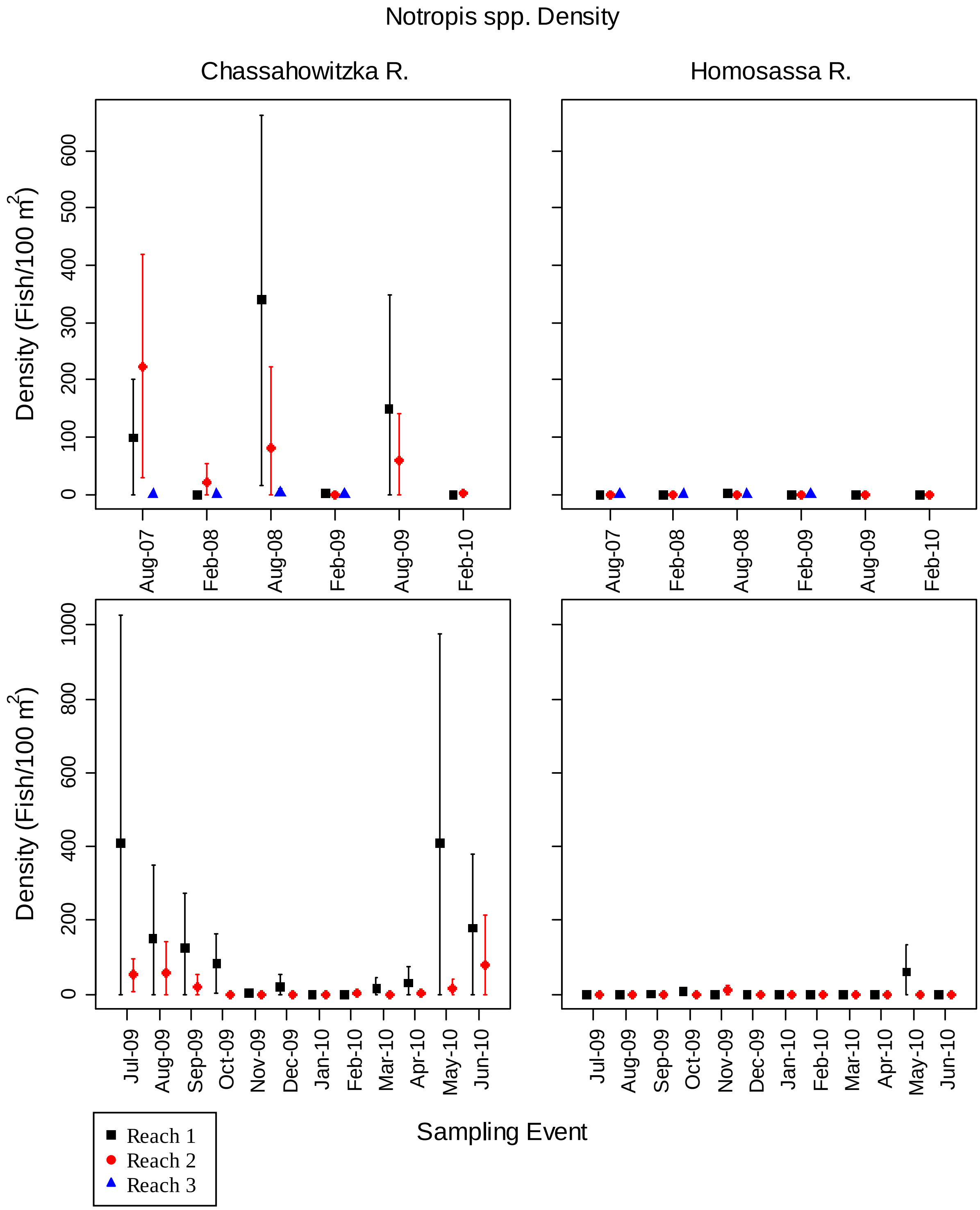


Figure 68. Estimated mean density of *Notropis* spp. (*N. petersoni and N. harperi*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

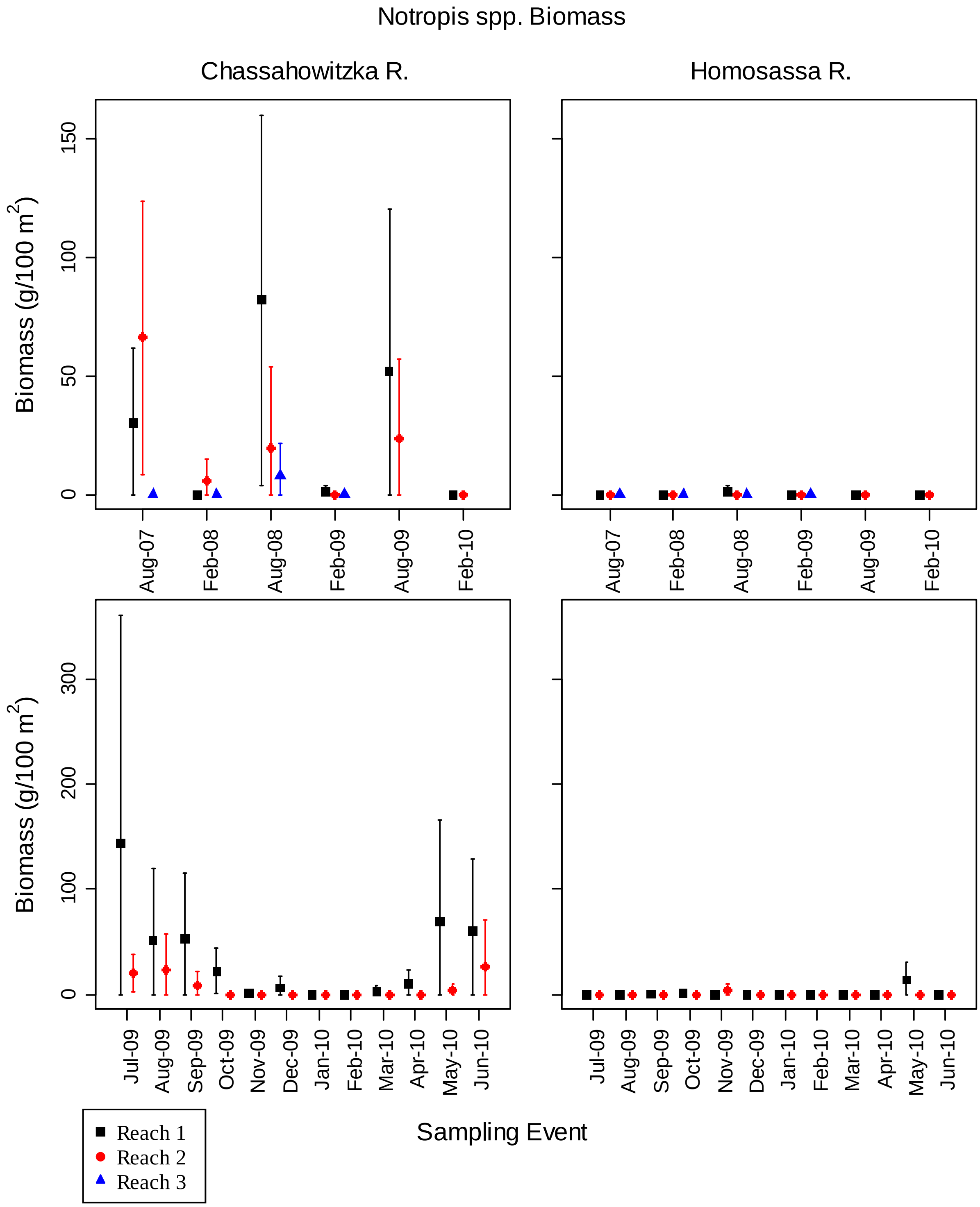


Figure 69. Estimated mean biomass of *Notropis* spp. (*N. petersoni and N. harperi*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

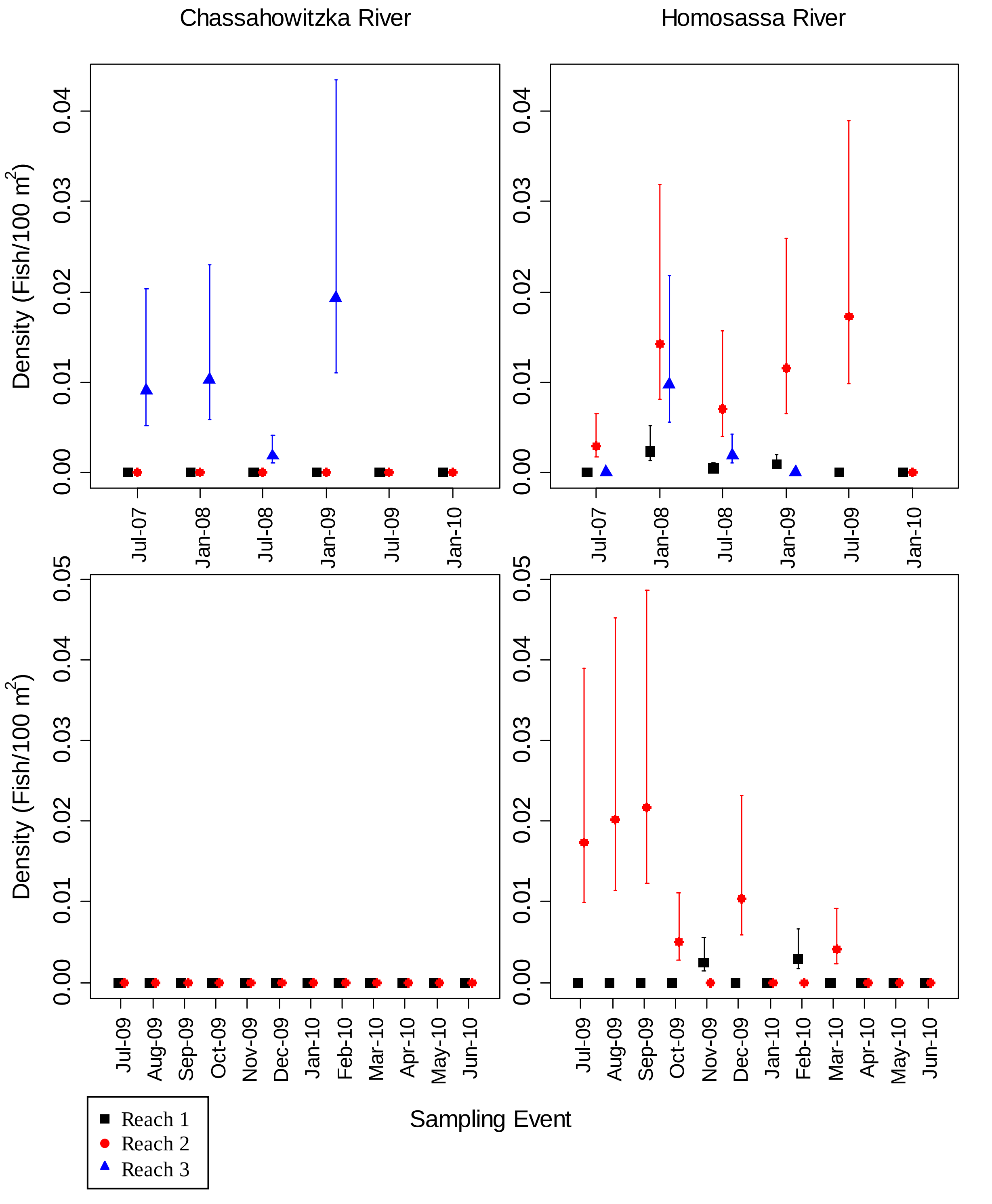


Figure 70. Estimated mean density of red drum captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

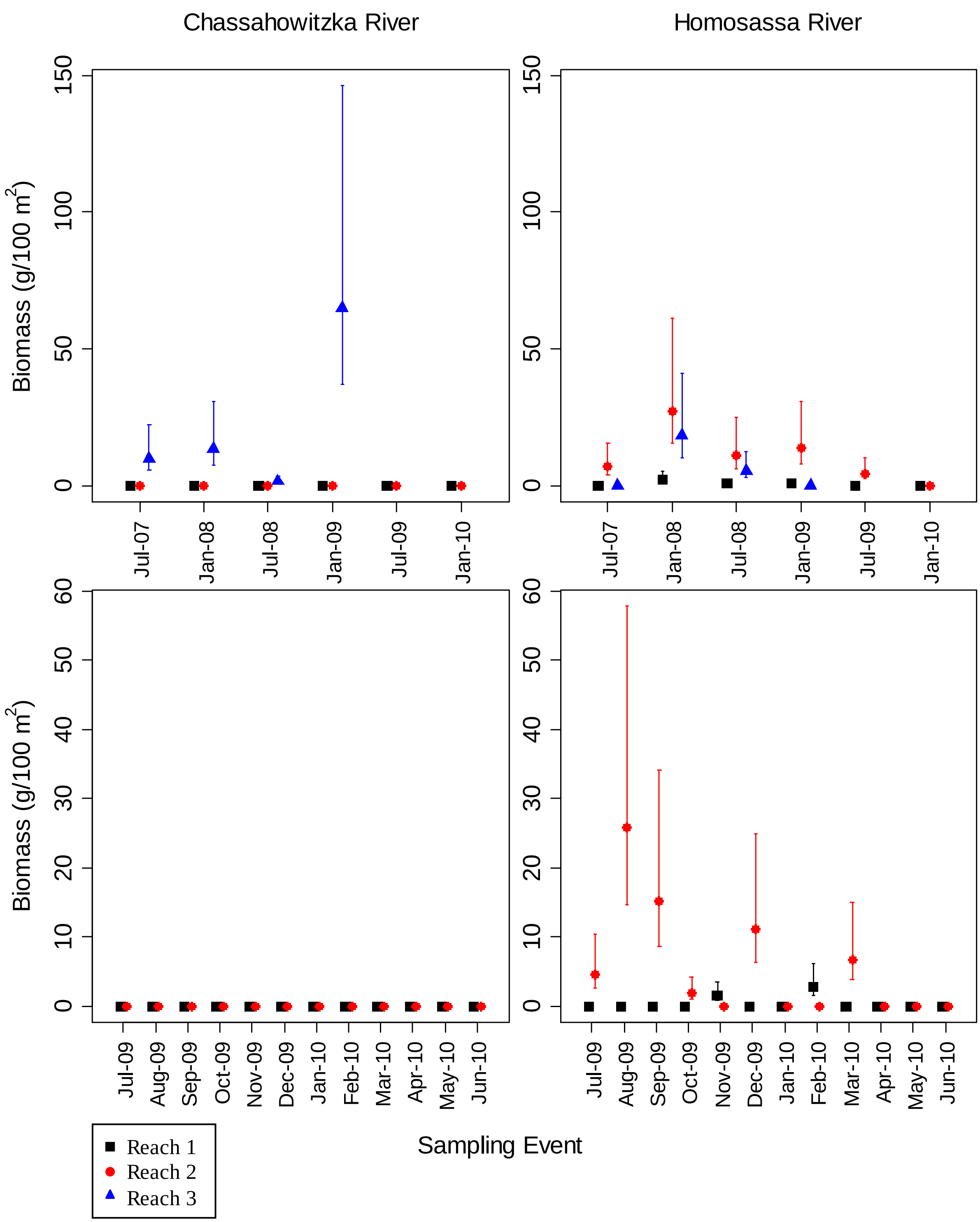


Figure 71. Estimated mean biomass of red drum captured during mark-recapture electrofishing sampling within the Homosassa and Chassahowitzka rivers. Error bars represent 95% confidence intervals of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

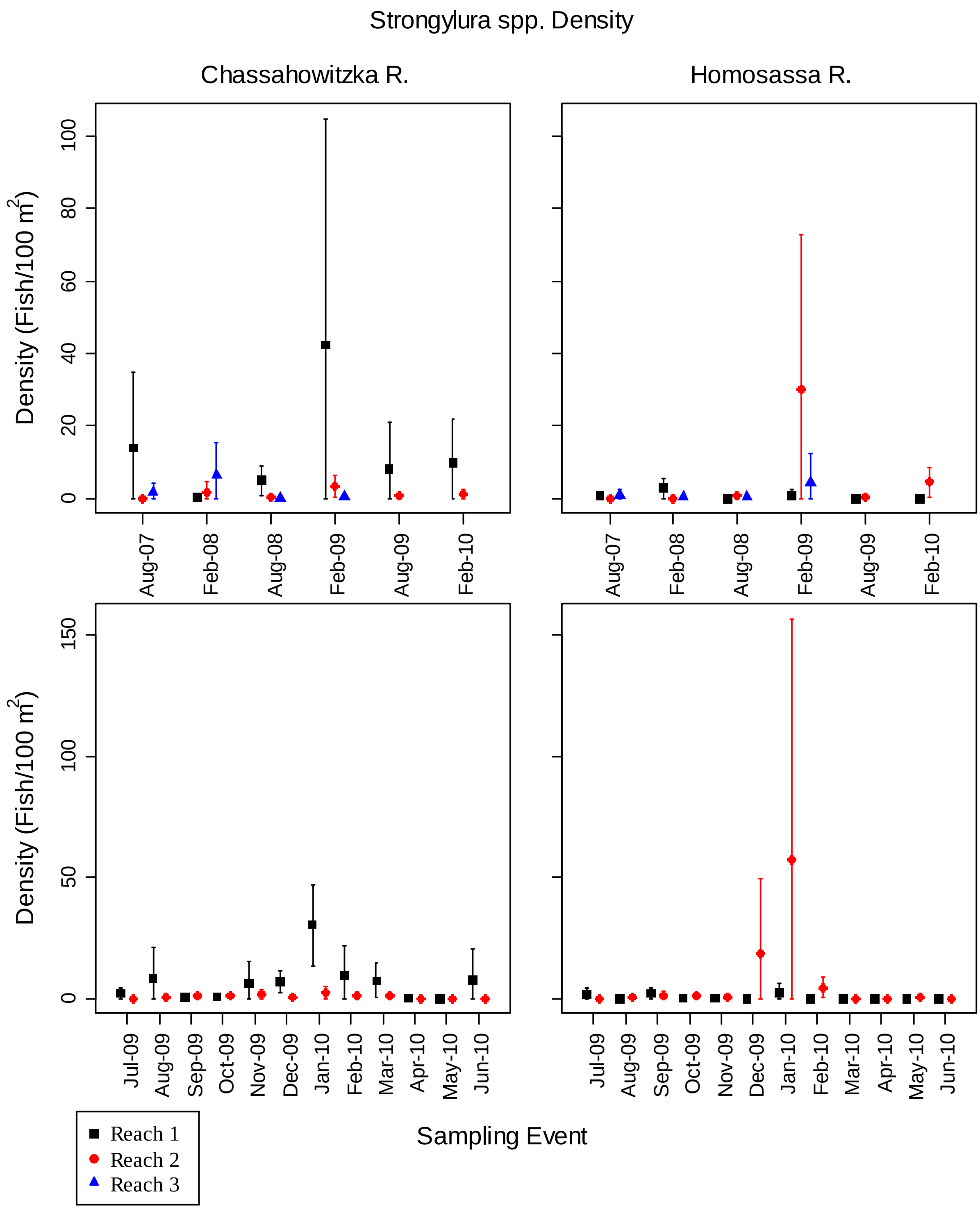


Figure 72. Estimated mean density of *Strongylura* spp. (*S. marina*, *S. notata and S. timucu*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

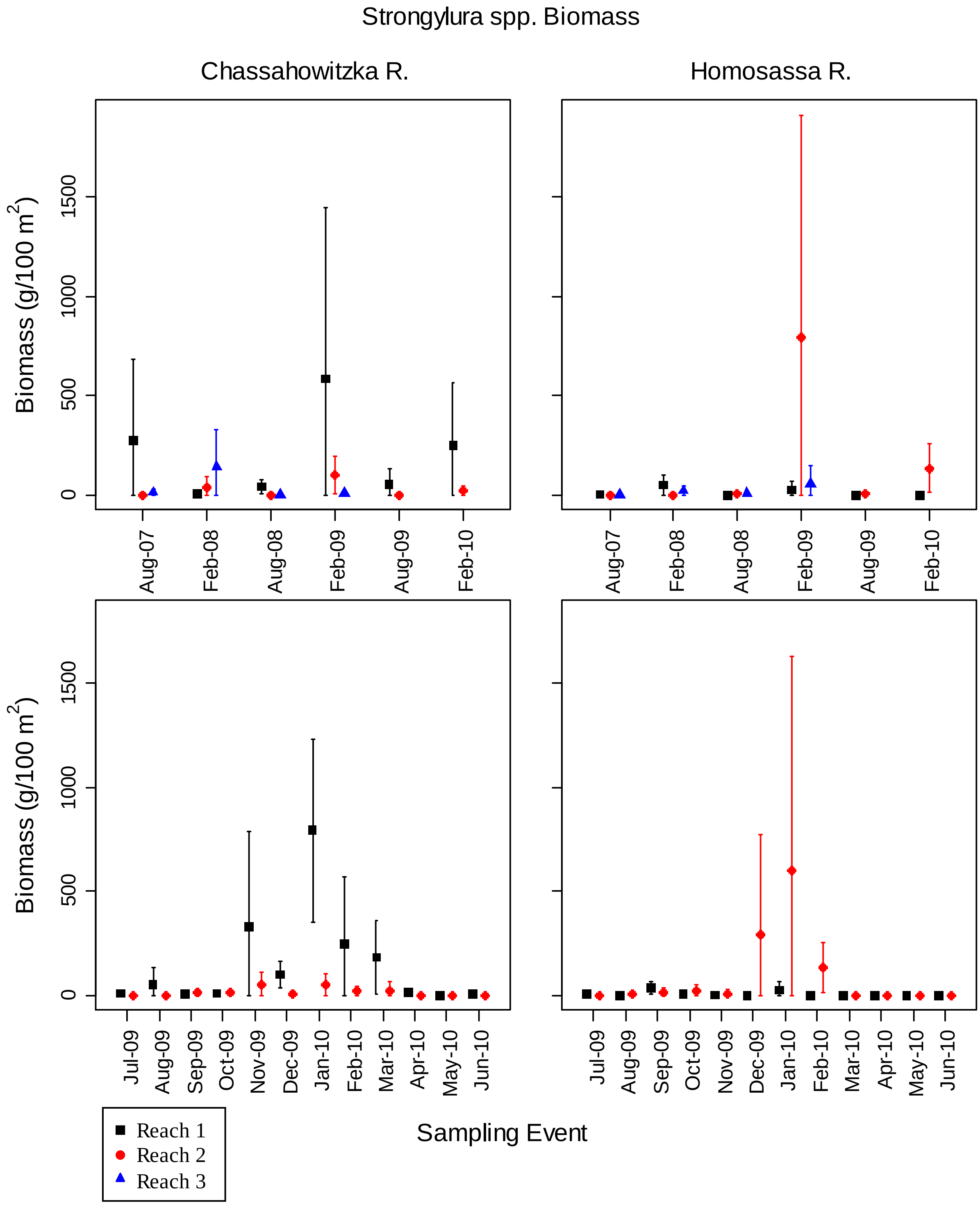


Figure 73. Estimated mean biomass of *Strongylura* spp. (*S. marina, S. notata and S. timucu*) captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

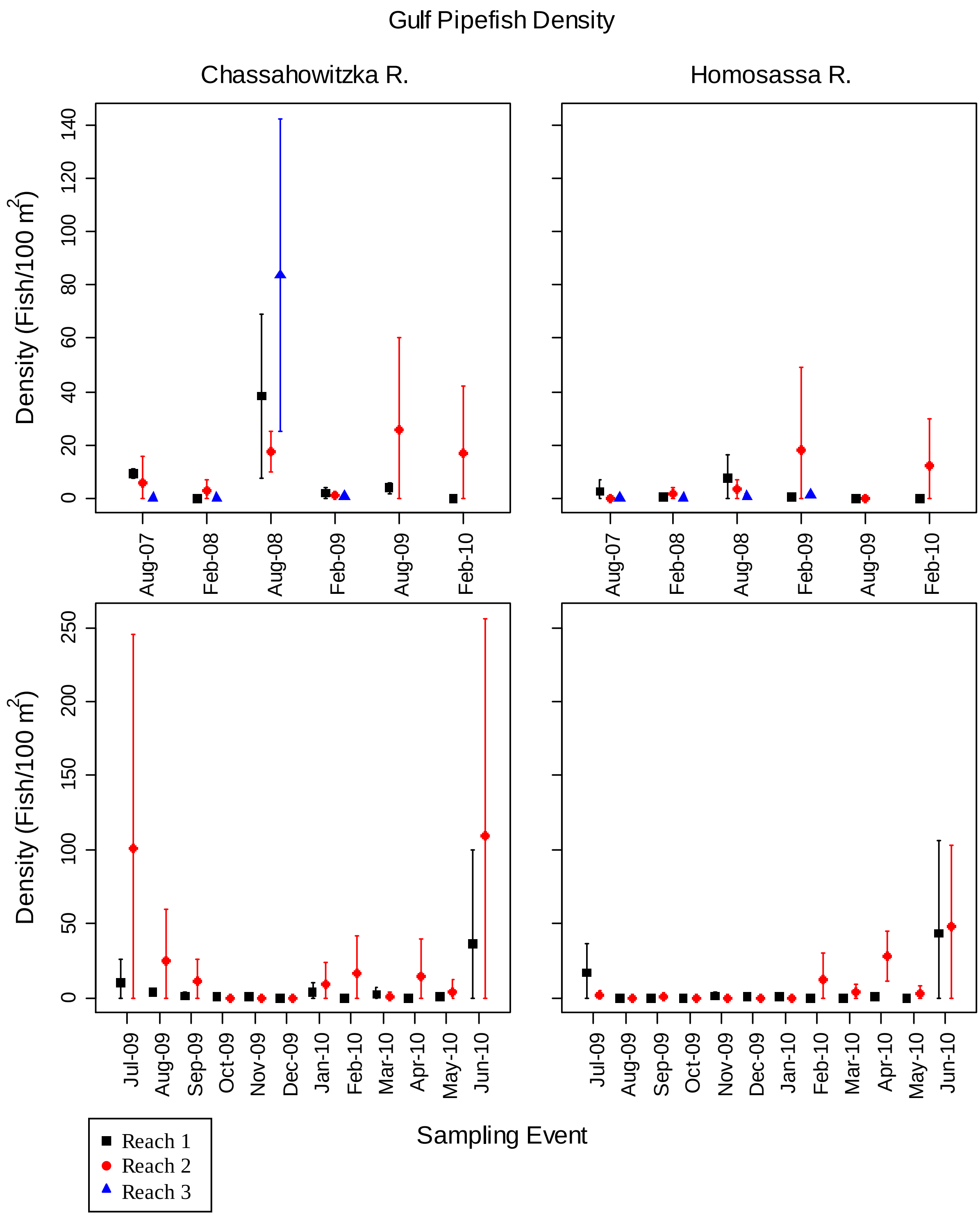


Figure 74. Estimated mean density of gulf pipefish captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

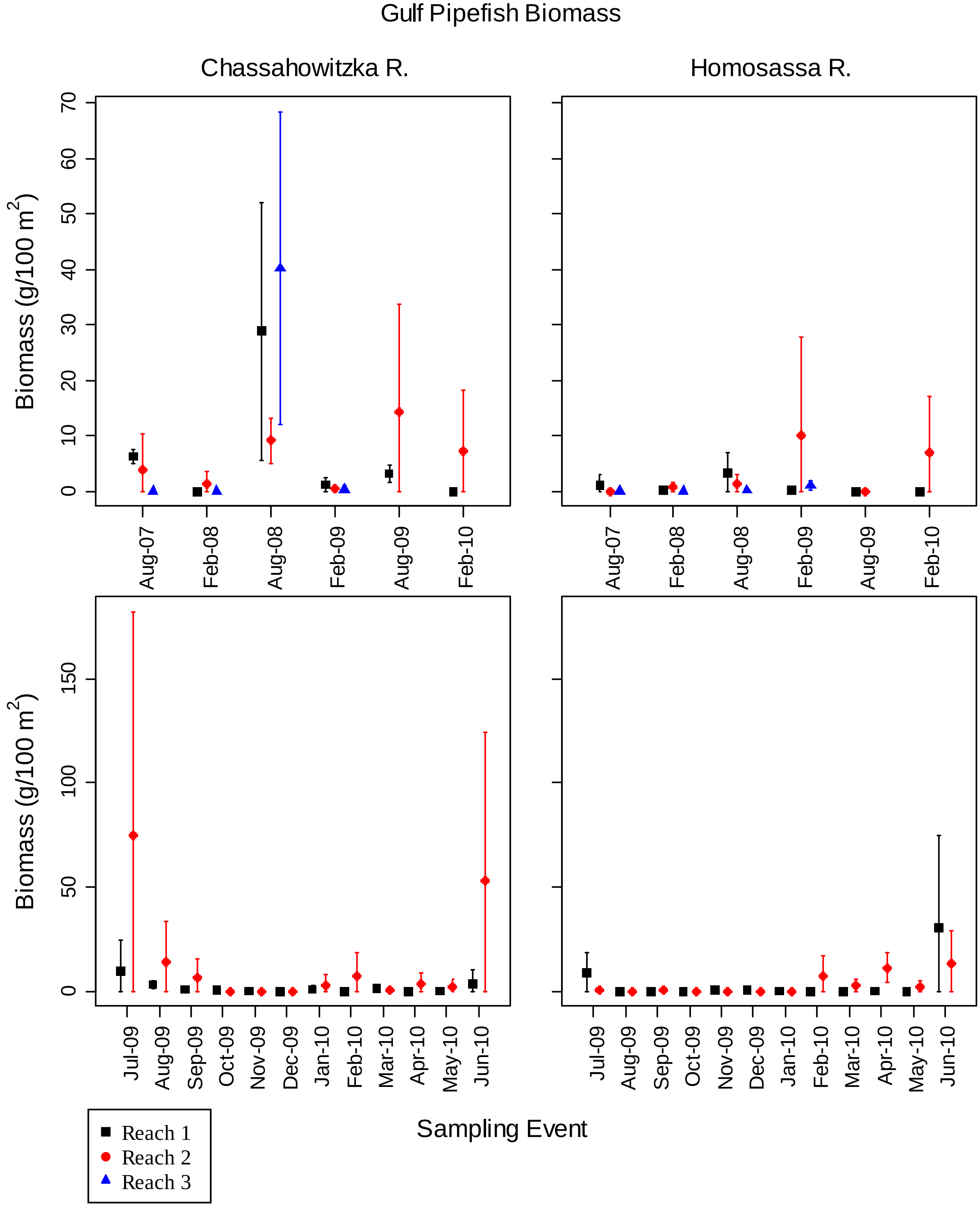


Figure 75. Estimated mean biomass of gulf pipefish captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

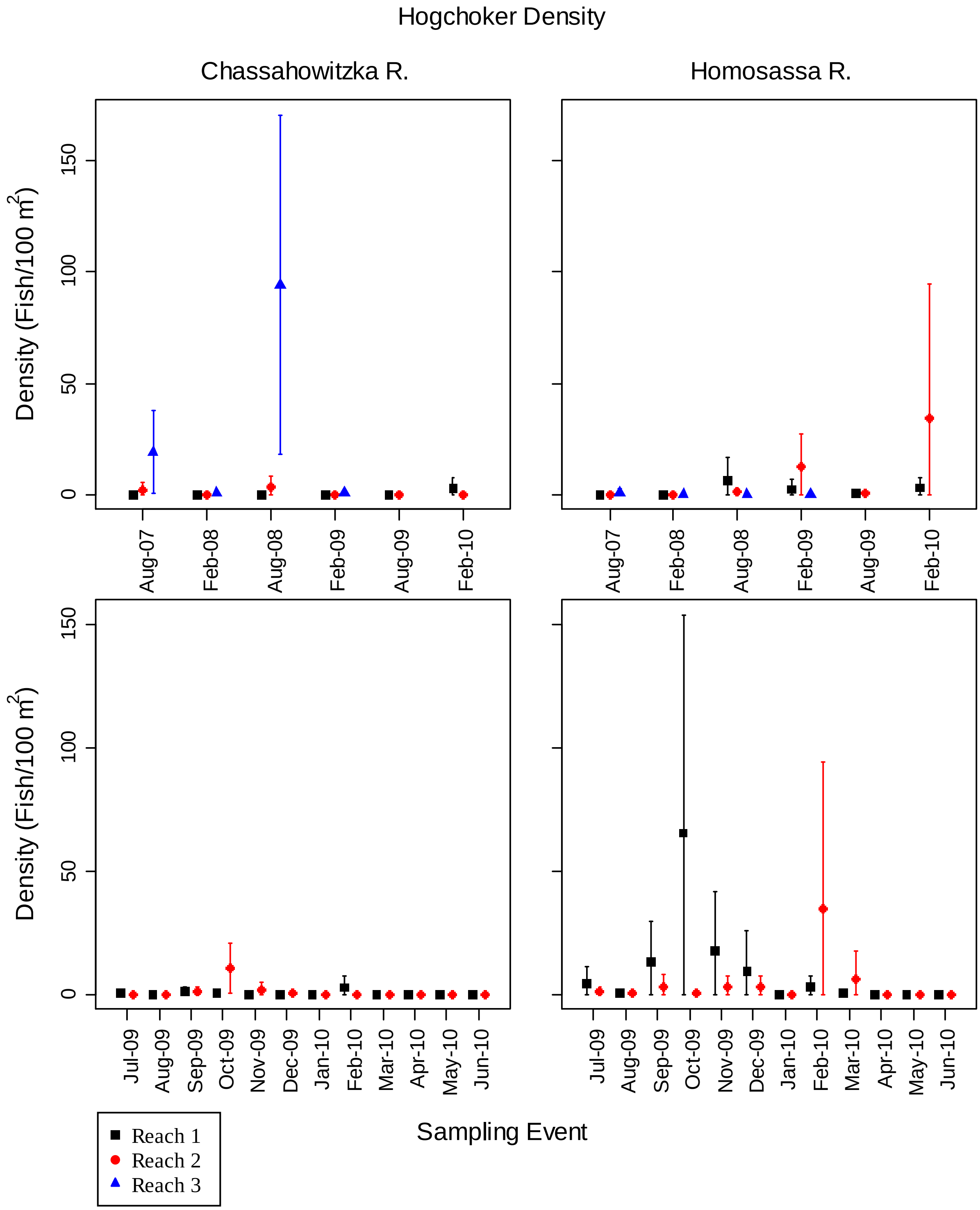


Figure 76. Estimated mean density of hogchoker captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

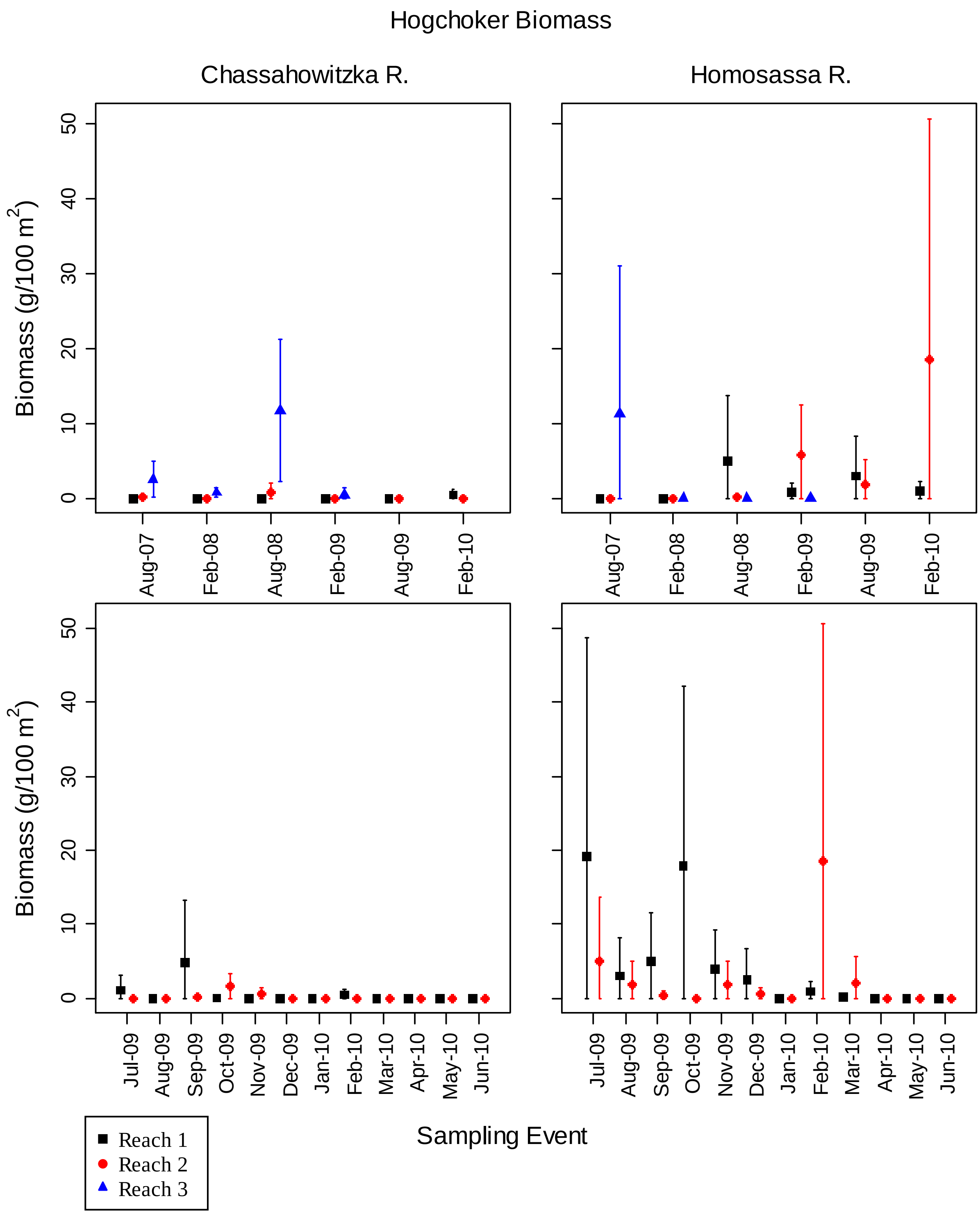


Figure 77. Estimated mean biomass of hogchoker captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

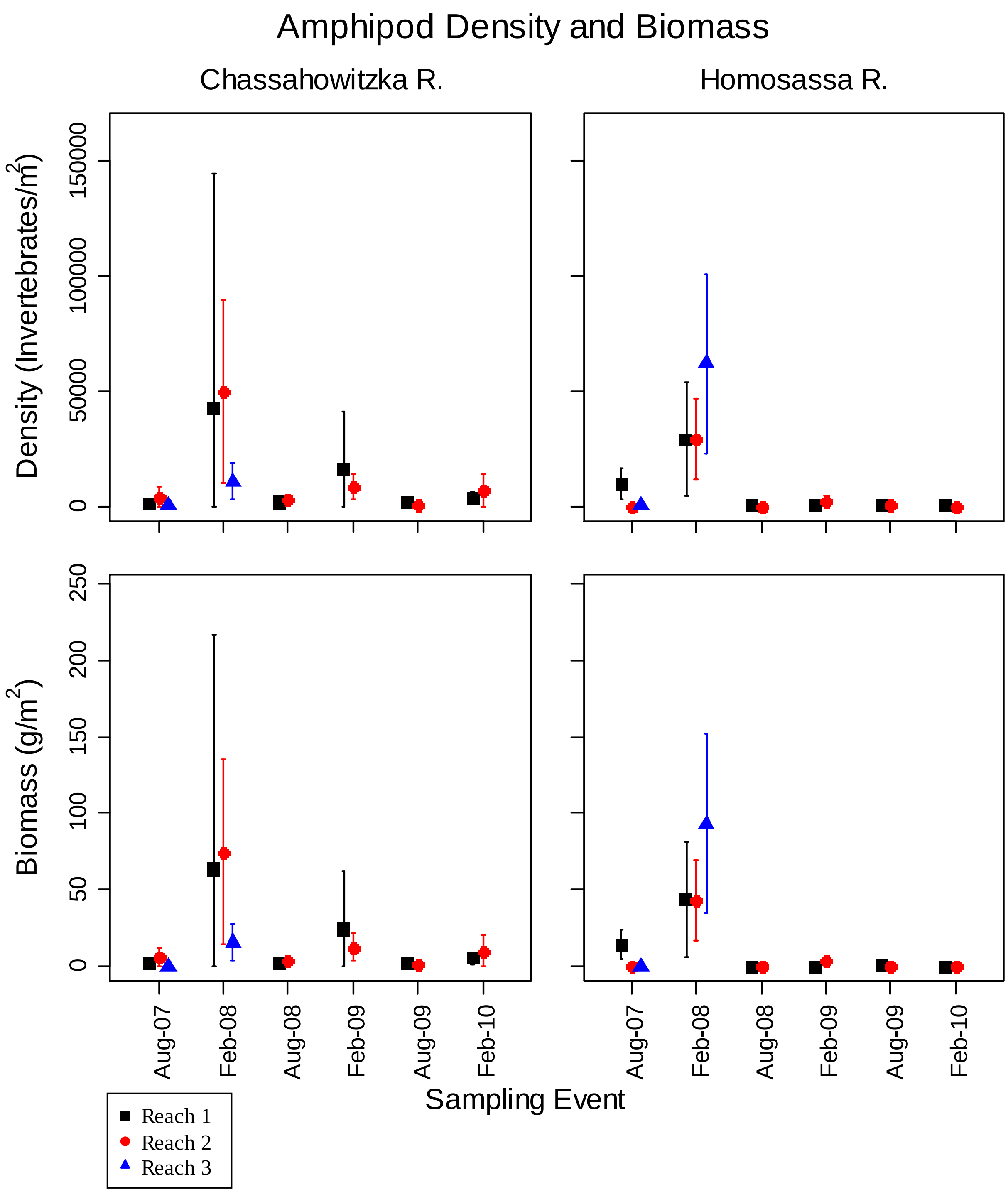


Figure 78. Estimated mean density and biomass of amphipods associated with SAV within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean.

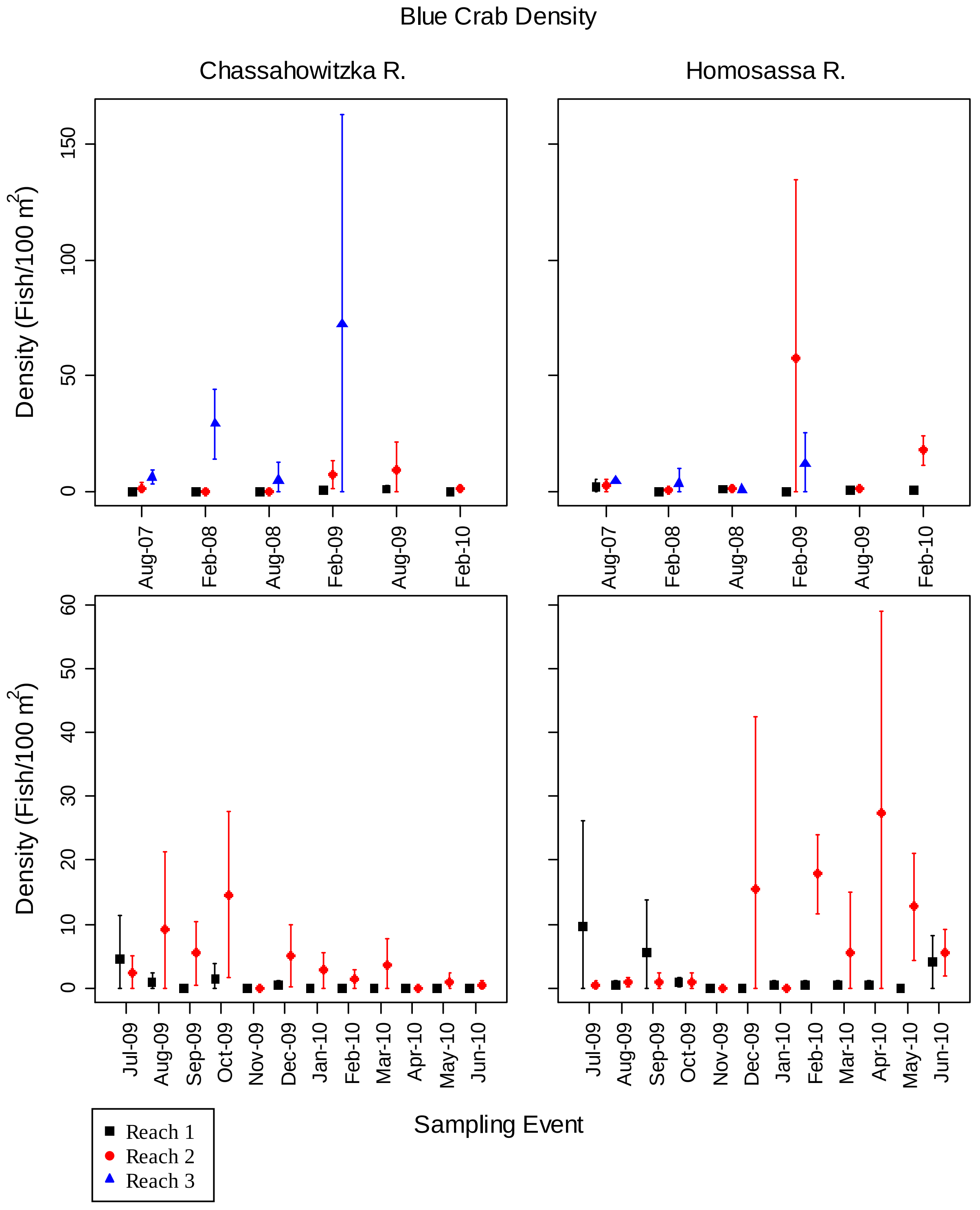


Figure 79. Estimated mean density of blue crab captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

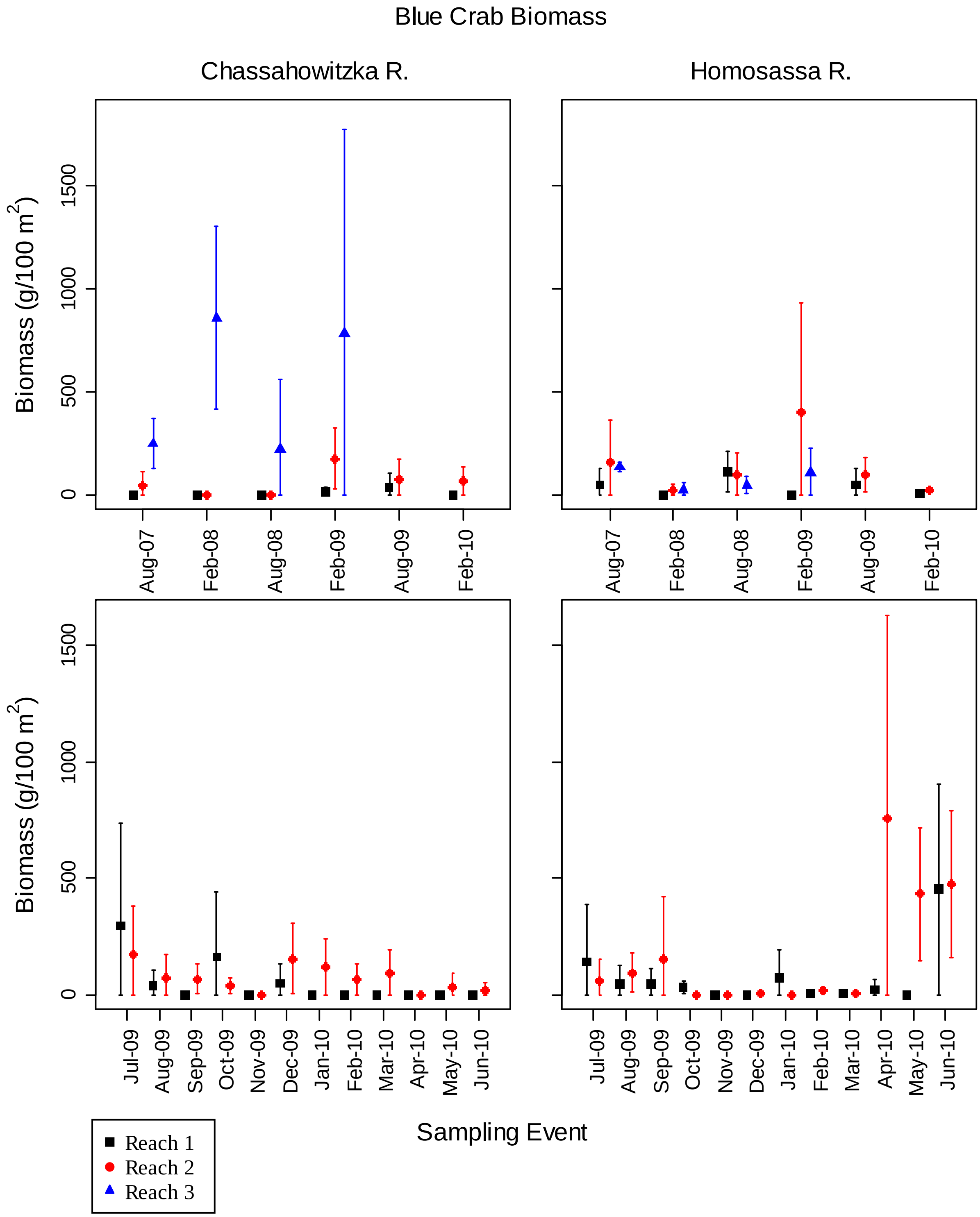


Figure 80. Estimated mean biomass of blue crab captured during seine depletion sampling within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean. Biannual time series (upper panels) are shown for the period of study and monthly time series (lower panels) are shown for year 3.

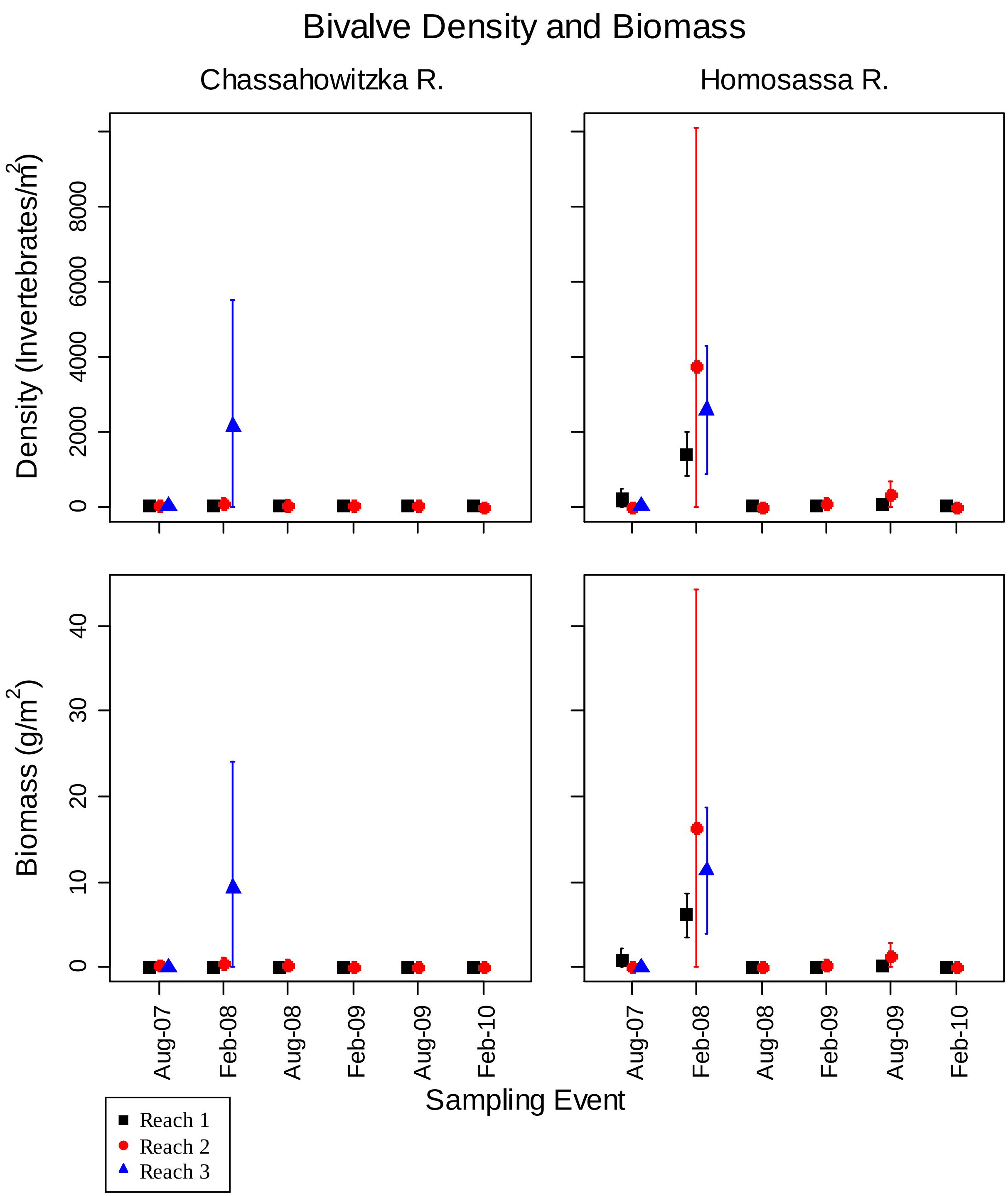


Figure 81. Estimated mean density and biomass of bivalves associated with SAV within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean.

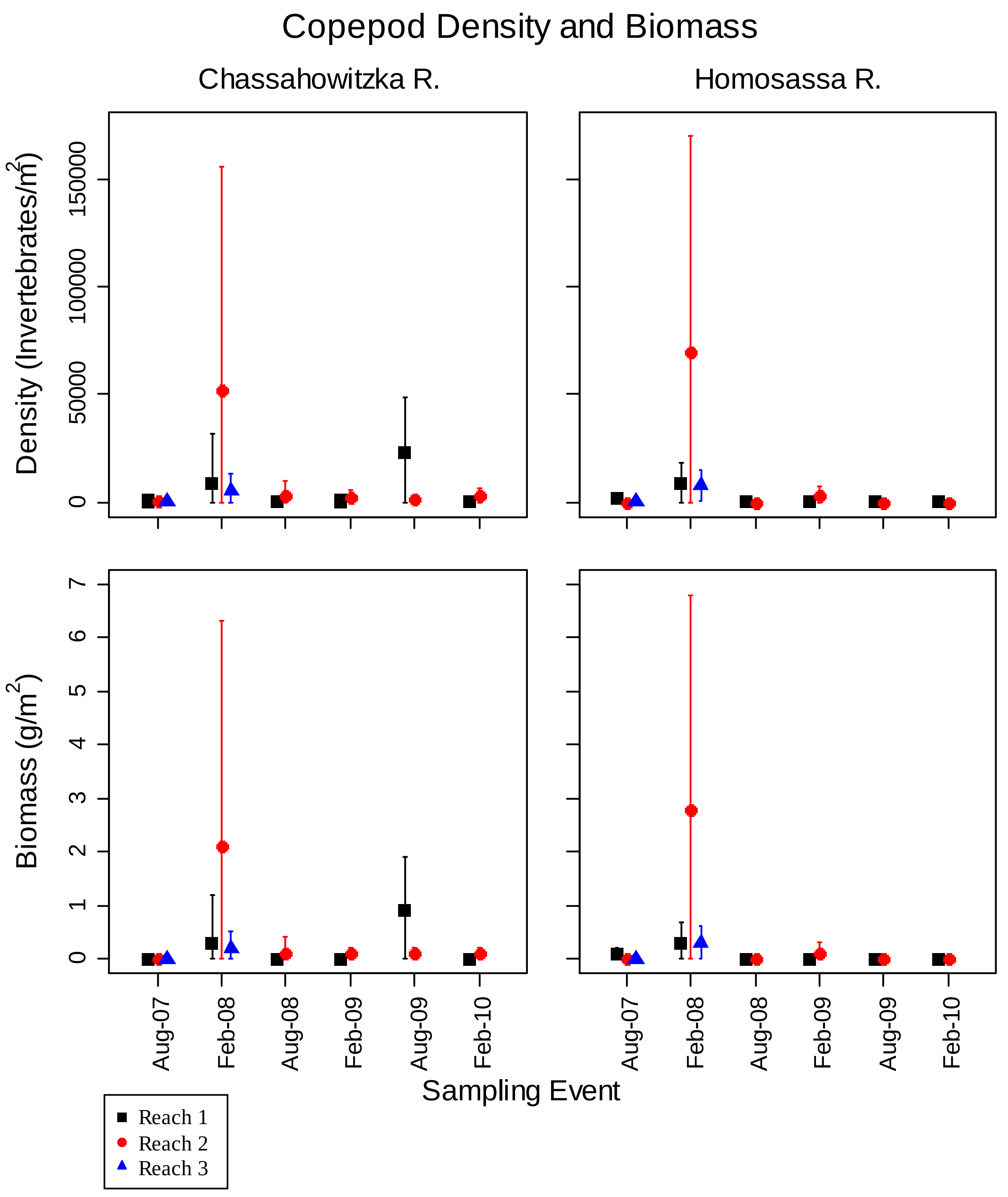


Figure 82. Estimated mean density and biomass of copepods associated with SAV within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean.

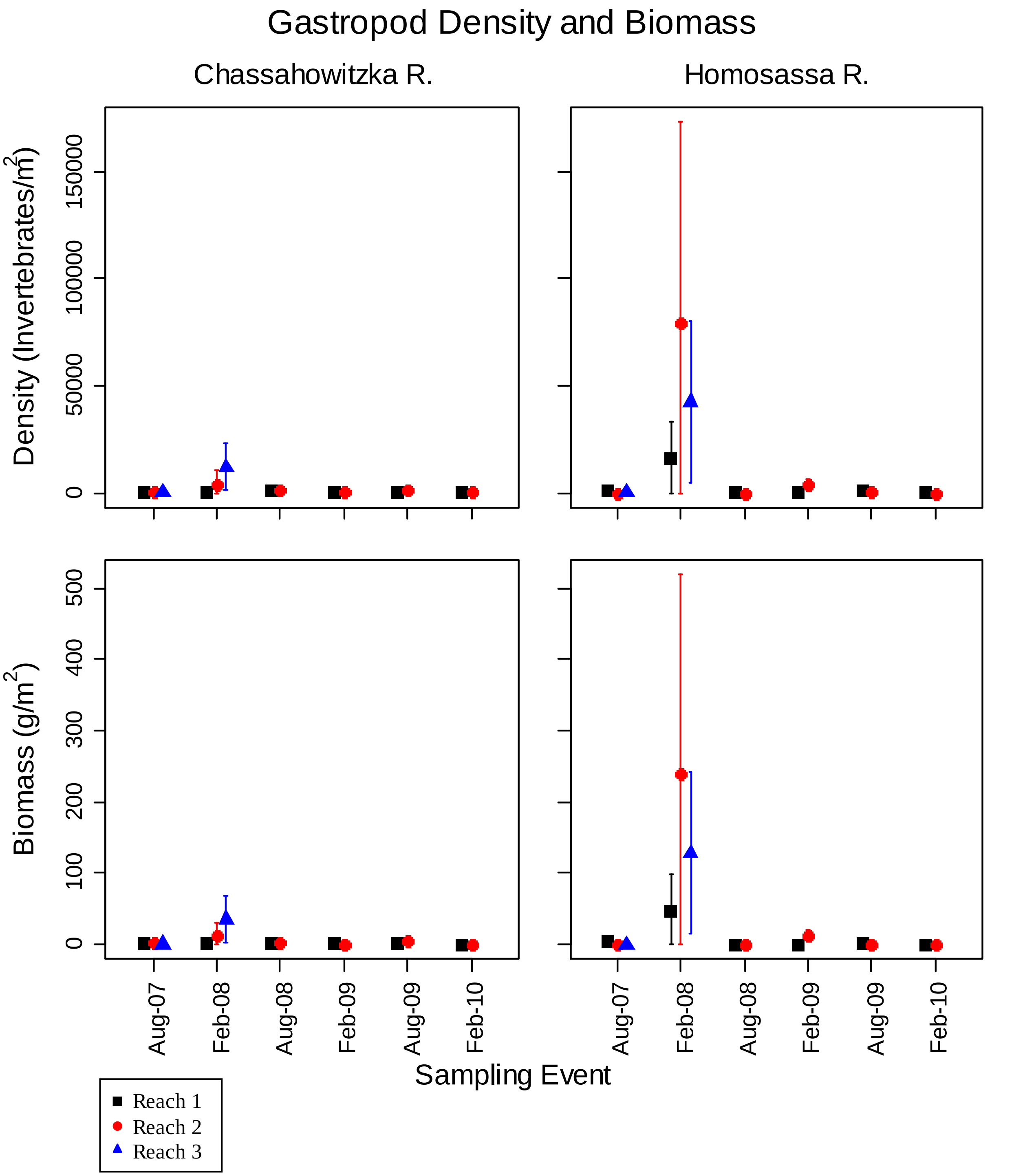


Figure 83. Estimated mean density and biomass of gastropods associated with SAV within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean.

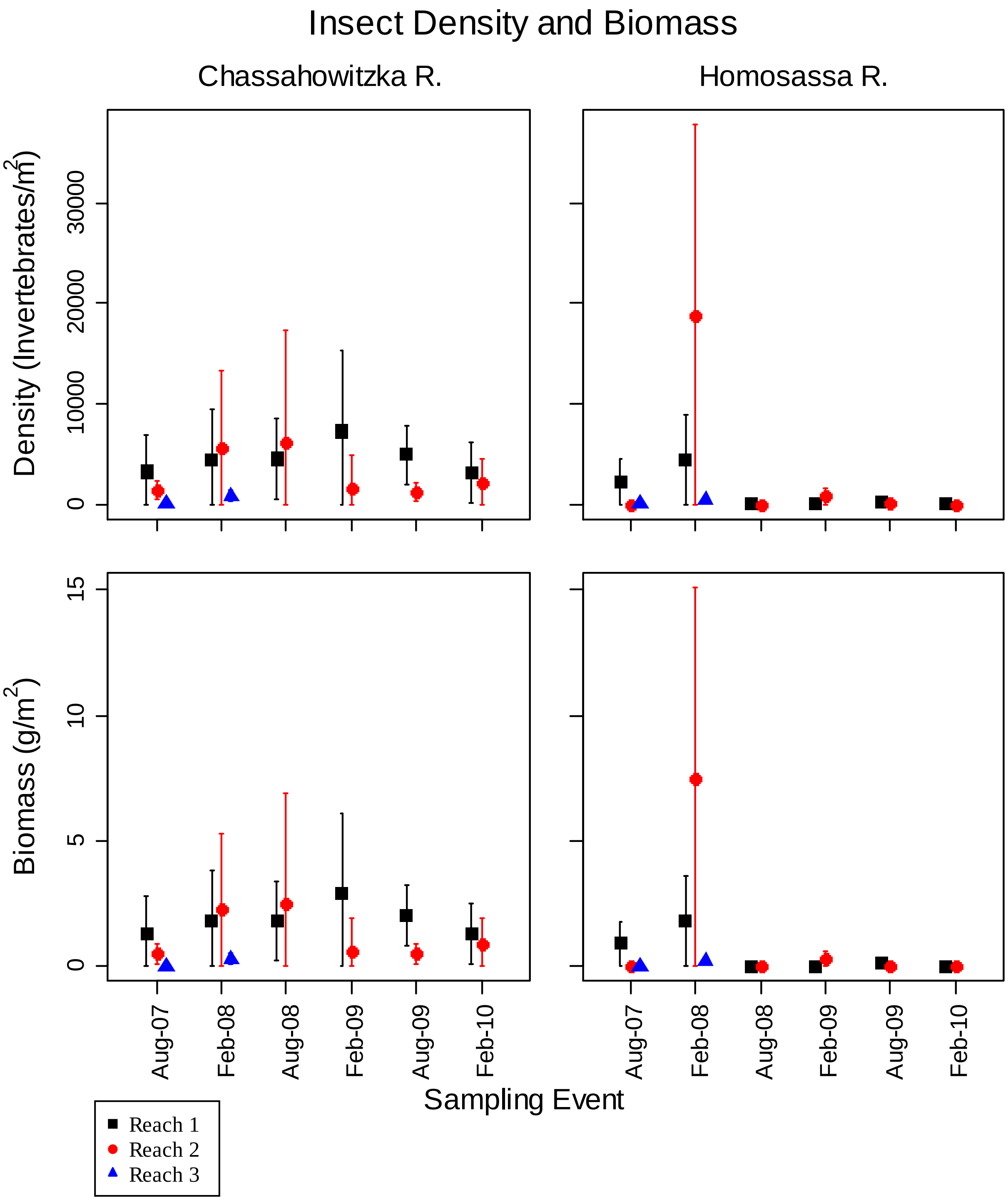


Figure 84. Estimated mean density and biomass of insects (larvae and pupae) associated with SAV within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean.

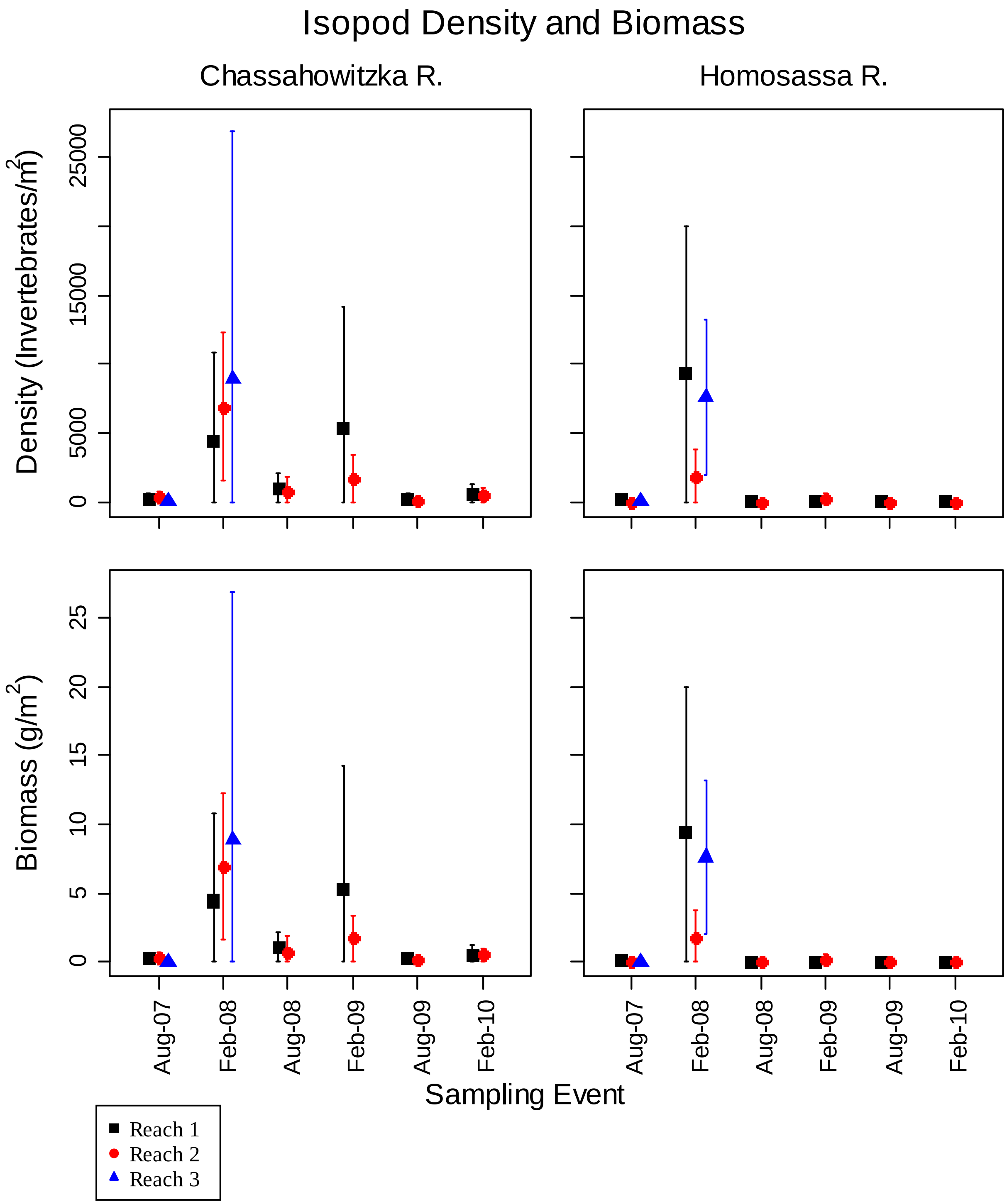


Figure 85. Estimated mean density and biomass of isopods associated with SAV within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean.

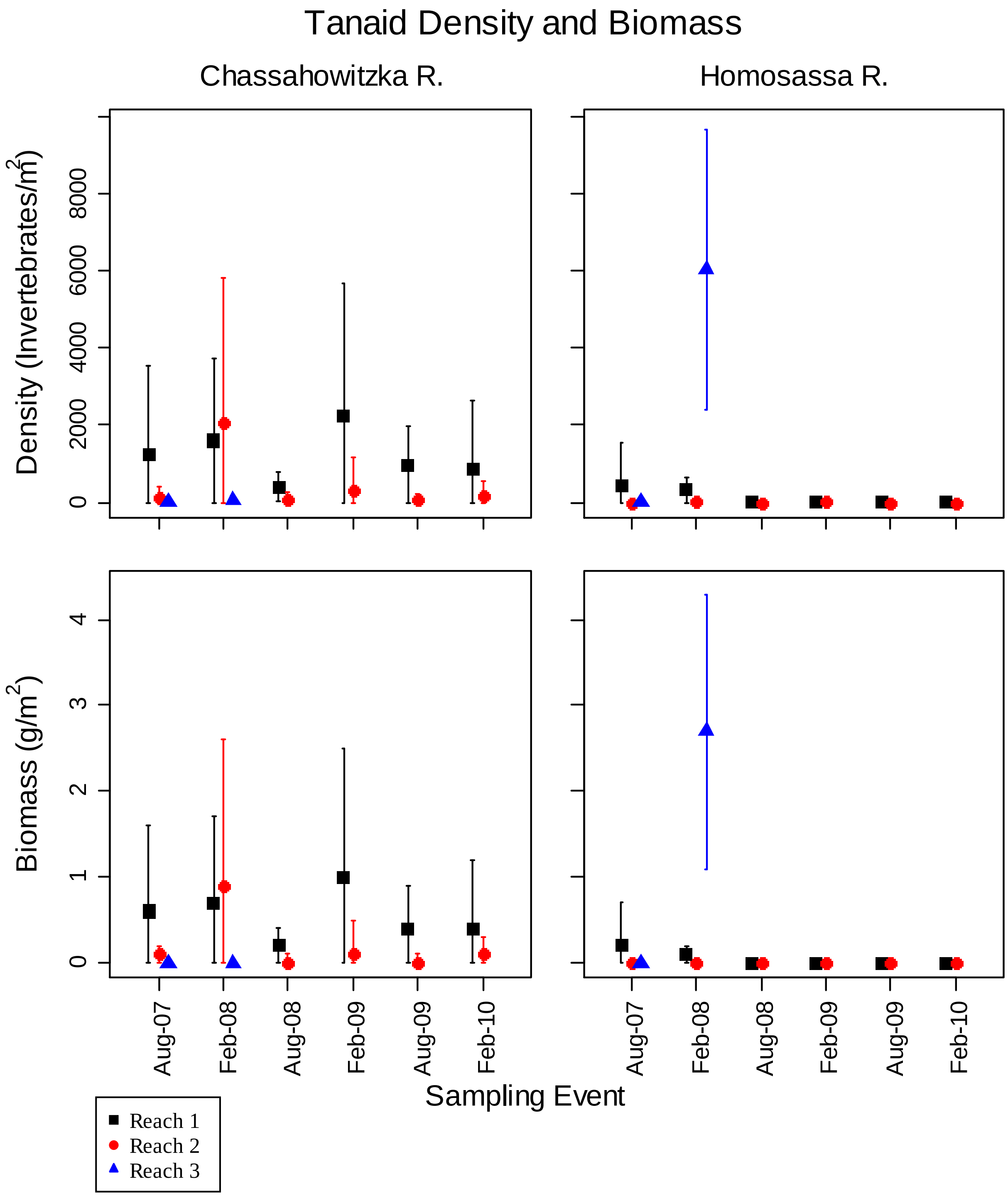


Figure 86. Estimated mean density and biomass of tanaids associated with SAV within the Homosassa and Chassahowitzka rivers. Error bars represent the standard deviation of the mean.