

## Assessing drivers of rocky reef fish biomass density from the Southern California Bight

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Marine Ecology Progress Series 628: 125–140 (2019)

Table S1. Study reef sites and species biomass density ( $\text{g m}^{-2}$ )

| Site                                     | Latitude | Longitude | All fishes | Kelp bass | California sheephead | Blacksmith | Opaleye | Garibaldi | Senorita | Blue rockfish | Kelp rockfish |
|--|----------|-----------|------------|-----------|----------------------|------------|---------|-----------|----------|---------------|---------------|
| Arroyo Quemado                           | 34.468   | -120.121  | 83.52      | 5.90      | 3.75                 | 0.00       | 0.66    | 0.00      | 16.42    | 0.32          | 2.79          |
| Bullito                                  | 34.457   | -120.332  | 78.28      | 0.29      | 0.00                 | 0.00       | 0.00    | 0.00      | 5.22     | 0.00          | 0.47          |
| Cojo                                     | 34.444   | -120.419  | 13.40      | 1.41      | 1.42                 | 0.00       | 0.00    | 0.00      | 1.37     | 0.00          | 0.61          |
| Naples                                   | 34.424   | -119.953  | 81.80      | 10.57     | 13.62                | 1.79       | 2.47    | 0.31      | 7.72     | 0.95          | 2.02          |
| IV Reef                                  | 34.404   | -119.869  | 37.67      | 9.27      | 3.23                 | 0.02       | 0.00    | 0.00      | 2.57     | 0.09          | 2.70          |
| Horseshoe Reef                           | 34.392   | -119.550  | 46.00      | 9.84      | 6.44                 | 0.72       | 0.10    | 0.17      | 3.36     | 0.07          | 0.44          |
| Santa Cruz Island - Painted Cave         | 34.073   | -119.870  | 115.29     | 18.18     | 24.50                | 8.76       | 14.43   | 1.08      | 6.21     | 2.78          | 2.69          |
| San Miguel Island - Harris Point Reserve | 34.060   | -120.351  | 99.73      | 2.89      | 7.59                 | 12.31      | 0.00    | 0.00      | 6.75     | 17.52         | 7.65          |
| Santa Cruz Island - Hazards              | 34.056   | -119.822  | 88.23      | 10.96     | 8.51                 | 5.35       | 9.70    | 2.38      | 2.62     | 0.79          | 7.32          |
| San Miguel Island - Cuyler               | 34.054   | -120.350  | 47.24      | 0.00      | 2.58                 | 0.20       | 0.00    | 0.00      | 1.42     | 7.31          | 6.54          |
| Santa Cruz Island - Cavern Point         | 34.054   | -119.569  | 122.57     | 25.40     | 17.68                | 13.72      | 16.50   | 9.90      | 4.59     | 0.40          | 1.25          |
| Santa Cruz Island - Forney               | 34.054   | -119.914  | 69.90      | 13.29     | 11.70                | 2.30       | 6.72    | 0.18      | 5.64     | 0.19          | 4.16          |
| Santa Cruz Island - Scorpion             | 34.050   | -119.551  | 127.32     | 34.67     | 15.19                | 10.44      | 15.15   | 7.75      | 3.68     | 0.39          | 1.35          |
| Deep Hole East                           | 34.045   | -118.959  | 47.84      | 4.26      | 6.42                 | 1.82       | 2.20    | 3.10      | 2.09     | 0.12          | 2.20          |
| Santa Cruz Island - Coche Point          | 34.044   | -119.603  | 75.11      | 13.44     | 5.84                 | 6.72       | 8.88    | 11.13     | 6.18     | 0.99          | 0.47          |
| Santa Rosa Island - Beacon Reef          | 34.041   | -120.047  | 20.18      | 2.38      | 11.02                | 0.04       | 0.00    | 0.00      | 2.11     | 0.09          | 0.73          |
| Leo Carrillo East                        | 34.040   | -118.924  | 127.84     | 20.64     | 17.54                | 1.79       | 0.36    | 0.70      | 13.83    | 0.26          | 2.75          |
| Encinal Canyon East                      | 34.035   | -118.871  | 117.87     | 28.56     | 10.72                | 4.65       | 0.00    | 0.00      | 6.22     | 0.11          | 4.18          |
| Santa Cruz Island - Pelican              | 34.032   | -119.697  | 111.16     | 19.75     | 6.18                 | 12.45      | 10.84   | 17.31     | 2.66     | 0.41          | 9.45          |
| Santa Rosa Island - Rodes Reef           | 34.031   | -120.111  | 41.59      | 4.76      | 18.48                | 1.47       | 0.85    | 0.00      | 5.25     | 1.97          | 0.80          |
| San Miguel Island - Tyler Bight          | 34.027   | -120.409  | 178.82     | 0.00      | 4.23                 | 4.80       | 0.00    | 0.00      | 2.82     | 47.94         | 28.08         |
| Anacapa Island - West Isle               | 34.017   | -119.431  | 76.37      | 15.86     | 11.25                | 5.35       | 12.39   | 10.09     | 1.44     | 0.25          | 0.97          |
| Anacapa Island - East Isle               | 34.017   | -119.366  | 72.26      | 14.37     | 10.41                | 9.14       | 12.15   | 5.59      | 2.77     | 0.04          | 1.26          |
| San Miguel Island - Crook Point          | 34.016   | -120.335  | 37.98      | 0.01      | 9.24                 | 0.04       | 0.00    | 0.00      | 2.24     | 2.23          | 10.74         |
| Anacapa Island - Black Seabass Reef      | 34.013   | -119.389  | 69.72      | 37.61     | 7.16                 | 8.35       | 2.74    | 3.93      | 4.24     | 0.12          | 0.65          |
| Anacapa Island - Lighthouse Reef         | 34.012   | -119.365  | 84.90      | 7.19      | 3.66                 | 11.62      | 17.66   | 10.38     | 3.47     | 0.16          | 0.52          |
| Anacapa Island - Middle Isle             | 34.009   | -119.390  | 64.08      | 11.73     | 6.77                 | 10.91      | 10.19   | 10.51     | 0.90     | 0.13          | 0.20          |
| Little Dume West                         | 34.007   | -118.791  | 109.68     | 18.29     | 26.24                | 1.11       | 14.75   | 3.32      | 9.71     | 0.01          | 2.16          |
| Point Dume                               | 33.999   | -118.807  | 155.47     | 22.96     | 22.95                | 11.86      | 6.46    | 20.78     | 6.03     | 0.11          | 1.56          |
| Santa Cruz Island - Yellowbanks          | 33.993   | -119.559  | 45.32      | 9.93      | 6.74                 | 3.60       | 6.81    | 1.96      | 4.36     | 0.07          | 1.98          |
| Santa Rosa Island - Monacos              | 33.985   | -120.013  | 21.65      | 1.78      | 4.55                 | 0.01       | 1.44    | 0.00      | 1.95     | 0.00          | 1.23          |
| Santa Cruz Island - Valley               | 33.983   | -119.642  | 44.98      | 8.08      | 4.46                 | 1.23       | 8.55    | 3.89      | 4.10     | 0.41          | 1.22          |
| Santa Rosa Island - Bee Rock             | 33.954   | -120.212  | 27.90      | 0.00      | 6.15                 | 0.05       | 0.00    | 0.00      | 0.29     | 4.72          | 1.88          |
| Santa Cruz Island - Gull Island          | 33.948   | -119.825  | 133.61     | 10.34     | 31.93                | 7.80       | 28.66   | 2.42      | 10.73    | 2.10          | 5.84          |
| Santa Rosa Island - Cluster Point        | 33.929   | -120.191  | 42.98      | 0.00      | 6.30                 | 0.73       | 0.54    | 0.00      | 0.71     | 7.16          | 5.88          |
| Santa Rosa Island - Jolla Vieja          | 33.908   | -120.068  | 33.61      | 1.90      | 7.86                 | 1.51       | 1.77    | 0.59      | 1.20     | 0.46          | 1.93          |

| Site                                     | Latitude | Longitude | All fishes | Kelp bass | California sheephead | Blacksmith | Opaleye | Garibaldi | Senorita | Blue rockfish | Kelp rockfish |
|--|----------|-----------|------------|-----------|----------------------|------------|---------|-----------|----------|---------------|---------------|
| Santa Rosa Island - Chickasaw            | 33.901   | -120.138  | 84.63      | 0.40      | 19.98                | 3.49       | 1.75    | 0.00      | 3.69     | 15.20         | 3.82          |
| Santa Rosa Island - Johnson's Lee South  | 33.897   | -120.104  | 52.05      | 2.16      | 9.33                 | 1.05       | 6.80    | 0.30      | 4.70     | 5.02          | 5.89          |
| Santa Rosa Island - South Point          | 33.893   | -120.121  | 152.34     | 3.24      | 39.75                | 8.68       | 3.31    | 0.00      | 7.75     | 23.49         | 17.94         |
| Ridges North                             | 33.788   | -118.423  | 13.03      | 0.92      | 4.98                 | 0.00       | 0.63    | 1.41      | 1.39     | 0.10          | 0.99          |
| Ridges South                             | 33.786   | -118.426  | 8.02       | 0.75      | 2.97                 | 0.03       | 0.19    | 0.60      | 0.53     | 0.10          | 0.09          |
| Rocky Point North                        | 33.781   | -118.430  | 42.75      | 3.96      | 7.63                 | 5.07       | 7.13    | 4.33      | 4.92     | 0.10          | 0.21          |
| Rocky Point South                        | 33.776   | -118.432  | 26.36      | 2.39      | 8.67                 | 0.00       | 5.56    | 2.21      | 2.13     | 0.03          | 0.38          |
| Lunada Bay                               | 33.772   | -118.430  | 37.94      | 1.83      | 15.19                | 1.74       | 3.53    | 2.81      | 2.83     | 0.00          | 0.26          |
| Resort Point                             | 33.767   | -118.427  | 33.56      | 3.88      | 9.20                 | 1.57       | 3.33    | 3.22      | 3.75     | 0.00          | 0.09          |
| Hawthorne Reef                           | 33.747   | -118.417  | 78.73      | 3.04      | 7.00                 | 25.14      | 5.37    | 5.81      | 5.33     | 0.00          | 0.18          |
| Point Vicente West                       | 33.740   | -118.414  | 47.85      | 3.29      | 5.12                 | 1.84       | 7.01    | 9.36      | 5.80     | 0.18          | 0.40          |
| Abalone Cove Kelp West                   | 33.739   | -118.388  | 29.59      | 2.43      | 3.85                 | 1.09       | 1.49    | 9.28      | 2.02     | 0.00          | 2.64          |
| Long Point East                          | 33.736   | -118.401  | 37.89      | 0.80      | 4.54                 | 1.38       | 5.23    | 3.56      | 3.40     | 0.00          | 0.50          |
| Bunker Point                             | 33.725   | -118.353  | 84.77      | 9.49      | 14.49                | 3.17       | 32.86   | 4.72      | 4.86     | 0.02          | 0.59          |
| Whites Point                             | 33.715   | -118.325  | 61.04      | 8.85      | 9.76                 | 1.80       | 11.86   | 4.43      | 2.32     | 0.00          | 0.83          |
| Point Fermin                             | 33.707   | -118.299  | 38.21      | 10.10     | 5.66                 | 0.74       | 5.79    | 2.23      | 1.65     | 0.00          | 0.71          |
| Crystal Cove                             | 33.563   | -117.838  | 168.79     | 13.01     | 45.20                | 7.36       | 2.35    | 64.04     | 6.92     | 0.00          | 0.59          |
| Heisler Park                             | 33.540   | -117.792  | 82.97      | 4.98      | 24.97                | 5.76       | 2.15    | 31.56     | 0.69     | 0.00          | 0.13          |
| Santa Barbara Island - Arch Point        | 33.489   | -119.028  | 47.62      | 1.44      | 5.17                 | 2.63       | 16.14   | 13.37     | 1.84     | 0.00          | 0.00          |
| Santa Barbara Island - Graveyard Canyon  | 33.475   | -119.027  | 30.29      | 2.19      | 0.00                 | 1.17       | 7.39    | 1.17      | 0.91     | 0.00          | 0.00          |
| Santa Catalina Island - Indian Rock      | 33.469   | -118.526  | 75.88      | 10.80     | 4.25                 | 9.81       | 26.48   | 16.71     | 1.55     | 0.00          | 0.00          |
| Santa Barbara Island - Southeast Sealion | 33.469   | -119.029  | 36.11      | 1.53      | 3.35                 | 8.09       | 2.38    | 2.87      | 0.81     | 0.06          | 0.04          |
| Santa Barbara Island - Sutil             | 33.466   | -119.048  | 176.74     | 6.62      | 15.99                | 112.73     | 19.55   | 4.28      | 0.65     | 0.46          | 0.22          |
| Santa Barbara Island - Cat Canyon        | 33.464   | -119.044  | 61.35      | 2.61      | 5.99                 | 29.00      | 3.06    | 2.79      | 1.98     | 0.25          | 0.45          |
| Santa Catalina Island - Ship Rock        | 33.463   | -118.491  | 159.98     | 5.40      | 5.20                 | 113.39     | 20.98   | 6.69      | 1.07     | 0.00          | 0.25          |
| Santa Barbara Island - Southeast Reef    | 33.463   | -119.031  | 52.60      | 2.76      | 13.78                | 4.28       | 3.20    | 1.60      | 0.71     | 0.00          | 0.25          |
| Dana Point                               | 33.462   | -117.721  | 36.32      | 4.85      | 6.94                 | 1.56       | 1.25    | 0.68      | 1.95     | 0.00          | 0.58          |
| Santa Catalina Island - Bird Rock        | 33.452   | -118.488  | 58.33      | 15.07     | 5.39                 | 10.3       | 8.52    | 14.62     | 0.87     | 0.00          | 0.18          |
| Santa Catalina Island - Blue Cavern      | 33.448   | -118.479  | 97.87      | 32.32     | 13.96                | 8.37       | 20.29   | 9.53      | 0.41     | 0.00          | 0.00          |
| Santa Catalina Island - Iron Bound Cove  | 33.448   | -118.575  | 41.19      | 4.84      | 5.79                 | 7.27       | 3.34    | 5.79      | 0.91     | 0.00          | 0.58          |
| Santa Catalina Island - West Quarry      | 33.443   | -118.470  | 92.11      | 7.36      | 6.73                 | 41.97      | 6.73    | 23.45     | 0.60     | 0.00          | 0.40          |
| Santa Catalina Island - Ripper's Cove    | 33.428   | -118.435  | 72.41      | 5.30      | 1.11                 | 6.36       | 20.43   | 11.97     | 0.55     | 0.00          | 0.00          |
| Santa Catalina Island - Cat Harbor       | 33.426   | -118.512  | 112.71     | 29.00     | 11.34                | 5.04       | 12.33   | 5.42      | 1.65     | 0.00          | 0.01          |
| Santa Catalina Island - Hen Rock         | 33.400   | -118.367  | 47.22      | 5.52      | 1.33                 | 12.05      | 7.02    | 11.60     | 2.47     | 0.00          | 0.06          |
| San Mateo Kelp                           | 33.369   | -117.611  | 9.99       | 1.20      | 2.22                 | 0.00       | 0.00    | 0.00      | 1.22     | 0.00          | 0.18          |
| San Nicolas Island - Begg Rock           | 33.362   | -119.695  | 103.69     | 0.00      | 66.82                | 16.71      | 14.87   | 0.00      | 0.00     | 0.62          | 0.00          |
| Santa Catalina Island - Lover's Cove     | 33.344   | -118.317  | 219.49     | 143.77    | 17.31                | 6.49       | 28.92   | 7.13      | 0.10     | 0.00          | 0.00          |
| Santa Catalina Island - China Point      | 33.330   | -118.470  | 76.01      | 11.87     | 9.67                 | 3.07       | 6.54    | 4.89      | 1.56     | 0.00          | 0.00          |
| Santa Catalina Island - East Quarry      | 33.319   | -118.303  | 166.16     | 23.90     | 14.03                | 82.35      | 2.32    | 13.09     | 0.58     | 0.00          | 0.25          |
| Santa Catalina Island - Salta Verde      | 33.315   | -118.422  | 63.34      | 6.38      | 4.37                 | 2.24       | 7.02    | 7.21      | 1.85     | 0.00          | 0.95          |
| Barn Kelp                                | 33.292   | -117.488  | 32.22      | 2.68      | 11.84                | 0.81       | 0.00    | 5.70      | 3.51     | 0.00          | 0.37          |
| San Nicolas Island - Sand Spit           | 33.220   | -119.434  | 109.40     | 6.79      | 19.64                | 7.78       | 26.20   | 9.80      | 2.12     | 2.97          | 2.78          |
| Leucadia                                 | 33.064   | -117.309  | 23.53      | 3.07      | 2.90                 | 0.05       | 4.15    | 1.18      | 0.44     | 0.00          | 0.00          |
| Children's Pool                          | 32.852   | -117.278  | 25.45      | 2.90      | 2.44                 | 2.16       | 0.98    | 5.60      | 5.60     | 0.00          | 0.18          |
| Matlahuayl                               | 32.851   | -117.270  | 108.74     | 28.81     | 8.88                 | 2.16       | 16.97   | 3.77      | 2.69     | 0.00          | 0.00          |
| San Clemente Island - Lil Flower         | 32.837   | -118.366  | 67.60      | 7.54      | 9.70                 | 12.14      | 2.86    | 14.74     | 2.85     | 0.00          | 0.05          |
| South La Jolla                           | 32.816   | -117.284  | 53.65      | 14.22     | 3.72                 | 1.23       | 13.17   | 1.71      | 1.91     | 0.00          | 1.06          |
| San Clemente Island - Pyramid Cove       | 32.816   | -118.371  | 61.89      | 7.36      | 10.37                | 7.35       | 11.25   | 7.23      | 3.58     | 0.00          | 0.09          |
| San Clemente Island - China Point        | 32.801   | -118.429  | 69.60      | 9.03      | 24.01                | 1.22       | 15.43   | 11.08     | 3.47     | 0.00          | 0.36          |
| Point Loma North                         | 32.724   | -117.277  | 17.55      | 2.78      | 1.02                 | 0.01       | 0.18    | 1.22      | 0.43     | 0.00          | 0.12          |
| Point Loma Central                       | 32.712   | -117.263  | 9.46       | 3.93      | 0.00                 | 0.03       | 1.80    | 0.33      | 2.38     | 0.00          | 0.00          |
| Point Loma South                         | 32.676   | -117.256  | 20.84      | 5.20      | 3.72                 | 0.30       | 1.82    | 2.71      | 1.86     | 0.00          | 0.15          |
| Cabrillo National Monument               | 32.664   | -117.244  | 56.66      | 8.17      | 26.22                | 2.15       | 2.06    | 0.82      | 0.67     | 0.00          | 0.85          |

Table S2. Model Selection of Top GLS models ( $\Delta AICc < 2$ ; top 10 models displayed for species with  $>10$  models included in confidence set). Details of model terms are given in Table 1. DIST = distance to shelf break, HII = harvest intensity index, WHM = maximum wave height, KBIO = kelp canopy biomass, STIP = *Macrocystis* stipes/kelp, KUSP = kelp understory species density, MRI = mean relief index, CHL = sea surface chlorophyll *a*, SST = sea surface temperature, UD = sea urchin species density, RISD = relief index standard deviation, SLOP = reef slope, MSI = mean substrate index, SISD = substrate index standard deviation. R.I. = relative importance of model terms (calculated from all models included in the confidence model set). MRI and RISD were collinear and thus were not allowed to be included in the same model. n = number of sites included in the analysis for each species.

|                              | Model terms |      |      |      |      |       |     |      |      |      |     |      |      |      | Model support |        |               |        |
|------------------------------|-------------|------|------|------|------|-------|-----|------|------|------|-----|------|------|------|---------------|--------|---------------|--------|
|                              | DIST        | SLOP | WHM  | KBIO | CHL  | SST   | HII | UD   | STIP | KUSP | MRI | RISD | MSI  | SISD | df            | AICc   | $\Delta AICc$ | Weight |
| All fishes<br>(n = 89)       | -13.9       | 22.3 |      | 1.0  | 16.8 | -14.7 |     |      |      |      |     |      | 14.5 | -6.4 | 12            | 861.86 | 0.00          | 0.17   |
|                              | -13.5       | 22.8 |      |      | 16.5 | -15.7 |     | 1.9  |      |      |     |      | 14.4 | -6.3 | 12            | 861.91 | 0.05          | 0.17   |
|                              | -13.4       | 21.0 |      |      | 16.0 | -16.7 |     |      |      |      |     |      | 17.1 | -5.5 | 12            | 862.17 | 0.31          | 0.15   |
|                              | -13.9       | 21.4 |      |      | 16.3 | -14.9 |     |      | -1.5 |      |     |      | 14.1 | -6.1 | 12            | 862.26 | 0.40          | 0.14   |
|                              | -13.9       | 22.1 |      |      | 16.7 | -15.1 |     | -0.2 |      |      |     |      | 14.3 | -6.3 | 12            | 862.32 | 0.47          | 0.14   |
|                              | -13.7       | 20.1 | -2.3 |      | 16.4 | -14.8 |     |      |      |      |     |      | 15.0 | -6.4 | 12            | 862.47 | 0.61          | 0.13   |
|                              | -14.3       | 21.8 |      |      | 16.9 | -15.7 | 1.5 |      |      |      |     |      | 14.7 | -6.2 | 12            | 862.83 | 0.97          | 0.11   |
| R.I.                         | 1.0         | 1.0  | 0.1  | 0.2  | 1.0  | 1.0   | 0.1 | 0.1  | 0.2  | 0.1  | 0.0 | 1.0  | 0.2  | 1.0  |               |        |               |        |
| Blacksmith<br>(n = 85)       |             | 0.6  |      |      |      |       |     | 0.3  |      |      | 0.3 |      |      |      | 8             | 216.66 | 0.00          | 0.47   |
|                              | -0.2        | 0.5  |      |      |      |       |     | 0.3  |      |      | 0.3 |      |      |      | 9             | 217.32 | 0.66          | 0.34   |
|                              |             | 0.6  |      |      |      |       |     | -0.2 |      |      | 0.3 |      |      |      | 8             | 218.50 | 1.84          | 0.19   |
| R.I.                         | 0.3         | 1.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0 | 0.8  | 0.2  | 0.0  | 1.0 | 0.0  | 0.0  | 0.0  |               |        |               |        |
| Blue<br>rockfish<br>(n = 47) |             |      | 0.2  |      |      | -0.3  |     |      |      |      |     |      |      |      | 7             | 52.03  | 0             | 0.36   |
|                              | -0.1        |      | 0.3  |      |      | -0.4  |     |      |      |      |     |      |      |      | 8             | 52.32  | 0.29          | 0.31   |
|                              |             |      | 0.2  |      | -0.1 | -0.3  |     |      |      |      |     |      |      |      | 8             | 53.65  | 1.63          | 0.16   |
|                              |             |      |      |      | -0.1 |       |     |      |      |      |     |      |      |      | 6             | 53.67  | 1.64          | 0.16   |
| R.I.                         | 0.3         | 0.0  | 0.8  | 0.0  | 0.2  | 1.0   | 0.0 | 0.0  | 0.0  | 0.0  | 0.0 | 0.0  | 0.0  | 0.0  |               |        |               |        |
| Garibaldi<br>(n = 72)        |             | 0.2  |      |      |      | 0.7   |     | 0.3  |      |      |     |      | 0.2  |      | 8             | 151.94 | 0.00          | 0.62   |
|                              |             |      |      |      |      | 0.8   |     | 0.3  |      |      |     |      | 0.2  |      | 7             | 152.89 | 0.94          | 0.38   |
| R.I.                         | 0.0         | 0.6  | 0.0  | 0.0  | 0.0  | 1.0   | 0.0 | 1.0  | 0.0  | 0.0  | 0.0 | 1.0  | 0.0  | 0.0  |               |        |               |        |
| Kelp bass<br>(n = 83)        |             |      |      |      |      |       |     |      |      |      |     |      | -0.1 |      | 6             | 179.61 | 0.00          | 1.00   |
| R.I.                         | 0.0         | 0.0  | 0.0  | 0.0  | 0.0  | 0.0   | 0.0 | 0.0  | 0.0  | 0.0  | 0.0 | 0.0  | 1.0  | 1.0  |               |        |               |        |

|                              | Model terms |      |     |      |      |      |     |     |      |      |     |      |     |      | Model support |        |       |        |
|------------------------------|-------------|------|-----|------|------|------|-----|-----|------|------|-----|------|-----|------|---------------|--------|-------|--------|
|                              | DIST        | SLOP | WHM | KBIO | CHL  | SST  | HII | UD  | STIP | KUSP | MRI | RISD | MSI | SISD | df            | AICc   | ΔAICc | Weight |
| Kelp<br>rockfish<br>(n = 81) |             |      |     |      |      | -0.5 |     |     |      |      |     |      |     |      | 6             | 90.60  | 0.00  | 1.00   |
| R.I.                         | 0.0         | 0.0  | 0.0 | 0.0  | 0.0  | 1.0  | 0.0 | 0.0 | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0  |               |        |       |        |
| Opaleye<br>(n = 77)          |             |      |     |      | -0.3 |      |     |     |      |      |     | 0.3  |     |      | 6             | 188.47 | 0.00  | 0.34   |
|                              | -0.3        |      |     | -0.2 |      |      |     |     |      |      |     | 0.3  |     |      | 7             | 188.72 | 0.25  | 0.30   |
|                              | -0.2        |      |     |      |      |      |     |     |      |      |     | 0.4  |     |      | 6             | 189.51 | 1.04  | 0.20   |
|                              |             |      |     | -0.2 | -0.3 |      |     |     |      |      |     | 0.3  |     |      | 7             | 189.95 | 1.47  | 0.16   |
| R.I.                         | 0.5         | 0.0  | 0.0 | 0.5  | 0.5  | 0.0  | 0.0 | 0.0 | 0.0  | 0.0  | 0.0 | 1.0  | 0.0 | 0.0  |               |        |       |        |
| Senorita<br>(n = 88)         |             |      |     |      |      | -0.2 |     |     |      |      |     |      |     |      | 5             | 150.91 | 0.00  | 0.55   |
| R.I.                         | 0.0         | 0.0  | 0.0 | 0.0  | 0.0  | 0.6  | 0.0 | 0.0 | 0.0  | 0.0  | 0.0 | 0.0  | 0.0 | 0.0  | 4             | 151.28 | 0.37  | 0.45   |
| Sheephead<br>(n = 86)        |             |      |     |      |      |      |     |     |      |      |     | 0.2  |     | -0.2 | 6             | 191.12 | 0.00  | 1.00   |
| R.I.                         | 0.0         | 0.0  | 0.0 | 0.0  | 0.0  | 0.0  | 0.0 | 0.0 | 0.0  | 0.0  | 0.0 | 1.0  | 0.0 | 1.0  |               |        |       |        |

Table S3. Reef sites and explanatory variables (values not standardized). SST = sea surface temperature, DIST = distance to shelf break, HII = harvest intensity index, WHM = maximum wave height, KBIO = kelp canopy biomass, STIP = *Macrocystis stipes*/kelp, KUSP = kelp understory species density, MRI = mean relief index, CHL = sea surface chlorophyll *a*, UD = sea urchin species density, RISD = relief index standard deviation, SLOP = reef slope, MSI = mean substrate index, SISD = substrate index standard deviation.

| Site                                     | SST   | CHL  | KUSP | UD    | STIP  | MRI  | RISD | MSI  | SISD | WHM  | KBIO    | HII  | SLOP | DIST  |
|--|-------|------|------|-------|-------|------|------|------|------|------|---------|------|------|-------|
| Arroyo Quemado                           | 15.25 | 4.03 | 2.42 | 6.25  | 6.92  | 0.00 | 0.00 | 0.94 | 1.15 | 0.66 | 199.00  | 0.80 | 1.43 | 7556  |
| Bullito                                  | 14.79 | 3.50 | 3.16 | 0.01  | 14.56 | 0.00 | 0.00 | 0.87 | 1.18 | 0.71 | 429.70  | 0.72 | 1.14 | 6191  |
| Cojo                                     | 14.68 | 2.92 | 2.48 | 0.00  | 20.03 | 0.00 | 0.00 | 0.85 | 1.27 | 1.17 | 741.21  | 0.78 | 0.88 | 7877  |
| Naples                                   | 15.55 | 4.02 | 3.21 | 5.89  | 3.79  | 0.06 | 0.18 | 0.90 | 1.35 | 0.81 | 843.03  | 0.49 | 0.49 | 4713  |
| IV Reef                                  | 15.27 | 4.32 | 1.50 | 11.90 | 3.51  | 0.01 | 0.05 | 0.86 | 1.27 | 0.63 | 508.43  | 0.52 | 1.27 | 5181  |
| Horseshoe Reef                           | 15.59 | 6.49 | 0.01 | 9.50  | 0.38  | 0.01 | 0.04 | 0.84 | 1.23 | 0.94 | 266.55  | 1.17 | 0.55 | 19614 |
| Santa Cruz Island - Painted Cave         | 14.91 | 2.84 | 2.59 | 14.72 | 1.07  | 0.18 | 0.55 | 0.89 | 1.40 | 1.28 | 0.00    | 1.15 | 3.94 | 6279  |
| San Miguel Island - Harris Point Reserve | 13.98 | 3.02 | 0.13 | 8.56  | 3.52  | 0.09 | 0.33 | 0.93 | 1.29 | 2.17 | 414.02  | 0.28 | 1.08 | 9439  |
| Santa Cruz Island - Hazards              | 15.16 | 3.08 | 1.29 | 6.53  | 5.36  | 0.13 | 0.42 | 0.86 | 1.40 | 0.98 | 67.48   | 0.84 | 4.49 | 7244  |
| San Miguel Island - Cuyler               | 14.02 | 3.05 | 0.07 | 3.15  | 5.37  | 0.06 | 0.29 | 0.91 | 1.29 | 1.93 | 356.68  | 0.28 | 0.22 | 10143 |
| Santa Cruz Island - Cavern Point         | 15.38 | 2.56 | 0.76 | 11.64 | 3.98  | 0.07 | 0.20 | 0.85 | 1.17 | 1.08 | 481.44  | 0.91 | 2.34 | 4600  |
| Santa Cruz Island - Forney               | 14.76 | 2.50 | 0.89 | 11.46 | 4.53  | 0.03 | 0.17 | 0.85 | 1.40 | 0.00 | 402.44  | 1.15 | 1.38 | 8745  |
| Santa Cruz Island - Scorpion             | 15.54 | 2.01 | 0.04 | 14.80 | 0.69  | 0.15 | 0.67 | 0.80 | 1.38 | 0.81 | 69.96   | 0.92 | 2.89 | 4841  |
| Deep Hole East                           | 15.75 | 3.33 | 0.25 | 13.96 | 4.45  | 0.04 | 0.21 | 0.85 | 1.34 | 0.85 | 214.18  | 0.57 | 1.37 | 5280  |
| Santa Cruz Island - Coche Point          | 15.47 | 2.94 | 0.03 | 20.31 | 0.00  | 0.08 | 0.20 | 0.88 | 1.23 | 0.84 | 0.00    | 0.92 | 3.48 | 5712  |
| Santa Rosa Island - Beacon Reef          | 14.57 | 3.43 | 0.78 | 8.35  | 2.39  | 0.02 | 0.07 | 0.89 | 1.16 | 2.03 | 251.36  | 1.23 | 0.80 | 8061  |
| Leo Carrillo East                        | 15.87 | 3.35 | 0.34 | 3.31  | 17.53 | 0.02 | 0.13 | 0.75 | 1.44 | 0.91 | 503.92  | 0.57 | 1.15 | 4704  |
| Encinal Canyon East                      | 15.83 | 3.58 | 0.70 | 6.80  | 12.18 | 0.01 | 0.02 | 0.83 | 1.29 | 0.84 | 391.51  | 0.58 | 1.33 | 4617  |
| Santa Cruz Island - Pelican              | 15.50 | 2.78 | 0.53 | 11.11 | 5.35  | 0.12 | 0.32 | 0.82 | 1.28 | 0.49 | 31.61   | 0.84 | 5.46 | 8665  |
| Santa Rosa Island - Rodes Reef           | 14.57 | 3.54 | 0.63 | 4.23  | 8.05  | 0.00 | 0.00 | 0.81 | 1.27 | 1.67 | 408.34  | 1.23 | 0.44 | 8990  |
| San Miguel Island - Tyler Bight          | 13.75 | 1.96 | 1.34 | 2.06  | 9.45  | 0.06 | 0.28 | 0.92 | 1.29 | 1.11 | 1159.67 | 0.28 | 1.87 | 7014  |
| Anacapa Island - West Isle               | 15.76 | 1.33 | 0.33 | 14.73 | 0.47  | 0.15 | 0.44 | 0.84 | 1.40 | 0.66 | 85.42   | 0.77 | 4.40 | 3918  |
| Anacapa Island - East Isle               | 15.73 | 1.31 | 5.47 | 3.57  | 4.36  | 0.18 | 0.71 | 0.86 | 1.35 | 0.82 | 183.64  | 0.00 | 3.06 | 2601  |
| San Miguel Island - Crook Point          | 14.10 | 2.37 | 3.05 | 0.35  | 9.13  | 0.02 | 0.13 | 0.91 | 1.30 | 1.15 | 654.24  | 0.28 | 1.80 | 7600  |
| Anacapa Island - Black Seabass Reef      | 15.71 | 1.30 | 4.27 | 13.52 | 2.39  | 0.01 | 0.02 | 0.58 | 0.83 | 0.74 | 176.71  | 0.77 | 1.79 | 2630  |
| Anacapa Island - Lighthouse Reef         | 15.77 | 1.26 | 0.56 | 23.10 | 2.94  | 0.10 | 0.37 | 0.83 | 1.32 | 0.84 | 180.65  | 0.77 | 3.01 | 2137  |
| Anacapa Island - Middle Isle             | 15.83 | 1.28 | 0.89 | 24.74 | 1.26  | 0.08 | 0.21 | 0.86 | 1.30 | 0.79 | 102.02  | 0.77 | 2.60 | 2238  |
| Little Dume West                         | 16.20 | 3.39 | 3.90 | 1.50  | 16.06 | 0.01 | 0.23 | 0.68 | 1.04 | 0.71 | 418.35  | 0.74 | 1.19 | 2301  |
| Point Dume                               | 16.20 | 3.09 | 0.81 | 13.99 | 3.39  | 0.07 | 0.33 | 0.83 | 1.27 | 1.01 | 138.96  | 0.50 | 1.90 | 1139  |
| Santa Cruz Island - Yellowbanks          | 16.03 | 1.53 | 2.51 | 3.72  | 5.23  | 0.01 | 0.04 | 0.81 | 1.35 | 0.84 | 335.58  | 1.13 | 1.13 | 3104  |
| Santa Rosa Island - Monacos              | 14.80 | 3.55 | 0.03 | 3.18  | 1.66  | 0.00 | 0.02 | 0.71 | 1.24 | 1.06 | 69.50   | 0.82 | 1.72 | 9137  |
| Santa Cruz Island - Valley               | 16.15 | 1.62 | 1.09 | 9.42  | 3.84  | 0.02 | 0.06 | 0.73 | 1.36 | 0.77 | 153.76  | 1.13 | 2.76 | 3708  |
| Santa Rosa Island - Bee Rock             | 14.64 | 1.78 | 0.51 | 2.50  | 3.54  | 0.02 | 0.09 | 0.92 | 1.20 | 1.65 | 630.43  | 0.29 | 0.51 | 6584  |
| Santa Cruz Island - Gull Island          | 15.53 | 1.48 | 2.29 | 11.89 | 3.12  | 0.13 | 0.52 | 0.94 | 1.22 | 0.97 | 493.79  | 0.70 | 2.88 | 1119  |
| Santa Rosa Island - Cluster Point        | 14.48 | 1.89 | 3.93 | 1.18  | 8.61  | 0.03 | 0.14 | 0.86 | 1.36 | 1.96 | 681.46  | 0.31 | 0.89 | 4814  |
| Santa Rosa Island - Jolla Vieja          | 15.59 | 2.02 | 3.40 | 14.25 | 5.08  | 0.02 | 0.10 | 0.76 | 1.32 | 1.07 | 545.41  | 0.82 | 1.44 | 8529  |
| Santa Rosa Island - Chickasaw            | 15.09 | 1.77 | 1.26 | 2.31  | 10.76 | 0.06 | 0.24 | 0.80 | 1.34 | 1.22 | 889.07  | 0.82 | 2.07 | 3963  |
| Santa Rosa Island - Johnson's Lee South  | 15.12 | 1.88 | 0.67 | 1.11  | 5.08  | 0.05 | 0.20 | 0.80 | 1.44 | 0.87 | 291.51  | 0.77 | 1.34 | 5766  |
| Santa Rosa Island - South Point          | 14.88 | 1.91 | 1.94 | 3.66  | 9.10  | 0.04 | 0.13 | 0.87 | 1.28 | 1.17 | 391.20  | 0.75 | 2.26 | 4371  |
| Ridges North                             | 16.63 | 3.68 | 1.69 | 0.57  | 8.74  | 0.07 | 0.16 | 0.86 | 1.19 | 0.89 | 625.33  | 0.72 | 1.67 | 3506  |
| Ridges South                             | 16.85 | 3.56 | 1.54 | 0.61  | 10.29 | 0.02 | 0.04 | 0.74 | 1.08 | 1.04 | 476.92  | 0.73 | 1.70 | 3348  |

| Site                                     | SST   | CHL  | KUSP | UD    | STIP  | MRI  | RISD | MSI  | SISD | WHM  | KBIO   | HII  | SLOP  | DIST  |
|--|-------|------|------|-------|-------|------|------|------|------|------|--------|------|-------|-------|
| Rocky Point North                        | 16.85 | 2.98 | 1.27 | 0.74  | 6.68  | 0.03 | 0.21 | 0.82 | 1.18 | 1.20 | 486.34 | 0.73 | 1.57  | 3583  |
| Rocky Point South                        | 16.58 | 3.02 | 1.28 | 0.78  | 10.07 | 0.03 | 0.07 | 0.93 | 1.15 | 0.95 | 619.71 | 0.72 | 2.27  | 3043  |
| Lunada Bay                               | 16.58 | 2.98 | 3.27 | 2.09  | 11.12 | 0.03 | 0.09 | 0.86 | 1.29 | 0.98 | 635.56 | 0.72 | 1.59  | 2995  |
| Resort Point                             | 16.80 | 2.84 | 0.30 | 2.43  | 5.48  | 0.01 | 0.02 | 0.82 | 1.28 | 0.96 | 405.05 | 0.73 | 2.34  | 2700  |
| Hawthorne Reef                           | 16.52 | 2.49 | 0.05 | 9.31  | 3.37  | 0.00 | 0.00 | 0.84 | 1.33 | 0.94 | 500.67 | 0.72 | 2.60  | 1672  |
| Point Vicente West                       | 16.82 | 2.23 | 0.53 | 4.05  | 4.70  | 0.15 | 0.37 | 0.92 | 1.31 | 0.91 | 328.53 | 0.73 | 2.77  | 1367  |
| Abalone Cove Kelp West                   | 16.53 | 2.83 | 0.38 | 9.22  | 6.74  | 0.06 | 0.18 | 0.88 | 1.31 | 0.69 | 258.01 | 0.72 | 2.25  | 2503  |
| Long Point East                          | 16.54 | 2.61 | 1.00 | 0.89  | 6.95  | 0.16 | 0.51 | 0.92 | 1.22 | 1.12 | 535.04 | 0.72 | 1.94  | 1550  |
| Bunker Point                             | 16.56 | 2.92 | 1.21 | 1.44  | 11.30 | 0.03 | 0.12 | 0.88 | 1.45 | 0.73 | 181.16 | 0.72 | 1.86  | 2196  |
| Whites Point                             | 16.72 | 2.99 | 3.51 | 1.15  | 15.37 | 0.02 | 0.09 | 0.80 | 1.43 | 0.80 | 253.73 | 1.15 | 1.48  | 2726  |
| Point Fermin                             | 16.66 | 3.18 | 1.66 | 2.54  | 11.40 | 0.02 | 0.05 | 0.81 | 1.40 | 0.82 | 257.98 | 1.15 | 1.61  | 3601  |
| Crystal Cove                             | 17.22 | 3.37 | 0.41 | 0.30  | 7.91  | 0.04 | 0.13 | 0.81 | 1.33 | 0.90 | 575.80 | 1.95 | 2.81  | 2123  |
| Heisler Park                             | 17.40 | 3.49 | 0.19 | 1.36  | 5.44  | 0.03 | 0.16 | 0.75 | 1.26 | 0.77 | 341.48 | 1.22 | 2.04  | 2780  |
| Santa Barbara Island - Arch Point        | 16.58 | 0.70 | 0.07 | 15.88 | 0.17  | 0.03 | 0.33 | 0.84 | 1.38 | 1.23 | 102.78 | 0.99 | 3.38  | 2205  |
| Santa Barbara Island - Graveyard Canyon  | 16.34 | 0.82 | 0.24 | 8.86  | 0.47  | 0.03 | 0.09 | 0.88 | 1.31 | 1.01 | 226.33 | 0.99 | 2.43  | 2817  |
| Santa Catalina Island - Indian Rock      | 17.19 | 0.82 | 0.36 | 1.18  | 8.24  | 0.17 | 0.51 | 0.86 | 1.26 | 0.36 | 430.29 | 1.16 | 4.78  | 2034  |
| Santa Barbara Island - Southeast Sealion | 16.39 | 0.77 | 0.11 | 9.08  | 1.86  | 0.02 | 0.09 | 0.82 | 1.34 | 0.71 | 137.15 | 0.99 | 2.64  | 2049  |
| Santa Barbara Island - Sutil             | 16.22 | 0.84 | 1.09 | 4.90  | 2.14  | 0.18 | 0.75 | 0.98 | 0.96 | 1.30 | 38.95  | 0.99 | 3.62  | 2617  |
| Santa Barbara Island - Cat Canyon        | 16.31 | 0.81 | 0.01 | 21.66 | 0.29  | 0.08 | 0.24 | 0.85 | 1.29 | 1.34 | 56.74  | 0.99 | 2.56  | 2351  |
| Santa Catalina Island - Ship Rock        | 17.27 | 0.77 | 0.70 | 0.73  | 8.00  | 0.17 | 0.46 | 0.89 | 1.06 | 0.18 | 0.00   | 1.20 | 5.12  | 793   |
| Santa Barbara Island - Southeast Reef    | 16.40 | 0.80 | 0.44 | 8.21  | 3.93  | 0.03 | 0.07 | 0.90 | 1.26 | 0.68 | 67.37  | 0.99 | 2.28  | 1691  |
| Dana Point                               | 17.29 | 2.84 | 0.37 | 0.35  | 10.68 | 0.03 | 0.09 | 0.74 | 1.11 | 1.14 | 526.01 | 1.26 | 1.24  | 2289  |
| Santa Catalina Island - Bird Rock        | 17.29 | 0.83 | 0.65 | 1.15  | 8.93  | 0.23 | 0.73 | 0.95 | 1.10 | 0.18 | 179.23 | 1.20 | 3.64  | 1142  |
| Santa Catalina Island - Blue Cavern      | 17.31 | 0.84 | 1.57 | 0.08  | 7.00  | 0.07 | 0.26 | 0.62 | 0.62 | 0.08 | 161.18 | 1.20 | 10.61 | 796   |
| Santa Catalina Island - Iron Bound Cove  | 17.05 | 0.84 | 2.14 | 0.53  | 10.40 | 0.09 | 0.29 | 0.90 | 1.23 | 1.11 | 120.33 | 1.14 | 2.11  | 2300  |
| Santa Catalina Island - West Quarry      | 17.49 | 0.72 | 0.41 | 0.71  | 7.06  | 0.06 | 0.29 | 0.79 | 0.88 | 0.08 | 163.57 | 1.15 | 10.49 | 908   |
| Santa Catalina Island - Ripper's Cove    | 17.60 | 0.73 | 0.21 | 0.35  | 9.57  | 0.07 | 0.16 | 0.75 | 0.89 | 0.05 | 189.58 | 1.16 | 3.99  | 1745  |
| Santa Catalina Island - Cat Harbor       | 17.22 | 0.93 | 0.12 | 0.23  | 6.89  | 0.02 | 0.05 | 0.56 | 0.57 | 0.76 | 280.09 | 1.12 | 4.41  | 2984  |
| Santa Catalina Island - Hen Rock         | 17.47 | 0.78 | 1.61 | 0.46  | 6.08  | 0.15 | 0.28 | 0.91 | 1.30 | 0.29 | 189.98 | 1.20 | 4.41  | 1844  |
| San Mateo Kelp                           | 17.36 | 3.22 | 0.04 | 0.01  | 11.73 | 0.02 | 0.05 | 0.63 | 0.85 | 0.91 | 145.40 | 0.81 | 0.52  | 4039  |
| San Nicolas Island - Begg Rock           | 14.89 | 1.25 | 0.00 | 0.59  | 0.00  | 0.48 | 0.47 | 1.00 | 0.00 | 2.49 | 0.00   | 0.00 | 10.61 | 9618  |
| Santa Catalina Island - Lover's Cove     | 17.45 | 0.70 | 0.53 | 0.22  | 8.29  | 0.09 | 0.45 | 0.66 | 0.92 | 0.01 | 0.00   | 0.00 | 9.37  | 2852  |
| Santa Catalina Island - China Point      | 16.92 | 0.84 | 1.60 | 0.51  | 13.42 | 0.08 | 0.19 | 0.89 | 1.24 | 1.18 | 424.78 | 1.08 | 2.34  | 2533  |
| Santa Catalina Island - East Quarry      | 17.73 | 0.72 | 0.39 | 0.70  | 3.57  | 0.04 | 0.23 | 0.76 | 0.90 | 0.33 | 0.00   | 1.22 | 10.34 | 3526  |
| Santa Catalina Island - Salta Verde      | 17.18 | 0.85 | 1.30 | 0.30  | 12.63 | 0.11 | 0.25 | 0.89 | 1.29 | 0.68 | 938.82 | 1.08 | 5.94  | 2196  |
| Barn Kelp                                | 17.73 | 3.37 | 0.48 | 0.27  | 14.94 | 0.00 | 0.00 | 0.58 | 0.57 | 0.98 | 381.06 | 1.94 | 0.20  | 7044  |
| San Nicholas Island - Sand Spit          | 15.54 | 1.52 | 1.24 | 6.49  | 4.65  | 0.02 | 0.13 | 0.94 | 1.04 | 0.98 | 532.61 | 0.53 | 1.47  | 3431  |
| Leucadia                                 | 17.41 | 4.08 | 0.32 | 0.09  | 9.78  | 0.01 | 0.03 | 0.93 | 1.15 | 1.01 | 347.98 | 0.77 | 1.43  | 4791  |
| Children's Pool                          | 17.41 | 3.79 | 0.86 | 0.06  | 2.91  | 0.01 | 0.02 | 0.81 | 1.36 | 1.10 | 140.52 | 0.41 | 1.55  | 1906  |
| Matlahuayl                               | 17.41 | 4.21 | 0.99 | 0.16  | 5.81  | 0.00 | 0.00 | 0.75 | 1.32 | 1.09 | 165.87 | 0.41 | 0.74  | 2272  |
| San Clemente Island - Lil Flower         | 17.49 | 0.51 | 1.19 | 0.99  | 7.63  | 0.18 | 0.45 | 0.77 | 1.30 | 0.04 | 349.71 | 0.87 | 8.22  | 701   |
| South La Jolla                           | 17.35 | 3.39 | 1.31 | 0.01  | 10.47 | 0.01 | 0.02 | 0.77 | 1.24 | 1.54 | 344.63 | 0.78 | 0.76  | 5878  |
| San Clemente Island - Pyramid Cove       | 17.28 | 0.52 | 0.85 | 0.52  | 5.25  | 0.13 | 0.41 | 0.89 | 1.37 | 0.03 | 377.63 | 0.59 | 4.40  | 2491  |
| San Clemente Island - China Point        | 17.06 | 0.58 | 1.21 | 0.66  | 7.28  | 0.18 | 0.49 | 0.91 | 1.41 | 1.54 | 231.78 | 0.59 | 2.95  | 4211  |
| Point Loma North                         | 17.56 | 3.17 | 4.95 | 0.00  | 15.24 | 0.01 | 0.03 | 0.74 | 1.21 | 1.18 | 597.61 | 0.77 | 1.30  | 7029  |
| Point Loma Central                       | 17.00 | 4.65 | 0.93 | 0.05  | 8.39  | 0.01 | 0.12 | 0.96 | 1.03 | 1.40 | 337.64 | 0.79 | 1.17  | 8239  |
| Point Loma South                         | 17.10 | 4.16 | 3.59 | 1.37  | 16.02 | 0.01 | 0.08 | 0.90 | 1.25 | 1.31 | 478.02 | 0.78 | 1.00  | 8963  |
| Cabrillo National Monument               | 16.59 | 5.05 | 1.29 | 0.21  | 11.83 | 0.01 | 0.03 | 0.89 | 1.35 | 1.64 | 222.45 | 0.60 | 0.72  | 10280 |

Fig. S1. Model residual plots for total fish biomass and individual species. In each case, standardized residuals are plotted against fitted fish biomass values and the standardized values of the predictor variables included in the top-ranked generalized least squares model.







